Promoting physical activity for disabled students inside and outside of secondary schools in Saudi Arabia: A mixed-methods approach using accelerometry and stakeholder insights

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Promoting physical activity for disabled students inside and outside of secondary schools in Saudi Arabia: A mixed-methods approach using accelerometry and stakeholder insights

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Declaration

The work in this thesis is based on research carried out by Khaled Alsofyani, under the supervision of Prof. Brett Smith and Prof. Cassandra Phoenix, within the Department of Sport and Exercise Sciences at the University of Durham in the United Kingdom. No part of this thesis has been submitted elsewhere for any other degree or qualification and it is all my own work unless referenced to the contrary in the text.

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Abstract

This study investigates strategies to enhance physical activity (PA) participation among children and adolescents with disabilities (CAWD) in Saudi secondary schools, aiming to support their physical and mental development. Using an inclusive, adaptive, and evidence-based approach, the research adopts a socio-ecological framework to examine the complex interplay of factors influencing PA behaviour in this population.

The study addresses significant knowledge gaps through six interrelated objectives: (1) exploring perceived barriers and facilitators of PA among CAWD, (2) objectively assessing whether CAWD meet the UK PA guidelines of 120–180 minutes of moderate to vigorous physical activity (MVPA) per week, (3) analysing associations between socio-ecological variables (SEV) and PA participation, (4) developing practical and contextually relevant PA-promoting strategies, (5) leveraging intelligent systems to identify behavioural patterns and stakeholder preferences, and (6) contributing to disability-inclusive health promotion and policy development.

Using wrist-worn accelerometers, PA levels were measured over seven days (five weekdays and two weekend days), including two sessions of semi-structured physical activities. Socio-ecological data were collected through tailored questionnaires, and the results were analysed using intelligent data processing models to identify patterns and predictors of PA behaviour.

The findings reveal that while CAWD face various personal, social, and environmental barriers to PA, school environments offer a more equitable platform for engagement, particularly for girls. However, most participants fell short of the recommended MVPA levels. Notably, PA participation was influenced by a range of SEVs, including family involvement, school support, peer relationships, and community accessibility.

This research offers a novel contribution to knowledge by integrating objective PA measurement, socio-ecological analysis, and technology-assisted evaluation in the context of disability. It proposes a set of practical school-based recommendations for enhancing PA participation among CAWD in Taif, Saudi Arabia, and highlights the need for inclusive curriculum policies and family engagement to ensure sustainability. Ultimately, it supports sustainable improvements in CAWD’s participation in PA and physical education (PE), helping to close gaps in health equity and educational access.

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Table of Abbreviations

Abbreviation	Full Term
ADL	Activities of daily living
AHP	Analytical Hierarchy Process
BMI	Body Mass Index
BMR	Basal Metabolic Rate
CAWD	Children and Adolescents with a Disability
CSV	Comma-Separated Values
FGD	Focus Group Discussion
GDET	Generate Directory of Education in Taif
HEPA	Health-Enhancing Physical Activity
HF	Health Factors
HIIT	High-Intensity Interval Training
ICF	International Classification of Functioning
IGDSS	Intelligent Group decision Support System
KSA	Kingdom of Saudi Arabia
LTPA	Leisure-time Physical Activity
LID	Light Intellectual Disability
MET	Metabolic Equivalent
MHI	Mild Hearing Impairment
MPA	Moderate Physical Activity
MVPA	Moderate and Vigorous Physical Activity
PA	Physical Activity
PE	Physical Education
PI	Physical Inactivity
RMR	Resting Metabolic Rate
SACYPPADD	Saudi Arabia Children and Young People Physical Activity Disability Data
Schools	S1, S2, S3 and S4
SB	Sedentary Behaviour
SEM	Socio-Ecological Model
SEV	Socio-Ecological Variables
SN	Special Needs
SSA	Semi-Structured Activity
SSFGD	Semi-Structured Focus Group Discussion
SVM	Sum of Vector Magnitude
UK	United Kingdom
WHtR	Weight Height Ratio
WHR	Weight Hip Ratio
YCPA	Youth Compendium of Physical Activities

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Chapter One: Introduction

1.0 Introduction

Existing quality data on the global percentage of disabled children and adolescents (aged from 6 to 17 years) not achieving recommended levels of PA) defined as any bodily movement produced by skeletal muscles that requires energy expenditure (Caspersen et al., 1985; WHO, 2021), is scarce due to major estimation difficulties and differences between countries, disabilities and population groups. However, depending on different measurement methods of PA participation and levels used in various studies, worldwide estimates range from as low as 8.5 % to around 40 % of disabled children and adolescents not meeting recommended PA guidelines (an average of 19 % in the USA), with girls being less active than boys. These estimates indicate alarmingly high rates of Physical inactivity (PI). Indeed, PI is estimated to be 4.5 times higher compared to their non-disabled peers, highlighting a critical area for PA interventions. These high rates of PI and low PA levels considerably and negatively affect children's health and well-being. They can harm mental health and emotional well-being and result in increased risk of chronic diseases, reduced muscle strength and poor body composition, and possibly delayed growth and development and higher mortality rates compared to their non-disabled and active peers (Yang et al., 2022).

This alarming situation has been a concern for governmental organisations and agencies (UK Chief Medical Officers -CMOs, Department of Health and Social Care UK, KSA Ministry of Health (MOH) and Ministry of Sports (MOS)) and non-governmental organisations (WHO, Disability Rights UK and Saudi Fakher Disability Sports Programme) and agencies, policymakers, researchers and health practitioners for more than five decades, with various research studies and investments in policy development, PA initiatives, strategies, resources, and programs implementation and evaluation that have cumulated into recommend global action plans (Saudi Vision 2030, 2016) to create a more active society for better health outcomes for different populations.

1.1 Background and Context

The research presented in this thesis is a sponsored Saudi Government programme in the context of the Saudi Vision 2030 to improve the nation's physical and social well-being and healthy lifestyles. It addresses the problem of understanding the complexity of the negative and positive influencing factors of PA behaviour change in the Saudi context, to enhance PA participation, increase PA levels and maintain positive changes through a quality PA. Such understanding is based on comprehensibly linking perceived barriers and facilitators at the different socio-ecological levels of PA influence to the numerous challenges faced by disabled children to regularly and effectively participate daily in PAs and at least, maintain recommended PA levels. An integrated approach based on intelligent group decision support systems and the socio-ecological approach is proposed to support the design, implementation, evaluation and review of PA-promoting strategies.

1.2 What is this PhD about?

Saudi Arabia likewise Western and most other countries worldwide, the lack of understanding of the challenges and barriers CAWD face during their PA participation significantly hinders the validity and effectiveness of PA-promoting strategies. This knowledge gap which leads to the development of interventions that are often inadequate, inaccessible, or unresponsive to the specific needs of this population, relates to the absence of evidence-based causal influence of the SEV on the children's non-objectively measured PA participation and levels. Addressing this knowledge gap involves examining whether the perceived PA participation barriers and facilitators have been thoroughly investigated in the appropriate real-life context, precisely identified, logically, and consistently linked or associated with the relevant, measurable, and quantifiable socio-ecological variables (SEV).

Identifying trends of PA behavioural change through causal influence links between SEV and PA participation and levels in CAWD is inherently complex due to the mutual interplay of multiple factors across different levels of influence and the possible nuanced nature of their relationships. Factors including individual attributes, family and playworkers dynamics and support, school and community environments and infrastructure, and broader policy contexts all interact in intricate ways that can vary significantly across population groups (individuals, gender, age group, disability group) and different settings. Adding to this complexity is the required comprehensive evaluation of these causal influence links and the creation of validated, reviewed and refined evidence-based knowledge for PA-promoting strategies. A more complex interaction is the collaborative facilitation, engaging PA stakeholders including families and children, PE and SN teachers, school and community managers, health practitioners and policymakers in semi-structured focus group discussions (SSFGD) to incorporate their preferences, perceptions, and experiences. This is essential to ensure that recommended PA strategies are contextually relevant and practically feasible, reflecting the real-world complexities and enhancing the likelihood of successful implementation and sustainability.

A holistic comprehensive approach is proposed to address the identified knowledge gaps and support problems. To effectively support this approach, it is essential to leverage intelligent group decision support systems to provide advanced mechanisms for large-scale data storage, validation and analysis, utilising intelligent models and algorithms to identify and interpret complex patterns and relationships among SEV. Additionally, group support aids are needed to enhance the SSFGD facilitation by offering real-time data insights, interactive tools, and structured frameworks for capturing stakeholders' preferences, perceptions, and experiences. By integrating these technological advancements, a more systematic, efficient, and inclusive process for developing and implementing evidence-based, contextually relevant PA-promoting strategies for CAWD can greatly contribute to enhanced PA participation, increased PA levels, and advanced disability rights.

1.3 Thesis Overview

The thesis is articulated around seven chapters as follows. **Chapter Two** provides a comprehensive literature review defining PA and related challenges, specifying the background and context of CAWD's PA insisting on the children' PA rights, PA policies and initiatives undertaken in KSA to enhance their PA participation, and focussing on disability definition, identification and measurement based on the functioning framework. It details the research aims and objectives, and research questions before closing with the study significance. **Chapter Three** provides the research philosophical foundation and details the design process and the data analysis approach of the sequential mixed methods employed in this research. This chapter focusses on the design of secondary and primary data collection based on the research foundation, the study population recruitment defining the various groups (schools, gender, disability and age group) and the different settings for PA measurement (home, school and the community), the PA measurement protocols and the analysis support of qualitative and quantitative data using the advanced capabilities of an Intelligent Group Decision Support Systems (IGDSS) The quantitative and quantitative data are collaboratively enriched by the stakeholders' qualitative insights in SSFGD. **Chapter Four** calculates PA levels, different MVPA patterns and health factors across all population groups of the study and computes systemic correlations between PA levels, health factors (HF) and SEV. **Chapter Five** explores plausible associations them using linear modelling and statistical testing SEV on objectively measured PA participation and levels. **Chapter Six** describes the stakeholders' interaction in SSFGD examining the findings from Chapters Four and Five, to gain analytical insights for the elaboration of evidence-based PA-promoting strategies. **Chapter Seven** concludes the thesis by summarising the key findings, their interpretation and impact on CAWD PA, the study's strength and contributions, limitations and implications for future research.

Chapter Two: Literature Review

2.0 Chapter Overview

This chapter is divided into specific aspects related to the different phases supporting this research, providing a thorough review of the literature, methodologies, and strategies pertinent to the research objectives. Following these phases is essential to provide a comprehensive understanding of the context surrounding PA among secondary school disabled children and adolescents, particularly in the Kingdom of Saudi Arabia, emphasising its significance and the necessity for measuring and promoting PA participation and performance inside and outside the school. The phases offer valuable in-depth insights into understanding the key issues inherent to portraying the children's PA behaviours and their overall engagement and performance objectively measured in free-living conditions monitored for seven days.

The background and context of PA in disabled children are explored in the second section, highlighting the importance of national and international frameworks to understand the children's rights and individual needs, PA policies, and strategies and programs to enhance their PA participation and increase their PA levels. In this section, the role and importance of the assessment of the implementation, monitoring and effectiveness of PA policies, strategies and programs are highlighted. Disability is defined in the third section along with mainstreaming education for the provision of inclusion education that integrates PA within the school curriculum. Disability measurement is examined in this section along with the disability models based on the use of the capability approach discussed in the context of the functioning classification, disability prevalence and mainstreaming to reduce social stigma and cater to diverse abilities. Disability PA is defined in the fourth section, with reference to its benefits, challenges, the global prevalence of PI and SB, the PA objective measurement in free-living conditions, and international guidelines to provide a real-time understanding of how they engage in activities in their natural environments, including the family, the school and the community. The conceptual framework and methodological approach are reviewed in the fifth section, emphasising the need for integration to define and measure the causal links existing between the personal, behavioural and environmental factors with PA participation and performance and use semi-structured focus group discussions to collaboratively explain and interpret the PA behaviour changes of the different population groups in the line of the implemented PA-Promoting strategies.

2.1 Background and Context of PA in Disabled Children

2.1.1 Physical Activity

World Health Organisation (WHO) has defined PA as any bodily movement produced by skeletal muscles that requires energy expenditure and keeps the body healthy and active.

However, periods of rest and low-intensity PAs are not considered part of PA. There are essential PA points to consider when studying PA promotion among disabled children and adolescents. These are PA benefits and risks and SB, levels of PA globally, challenges, measurements that include intensity and duration, how much of PA is recommended, how to increase PA levels, and the WHO response.

PA is an essential life component. According to WHO data (Naseer, 2022), PI is globally the fourth most dangerous cause of death and affects worldwide around 81 % of adolescents (11 – 17 years old) due to excessive sedentary lifestyle. Importantly, inactivity plus a sedentary lifestyle can be more accentuated among the disabled population groups due to their functioning limitations, socio-ecological factors and poor-quality sport environments.

2.1.2 Physical Activity Benefits

PA improves the overall well-being of people in general and ensures healthy and optimal growth and development in young people in particular, enhancing their thinking, learning, and judgment skills (WHO, 2019). It plays an important role in reducing the risk of overweight and obesity in childhood and adolescence and later in adulthood (Hills et al., 2011). This role includes living a healthy life based on active play which is important in the physical, mental, and social aspects of growth and development to eliminate or reduce inactive recreational choices and increase activity-related energy expenditure (Hills et al., 2010). Children must be made aware of these benefits which include reduced risk of chronic diseases, increased strength, improved balance and coordination, better motor skills, physical health and fitness, enhanced mental well-being, stronger self-esteem and confidence, increased independence, more developed social skills and better integration all contributing to achieving better in other activities including academically (Warburton et al., 2006; Borland et al., 2021; WHO, 2022; Du et al., 2023). They need to be effectively supported to be more active by creating inclusive and adapted PA programs to accommodate their specific needs and preferences, increasing the accessibility of sports facilities in the different settings that include schools, playgrounds and playfields, community and recreation centres, setting realistic goals, and encouraging regular participation and increased performance through support from the school, peers and families.

2.1.3 Physical Activity Challenges

Children's PA challenges refer to all obstacles that prevent them from being physically active. These challenges relate to barriers to movement, difficulties in engaging in PA and limitations to physical participation. They must be clearly defined in the real-life context in which every child spends their waking hours to better understand individual and group PA participation barriers which encompass a panoply of PA influencing factors associated with individual functional limitations and personal factors provoking changes in their physical and psychological behaviours. These changes are also affected by familial and socio-environmental factors that include lack of awareness, knowledge, family, peers and school support, sports facilities accessibility and transportation issues, cost of activities, negative attitudes and social barriers and lack of PA participation policy and strategies (Schields & Synnot, 2016; Smith et al., 2022). Over 200 PA influencing factors in leisure time have been examined in a systematic review study to characterise PA barriers and facilitators to PA participation for developing and delivering strategies to increase Leisure-time Physical Activity (LTPA) among persons with physical disabilities (Ginis et al., 2016). These factors have been also analysed in a systematic review study from the socio-ecological model (SEM) perspective to address the influencing factors of the global problem of a high prevalence of PI at the 5 levels of PA influence: intrapersonal, interpersonal, organisational, community, and public policy (Hu et al., 2021). This study suggested the most PA influencing factors for each SEM level and identified the positive and negative predictors of children's PA participation.

2.1.4 The PA Socio-Ecological Model (SEM)

The socio-ecological model is an expansion of the ecological model developed by Bronfenbrenner (1979) to structure the child’s environment that influences their development. Being applied to PA, it places a stronger emphasis on the extra individual factors (Spence & Lee, 2003) and environmental contexts that influence individual and group PA behaviour and promotion inside and outside school to provide a comprehensive understanding of PA engagement. Mehtälä MAK et al. (2014) suggested in a systematic review on applying the socio-ecological approach to PA interventions that PA-promoting strategies require the complex integration of the most essential multilevel and multi-components to fully capture the iterative mutual multiple influences and understand the child’s family and socio-environmental factors that facilitate and inhibit their PA. Of importance in promoting PA among disabled children is the identification, adaptation and prioritisation of intervention targets (family, school and community PA support programs, and school policy changes) at the different five levels of PA influence: intrapersonal (child), interpersonal (family, peers, PE teachers and support staff) organisational (community and school), environmental (cultural norms, physical environment), and policy (government and local authorities sports directives).This prioritisation is collaboratively performed in the context of the precedence of the different PA behavioural changes explained in the previous section, financial considerations, social norms and environmental cues. Moreover, the implementation specific potential impact and strategies that proved to be effective and successful for most and specific groups of children. This prioritisation process involves the major PA stakeholders: family, health practitioners, PE teachers and PA support staff.

2.2 Physical Activity Rights for Disabled Children

The comprehensive exploration of the background and context of PA in disabled children and adolescents has been based on the use of legal national or international frameworks to recognise their rights to equally access recreational opportunities through a regular PA of quality that supports their participation and engagement inside and outside school. These frameworks include the new *Global Action Plan on Physical Activity (GAPPA) 2018–2030* introduced in 2018 by the World Health Assembly to reduce global levels of PI in adults and adolescents (WHO, 2018-a), the Individuals with Disabilities Education Act (IDEA, 1990) previously promulgated in 1975 as Education for all Handicapped Children (EAHCA) in the United States before the introduction of the concept of early intervention (Article 30: Participation in cultural life, recreation, leisure and sport and Article 34: Parties shall promote the participation of persons with disabilities in sporting activities, the Right of People with Disabilities in the Kingdom of Saudi Arabia (Saudi Vision 2030, 2016) and the United Nations Convention on the Rights of Persons with Disabilities (UN-CRPD, 2006). All have acknowledged disability heterogeneity and insisted on providing equal opportunities and creating an inclusive culture for both PE and PA (CDCP, 2017) to enable these children and adolescents to lead active and fulfilling lives similar to their non-disabled peers (WHO, 2015).

2.2.1 Physical Activity Policies and Initiatives

The development and monitoring of policies and strategies for promoting PA among disabled children are increasingly receiving interest from academics and practitioners at both national and international levels. PA promotion based on personal, behavioural, social, environmental and policy approaches in the context of the socio-ecological model, extends its scope beyond PE classes to include intra and extracurricular activities inside and outside school organised around similar or different effective strategies put in place to implement PA-promoting policies. A panoply of appropriate strategies has been put in place worldwide, independently or per group of countries to address PA participation barriers. For example, in the European Union member states, PA school activities are organised in different categories: active school breaks, active breaks during school lessons, after-school Health-Enhancing Physical Activity (HEPA) promotion programs and active travel to and from school. The effectiveness of policies and strategies such as school, family or community-based to promote PA is the major research focus of the scientific community and governments (Gelius et al., 2020).

2.2.2 Saudi Health Enhancing Physical Activity Policies and Initiatives

The Kingdom of Saudi Arabia (KSA) became a signatory to the Convention on the Rights of Persons with Disabilities in 2009. This convention under Article 24 requires the government to provide an inclusive education system (Al-Mousa, 2010). Several HEPA, policies and initiatives have been introduced in the KSA since 2016 for the promotion of PA and community sports development and the design of frameworks for informed PA decision-making. They have been reviewed towards identifying design and implementation gaps using three existing frameworks: the WHO's HEPA Policy Audit Tool (to analyse the policy scope, content, implementation, environment and impact, and identify the best practices in PA promotion), the Global Observatory for PA Policy Inventory (to share information, best practices, and lessons learned from national PA-promoting policy experiences), and the European Monitoring Framework for PA Indicators (AlMarzooqi et al., 2023).

2.2.3 Saudi Physical Activity Policies and Strategies

A comprehensive assessment of PA policies and initiatives in Saudi Arabia 2016–2022 was carried out to identify gaps in their design and implementation (AlMarzooqi et al., 2023). The most important strategies and initiatives launched since 2018 are The Quality-of-Life Program, the National Diet and PA Strategy 2015–2025, the Twenty-Four-Hour Movement Practice Guidelines for Saudi Arabia, and the PA Guideline for Health Practitioners.

i) The Quality-of-Life Program Policy

The quality-of-life program policy was introduced in 2018 in the context of the Saudi Vision 2030 to enhance participation in sports and athletic activities, insisting on the inclusive participation of citizens in cultural, sports and entertainment activities (The Quality-of-Life Program, 2018). This policy insisted also on increasing sports and PA levels, inducing a cultural change in movement, monitoring sports policies and facilitating sports reforms involving the major stakeholders of the most important sectors (Health, Education and Sports). Hämäläinen et al. (2016), in a qualitative content analysis of health-enhancing PA policies, highlighted the importance of cross-sector cooperation for the co-production of goals and the provision of mechanisms for collaborative decision-making to empower the stakeholders and enhance the PA promotion processes.

ii) The National Diet and Physical Activity Strategy 2015–2025

This strategy was introduced in 2014 and focused primarily on Saudi schools to examine the school-day diet, measure the height and weight of the children, and assess PA programs to reduce the increasing obesity and overweight prevalence; the obesity rate has doubled over 10 years (Al-Hussaini et al., 2019). Building on the potential diversity recommendations from national and international PA policies, guidelines and practices including the impact of dietary behaviour on individual and group PA behaviours families and schools. The National Diet and Physical Activity Strategy also included recommendations concerning implementing workshops on healthy diet and cooking, enhancing family and peers group exercises for familial and peers PA support, improving the socio-cultural environment, reducing PI and improving the children’s PA engagement (Jackson et al., 2021). The strategy moreover includes supervising and monitoring all the above-mentioned aspects of children's PA, producing key indicators to measure PA changes over time in lifestyle and PA levels, and producing evidence-based knowledge needed for the review of the strategy.

iii) The Twenty-Four-Hour Movement Practice Guidelines for KSA

These guidelines (PHA, 2020) have been introduced in several countries as a comprehensive resource for health improvement, chronic disease prevention, and mortality and morbidity reduction. Its introduction in Saudi Arabia was made necessary to compensate for the absence of PA, SB and sleep national guidelines. They support sports initiatives and programmes elaborated in the Vision 2030 context to provide recommendations on the types of PA and the amount of time Saudi adults, adolescents and young children should spend being physically active 24 hours to reach optimal health. They aim at increasing PA levels and reducing SB and insufficient sleep, considered to be among the worst ones worldwide (Al-Hazzaa, 2018). These guidelines are based on international evidence-based practice and, it is hoped, help to create a cultural change in the Kingdom towards encouraging the different population groups to incorporate, when possible, PA in their waking hours to develop a healthy and active lifestyle. Although these guidelines are not aimed at the disabled population groups, they insist on the fact that PA, SB and sleep are major indicators of health which are strongly interrelated. They daily globally recommend 60 MVPA minutes, no more than 2 hours of sedentary recreational screen time and 9-12 or 8-12 hours of sleep for 6-12 or 13-17-year-old children. More importantly, their use to inform and guide practitioners and parents to control these three indicators provides additional metrics to determine acceptable PA behaviours for disabled children and adolescents.

iv) The Physical Activity Guideline for Health Practitioners

The PA guideline is a document elaborated by the Saudi Ministry of Health (MOH, 2020) to support PA interventions, insisting on the health benefits of regular PA among different groups of people including the disabled. It aims at directing health practitioners to train community members to carry out various PA programs. It specifies recommended types of activity, intensity and duration for a safe PA practice per age and chronic illness group and indicates their impact on the body functions. It provides general PA practice tips and advice and discusses PA misconceptions. However, it does not refer to any published research to justify the recommended PA prescriptions. It is essential to highlight that the PA guidelines for disabled children (UK Chief Medical Officers, 2022) are similar to those for their non-disabled peers, with just some specifications and adaptations to suit individual needs.

2.2.4 Implementation of Saudi Physical Activity Policies and Strategies

Several health-enhancing PA-related policies for PA promotion or SB reduction have been implemented in the Kingdom since 2016 in the following sectors: health ($n = 13$), education ($n = 12$), sports ($n = 16$), tourism ($n = 1$), and urban environment ($n = 2$). Their comprehensive assessment based on a self-administered survey to rate their implementation level and indicate whether they included quantifiable targets, key performance indicators and an evaluation component, was examined in a review study (AlMarzooqi et al., 2023) and indicated the lack of conceptual models and the inherent difficulties of evaluation. Additionally, this study highlighted the need to focus on the challenges or barriers that affect their sustainability and complex implementation which can be enhanced using a system-based approach to accelerate PA engagement among the different Saudi population groups. All PA policies for disabled children aim to have in general a clear purpose and scope to address barriers and challenges to PA participation. They insist on promoting collaboration, inclusivity and adaptability, and require a thorough and meaningful assessment of their design and implementation. The comprehensive understanding of disabled children's individual needs and the complexity of modelling and measuring the characteristics of their PA participation and adequate strategies are of great importance to eliminate the policies’ design flaws and overcoming the implementation challenges.

i) Eliminating the Design Flaws

The literature about the design of PA-promoting policies, programmes, and strategies has reported four common design flaws. First, a poor understanding of the problem often results in interventions that overlook key barriers specific to certain populations for example, assuming all children have access to safe outdoor spaces ignores the needs of those in urban or deprived areas. Second, the lack of practitioners' and stakeholders' engagement leads to low feasibility and adoption; for instance, school-based PA programmes that are developed without consulting teachers often fail due to time or curriculum constraints. Third, unrealistic goals such as expecting a significant increase in daily MVPA without providing adequate support or time can set up programmes for failure. Lastly, the absence of evidence-based practices results in reliance on generic activities that are not tailored to the target population; for example, promoting mainstream team sports to children with physical or intellectual disabilities without adaptation can limit participation and effectiveness.

These can compromise their success and lead to a waste of time and resources. The inclusion of a comprehensive implementation evaluation process from a multi-level perspective that includes the assessment of the different determinants associated with the various sectors involved (Wendt et al., 2023) is essential for addressing the true barriers faced by disabled children to regularly and effectively participate in PA inside and outside the school. This process when appropriately designed, focuses on evaluating whether different stakeholders have comprehensively understood the negative impact of every barrier on PA engagement and performance for every child based on their perceptions and experiences. More importantly, based on the use of a stakeholders' participatory approach, it anticipates the changes to be introduced and how they can contribute to solving the problem. The full involvement of the stakeholders in this collaborative action is crucial in setting realistic goals and relying on evidence-based knowledge and practice to base PA-promoting policies and strategies on what works.

ii) Overcoming the Implementation Challenges

The literature about the implementation of PA-promoting policies, programmes and strategies has reported four challenges: lack of resources, teacher and support staff training gaps, monitoring and evaluating issues and sustainability concerns. The monitoring of the implementation process can contribute significantly to knowledge gain (Wendt et al., 2023) and solve associated PA participation challenges, considering that the appropriate translation of the policy or strategies into operational practice is a key success factor in addressing the PA barriers and obstacles to increase PA participation.

Overcoming the implementation challenges of PA-promoting policies, programmes and strategies deals with several key points. The formulation of potential and plausible outcomes and accurate measurement of associate goals requires defining quantifiable targets and key performance indicators. On the other hand, the review of resources is crucial to assess the gap between required and available, insisting on the evaluation of the adaptability and usability of sports equipment to match the children's specific needs. The training of teachers and support staff is essential for creating, adapting and varying activities that can be fully and effectively performed by disabled children to meet their PA needs. The monitoring of PA issues is an important aspect of the assessment of the effectiveness and regularity of PA engagement and the detection of associated challenges which are the source of fizzling out the PA initiatives if not appropriately addressed in time. There are likewise challenges in measuring collaboration, inclusivity, adaptability and other PA quality characteristics. These are related to subjectivity within a PA environment where children might feel differently depending on their needs and expectations. The importance of clearly defining measurable goals and providing adequate resources and effective PA practice support facilitates policy design and implementation.

2.2.5 PA Policies and Initiatives Review

Of great importance in the promotion of PA participation in KSA is the crucial role played by the education sector in cross-sectoral cooperation where policymakers, planners, and principals of different schools and universities collaboratively implement systemic strategies and policies that integrate regular PA into the class curriculum and elaborate PA programs (Hämäläinen et al., 2016). A comprehensive literature on PA policies review has highlighted the conflation of PA policies, strategies and interventions whilst highlighting a lack of appropriate tools for benchmarking individual policies (Gelius et al., 2020). Research methodologies for collating PA evidence-based knowledge and practice on policies' impact on PA engagement among the different disabled children population groups need to be critically revisited to ensure their successful implementation (Gelius et al., 2020). Forty-four sports and PA policies and initiatives were identified from different sectors and their evaluation suggested that there is a need to focus on the challenges and the barriers that affect their sustainability (AlMarzooqi et al., 2023). These sectors reported significant progress in the implementation of PA-promoting strategies, policies and initiatives, particularly enabling the Public Health Authority to collect data and set policies for PA in all sectors, introducing systematic policy monitoring and evaluation, extending the scope of policies to cater for everyone including the disabled and female population groups, and enhancing cooperation and support from stakeholders. However, this progress has not led to enhanced PA participation and performance indicating increasing levels of PI and SB among disabled children and their able peers.

The most important reported challenges and barriers among the health, education and sports sectors mainly in the school setting, include limited PA data and funding for PA-promoting, limited PA resources, the absence of an evaluation and monitoring component in most initiatives, non-standardised measurement tools that may lead to inconsistent or inaccurate data, and challenges in involving and facilitating communities and spreading PA-promoting awareness (Nagrale & Jiandani, 2024).

2.2 Children and Adolescents' Disability

2.3.1 Disability and Impairment

Disability is defined as a '*physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder full and effective participation in society on an equal basis with others'* (UN-CRPD, 2006). The definition of disability in The Equality Act (2010) as a physical or mental impairment that "*affects negatively a person's ability to do normal daily activities*" highlights the importance of ability that is associated with individual limitations providing a functioning classification concept. The magnitude and duration of the disability impact can vary between people and differently affect them, depending on the personal and socio-ecological factors. Disability and impairment are distinct words used commonly in the literature. Impairment expresses the loss or the abnormality of an anatomical structure. In contrast, disability indicates a functioning restriction or incapacity or loss of ability due to an impairment creating a handicap i-e a disadvantage in developing appropriately and achieving desired goals.

2.3.2 Disability Identification and Classification in Children

Although there are varied methods for identifying childhood disability (Meltzer, 2016), its prevalence estimation in survey research studies is complex, mainly because many low and middle-income countries (LMICs) have not put in place reliable mechanisms for identifying children with disabilities (Cappa et al., 2015).

The process of disability identification in childhood and young age occurs generally at the early school stage. This process is connected with the relationship of the child with education (Graham et al., 2017) although children and adolescents with severe disabilities are less likely to attend mainstream schools. More importantly, they can have special educational needs but no disability and vice-versa, and this can hinder their PE engagement (Seashell, 2021). It is essential to note that the main consideration in the incorporation of PA among children with disabilities is their allocation in mainstreaming or special education depending on several factors that include the type and level of their disability, the existence or not of local special schools, and other factors inherent to the country health, educational and sports policies.

i) The Capability Approach

The capability approach is a comprehensive framework used in the fields of health and well-being (Sen, 1993; Nussbaum, 2011) and adapted to PA with a specific focus on capabilities for health-enhancing PA. It is based on shifting the focus from disability to the provision of PA resources and opportunities to enhance participation and increase performance (Till et al., 2021). This shift aims at identifying and tackling obstacles that negatively impact PA participation and performance by recognizing individual needs and capabilities and offering opportunities to become more active. This approach can provide a "*unifying framework that incorporates insights from the social, medical and human rights models of disability* "(Mitra, 2006). Two key concepts are used in this framework: functioning indicates the basic things a child can do and the capabilities correspond to the opportunities they have to achieve that functioning. These capabilities can be enhanced or limited depending on personal factors and PA participation barriers and facilitators prevailing in the child's socio-ecological environment which combines individual, social and structural factors and plays a key role in shaping individual capabilities. This approach needs further development to cover PA capability change measurement across various settings and for different population groups of both disabled children and their able peers (Till et al., 2022), emphasising objective measures of functional limitations in daily living activities (ADL) using the two-scale index: severity level and the number of ADL limitations.

ii) Disability Measurement

Many efforts have been made under the banner of the WHO, the United Nations Children's Fund (UNICEF) and the Washington Group on Disability and Statistics (WG) in defining and measuring disability in an internationally comparable manner, using the International Classification of Functioning, Disability, and Health (ICF) conceptual framework. WG has elaborated the short set questions (WG-SS), the enhanced WG-SS, or the extended set questions (WG-ES) to identify the disability among children. UNICEF, building on the WG methodology, has developed in collaboration with WG the child functioning module (CFM) building on the WG methodology included in UNICEF's Multiple Indicator Cluster Surveys (MICS) to better identify children with disabilities (UNICEF, 2017). WHO has developed the Model Disability Survey (MDS) with the collaboration of the World Bank. This survey has been recommended by WHO and is used by 7 countries to provide national in-depth disability information every 5 to 10 years whereas the other survey questionnaires have been widely used: MICS in 60 countries and WG-SS or WG-ES in 70 countries (Groce & Mont, 2017; Groce, 2020).

Central to the data quality and validity about PA of children with a disability is the methodology used to collect disability data. Although the most common being used is the national census, the school-based targeted disability data is the most used to identify and measure children's disability. The use of this data collection method is based, on one hand, on the research study context of measuring children's PA in general and in the school setting in particular. On the other hand, this method is based on the disability model used in this research to conceptualise disability: the disability measurement is not based on the medical model, but the capability approach developed in the previous section and defining disability as a restriction or lack of ability to perform an activity in the manner or within the range considered normal for a human being (Baglieri & Shaoiro, 2012).

The identification and measurement of any form of disability among young children is a universal right adopted in 2006 by The United Nations Convention on the Rights of Persons with Disabilities (UN-CRPD, 2006). The purpose is to collect appropriate statistical data to be used to produce research data for formulating and implementing policies and develop reliable and comparable measures of disability prevalence at the global level and functioning limitations at the individual level, given the lack of consistent definitions, indicators, and measures of disability (Cappa et al., 2015).

2.3.3 Functioning Classification

Central to disability data collection is the use of a functioning classification system to identify children's health status and needs (i.e., child functioning profiles) and to inform the design of PA interventions (WHO, 2007; Cieza et al., 2019). This system supports the organisation of data within PA assessment tools to enhance data comparability and support data mining functionalities (Rosenbaum & Gorter, 2012). The functioning classification reflects the dynamic interaction between a child's health condition and personal and environmental factors, which is essential for accurately assessing limitations in PA and restrictions in participation (WHO, 2001).

The International Classification of Functioning, Disability and Health (ICF) is a globally endorsed framework developed by the World Health Organization (2001). It provides a standardised coding system for describing and understanding functioning profiles in children with disabilities, offering a biopsychosocial approach that integrates physical, social, and contextual dimensions (Simeonsson et al., 2003). The ICF is particularly useful for monitoring health and functioning over time, guiding intervention planning, and enabling consistent reporting.

Disability data compatibility is critical for reducing discrepancies when estimating the prevalence of disability and assessing PA levels across regions or countries using different data sources (Madans et al., 2011). Ensuring compatibility also allows school-based health information to be linked with administrative health databases, which supports continuity of care and enables health professionals (e.g., physicians, physical and occupational therapists) to monitor health status and PA participation for surveillance, evaluation, and personalised intervention (Granlund et al., 2021).

2.3.4 Scope of Disabilities in Children

The scope of disabilities addressed in this research includes only mild hearing impairments and light intellectual disability which are both associated with some impact on physical participation. Both impairments represent diverse spectrums within their respective disability categories, impacting children and young people in various ways, often affecting both their psychosocial health and their functioning which can be accentuated by behavioural problems and various personal and/or environmental factors (McDougall et al., 2004; Rimmer, 2006). These affect their PA participation and require rehabilitation, support and inclusion with appropriate accommodations of their environments (Xu et al, 2020). It is essential to note that each individual is unique, and the impact of a disability can vary widely from child to child.

Research on this topic has identified the need to offer children with a disability in addition to increased PE frequency and lessons variety and intensity as the baseline, non-structured school and outside school time, more PA opportunities involving family, school and community agencies to meet international PA recommendations (Cindy et al, 2007). Several studies have focused on examining the conceptual and methodological approaches to evaluating PA participation mainly for this population category.

i) Hearing impairment

The World Health Organisation has recommended addressing the rising prevalence of hearing loss (WHO, 2018-b) through the Universal Neonatal Hearing Screening Programme. Hearing loss is considered to be the fourth-highest cause of disability globally and tends to rapidly increase due to the rise and ageing of the global population and other risk factors across the course of life. It can affect the body's balance making it difficult to perform activities requiring coordination. It poses a significant challenge mainly to children's everyday lives and their families and peers, they are considered disabled if their hearing threshold exceeds 35 dB HL in the better-hearing ear (WHO, 2024). Previous studies indicated a hearing loss prevalence in KSA between 7.7% (Bafaqeeh et al., 1994; Mathers et al., 2000) and 13% (Daghistani et al., 2002).

Children and adolescents with mild hearing impairments suffer from a partial loss of hearing, affecting several aspects of life and impacting their learning, communication, and group interactions. They experience adverse psychosocial outcomes causing higher rates of emotional and behavioural difficulties compared to normally hearing children (Stevenson et al, 2015). These difficulties cause communication barriers in terms of proper hearing instructions and safety concerns, making more difficult their social interaction and collaboration and reducing their awareness. These affect their social and emotional factors leading to the development of low self-confidence, frustration and fear of failure. They reduce their physical functioning and these limitations can hinder their PA participation and lead to lower levels of participation and intensity, making them unlikely to meet PA guidelines (Xu et al, 2020; DeLuca & Rupp, 2022; Nedrud & Shafer, 2023). Communication and signing training are essential to create sports and PA-inclusive and adaptive environments and promote PA in this category

ii) Intellectual disability

Intellectual disability known as general learning disability in the United Kingdom, is a condition that limits day-to-day intellectual functioning, particularly learning and reasoning and reduces adaptive behaviour that affects social interaction and integration (APA, 2023). This condition has 4 levels of impairment (mild, moderate, severe and profound) and affects approximately 1.74 % of the global population according to the Global Burden of Diseases Study (Tian et al., 2023). Mild intellectual disability characterised by an intelligence quotient (IQ) between 50 and 69, is estimated between 75 and 90 %. The intellectual disability prevalence rate among Saudi children and adolescents is estimated at 0.89 % for all levels of impairment, with mild impairment corresponding to 29,1 %. (El-Hazmi et al, 2003).

Children and young people with a mild intellectual disability develop cognitive impairments that result in limitations in their intellectual functioning and adaptive behaviour, reducing their PA participation (Sutherland et al, 2021; Yu et al, 2022). Although the children's executive functioning is positively influenced by PA and exercise (Protic & Válková, 2018), their difficulty in behaving in an adaptive and goal-directed fashion negatively affects their PA participation. They face cognitive, physical and coordination challenges and additional difficulties in understanding activities and safety instructions, rules and strategies, and planning and sequencing activity steps. These pose the problem of memory and recall leading to confusion, hesitation, and frustration that affect their performance, confidence, competence, self-esteem and enjoyment.

2.3.5 Disability Prevalence

The estimated prevalence of disability among children varies substantially across and within countries, genders and age groups. The data accuracy varies also depending on the survey method and questionnaires used to collect the data. The median disability prevalence among children is estimated to be respectively 0.8 % in primary schools and 1 % in secondary schools, in 15 LMICs (Mizunoya et al., 2016). An analysis of the 2004 Saudi demographic survey data indicates that Saudi's global prevalence rate (any disability and severity) was 0.8 %. This rate has been expected to evolve from 7.1 % in the 2017 survey to 8.4 % in 2022 (Hussein et al., 2022). Comparatively, according to recent statistics from the Government, the UK rate is around 11% (UK Disability Statistics, 2023).

Regarding Saudi children and adolescents, their disability rate is estimated according to the 2017 Survey respectively at 16, 11 and 20 % for those attending primary school, intermediate education (11 to 13 years old) and secondary and equivalent. The disability gender distribution for intermediate education is boys: 57% and girls: 43% and for secondary and equivalent is boys: 66% and girls: 34%. It is essential to note that there is a lack of accurate data on the prevalence of disabilities in Saudi Arabia due to data collected on a non-regular basis. Disability rates can be underestimated due to parents hiding or not reporting disability for cultural, societal and religious reasons due to the social stigma associated with disabilities (Ciftci, Jones & Corrigan, 2012). The current population of the "Makkah Al-Mokarramah" region where Taif is located is 2.185 million corresponding to 5.84 % of the Kingdom's global population of 37.434 million. The disability increasing rate from the 3 surveys is in this region respectively 18.7, 20.8 and 23.3 % (Macrotrends, 2024). The current population of the “Taif” district where the research study is taking place is 0.717 million corresponding to 32.81 % of the “Makkah Al-Mokarramah” population. The disability prevalence mainstreaming education in Taif-City middle schools is 210 boys and 95 girls, corresponding respectively to 68.85 and 31.15 %.

2.3.6 Disability and Mainstreaming Education

Distinguishing between placing children with disabilities in general education classrooms (mainstreaming) and creating an educational environment that effectively catering to their individual needs (inclusion) is essential to understanding the limitations of this approach in addressing specific needs, providing adequate resources and designing support systems for the implementation and monitoring of school PA and PE programmes. In 1990, mainstreaming was introduced in the Saudi education system and implemented on a small scale in schools after 6 years of trial and evaluation (Al-Mousa, 2010). Mainstreaming is a key policy objective for the provision to young people with special educational needs (SEN) and disabilities, of inclusive education that integrates PA participation in the school curriculum and activity programmes associated with positive educational and social outcomes (Lindsay, 2007).

Although this mainstreaming approach has several advantages for children benefiting enhanced social interaction, learning from able peers and developing improved self-esteem and confidence, there are difficulties in reducing potential social stigma and adapting PE lessons and PAs for all needs and preferences, altering rules and instructions when required. More importantly, a research study revealed the negative impact of a lack of teachers and resources along with unattainable PA participation targets (Alzamil et al., 2019; Love et al., 2020). However, these difficulties can be overcome by the implementation of effective inclusive PA strategies based on (Bailey & Sweeney, 2022), for example, understanding individual needs and focusing on different skills, offering an extended range of recommended activities, empowering children to choose and lead activities, praising participation, teamwork and collaboration and creating and maintaining a fully inclusive PA environment.

2.3.7 Catering to Diverse Abilities

This research works with students from mainstreaming education where children with special education needs are placed in a general education classroom, and the focus of this work is on schools attended by children with mild hearing impairments or light intellectual disability (see methodology chapter for more detail). These schools are required to design and implement supportive policies to promote full inclusion in education, sports, and PA of the different groups of children, addressing all their PA needs. This research is country-specific and restricted to LMICs where social emancipation becomes a necessity that will change the signification of disability from a medical issue to a social construct examined through its determinants, interactional models and support actions towards the child in their contextual environment (Graham et al., 2017). Of great influence among these interaction models is the one underlying the International Classification of Functioning, Disability and Health (ICF) (WHO, 2002) in which disability refers to the negative aspects of the interaction between the child's impairments, activity limitations, and participation restrictions in their global and shared contextual environment which includes participation for normal development, leisure activities and education. McConachie et al. (2006) explored the issues involved in measuring children's participation insisting on some limitations in terms of their applicability across impairment groupings. The evaluation of the feasibility, applicability, reliability, and validity of the active participation measurement among the different impairments groups of children and adolescents is a primary requirement in this research for a better understanding of their disablement and limitations.

2.4 Physical Activity Factors of Influence

2.4.1 Individual Functional Limitations and Personal Factors

Individual limitations and personal factors play a crucial role in influencing PA participation and levels in children with disabilities. Individual limitations are disability-specific and may affect coordination, balance, endurance, or cognitive functions and reduce the spectrum of activities the child can daily perform in sports or leisure time activities. They result from the child's condition development and movement limitations. They contribute to determining the child's PA profile.

PA participation and levels can be influenced by additional factors that include psychological factors, individual circumstances and the child's PA awareness, knowledge, practising skills and preferences (Sheilds et al., 2011), and experiences and perspectives of PE teachers and PA support staff with disabilities (Mitra, 2006). Of great importance is the positive impact of psychological factors that influence and relate to the child's self-efficacy and confidence, motivation and interests, emotional well-being and mental health. This positive impact is more accentuated by equipment adaptation and enhanced support provided by well-trained teachers or support workers. Self-efficacy scores were found to significantly increase after participation in adapted PA programmes for 10 weeks (Tindall et al., 2016). Following a study of the effect of training twice a week of disabled children for 8 months by specialised educators on 13 PAs, Wickman et al. (2018) reported a statistically significant increase in the means in four out of six different domains of self-efficacy. The child must therefore believe in their ability and have the inclusive opportunities to participate in meaningful and enjoyable PAs.

2.4.2 Family Environment Factors

There are positive and negative family factors that can hinder or promote the child's PA participation. These factors have been identified by analysing their influence on children's PA in a systematic review study, using 6 themes and 18 sub-themes to extract 18 factors: 10 positive, 7 negative and 1 inconclusive for the development of the concept of family unit role in children's PA (Hao & Razman, 2022). This work by Hao and Razman (2022) highlighted the importance of encouragement, support and involvement of family members including parents, siblings and caregivers. Health, psychological and parental PA behavioural factors, educational and socioeconomic status, responsibilities and electronic devices are the most essential factors (Hao & Razman, 2022) used to better understand the positive impact of these variables on enhancing PA engagement and increasing performance levels. However, the children's physical impairments in terms of what can hinder PA participation can be accentuated by negative family factors such as the lack of family awareness, knowledge and emotional and material support.

2.4.3 Socio-Environmental Factors

The description of the full spectrum of the broader social and environmental context in which children with disabilities spend their waking hours learning and playing is crucial for a comprehensive understanding of its positive or negative impact on their PA participation and performance, and what is needed to create more equitable PA opportunities. An extensive research literature highlighted how the socio-environmental factors influence their PA opportunities through a panoply of construct complex concepts that include accessibility of sports facilities and built environment, inclusive programming and policies, educational and social support and peer relationships, parental and teacher influence, societal attitudes, and accessible transportation and community infrastructure (King et al., 2003; Shields et al., 2011; Shields et al., 2016; Li et al., 2016). In their longitudinal study, Law et al. (2007) highlighted that parents of children with disabilities reported that barriers to PA participation were encountered in school environments, physical and built environments, institutional and governmental policies, services and assistance, and attitudes and social support.

2.4.4 Physical Inactivity and Sedentary Behaviour

Physical Inactivity relates to insufficient engagement in MVPA or muscle-strengthening exercises, leading to not meeting the MVPA guidelines, causing a growing concern worldwide for the health and wellbeing of disabled children. SB relates to excessive sitting or very low-intensity PAs. The prevalence of PI during childhood increases with advancing age as SB may track into adulthood, and also even if resulting chronic diseases do not become apparent at an early age, they can affect childhood behaviours. Ross et al. (2021) reported in a data analysis of 33,093 children and adolescents aged 6-17 years (12% with disabilities) that disability emerged after age, sex, body mass index, and income, emphasising the importance of socio-demographic factors influencing PA levels.

PI and SB can result in damaging consequences such as physical health problems, mental health concerns and social isolation, increasing the risks for morbidity and mortality of a great number of chronic diseases. These consequences can be substantially reduced by engaging in regular PA at a certain level of intensity to improve all levels of functioning and meet national or international PA guidelines elaborated for different categories and age groups.

2.4.5 Global Prevalence of Insufficient Physical Activity and Age Decline

The situation in KSA, concerning young people's PA levels, is highly concerning, with previous research indicating that 60 % of Saudi children and 71 % of adolescents do not participate in any type of PA (Al-Hazzaa, 2018). Although studies explored the PA levels of children and adolescents in KSA (Mahfouz et al., 2008; Al-Saeed et al., 2007), their scope was limited, often relying on small sample sizes or simplistic tools of PA assessment, with poor or unproven validity as opposed, for example, as opposed to the global dimension of obesity pandemic from around the world investigated in the International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE) (Katzmarzyk et al., 2013; Katzmarzyk et al., 2019). The study by Guthold et al. (2018) investigated relationships between lifestyle behaviours and obesity based on self-reported PA assessment at the individual, neighbourhood and school levels. The world trends in insufficient PA reported in a study based on 358 surveys across 168 countries, including 1.9 million participants and covering the period 2001-2016, were stable and did not change significantly. This research found that inactivity was more than twice as high in high-income countries (36·8%,) as in low-income countries (16·2%) and the objective target of a 10 % reduction of insufficient PA cannot be without PA promotion for enhanced.

2.4.6 Physical Activity Levels

The investigation of children's PA has reported a decline in their PA levels and participation due to today's environment enforcing an inactive lifestyle (Hills et al., 2007), and importantly, those with physical disabilities are even less physically active than their peers (Rimmer & Rowland, 2008). The PI and SB prevalence objectively measured data (accelerometer-assessed) in disabled children is very scarce and should be disability and setting-specific. It is estimated to be high at school, representing a sedentary time (ST) of 70 % of their school day, and MVPA times are recorded in recess (8.9 min) rather than in PE (7.9 min) or breaks (Sit et al., 2007; Sit et al., 2017), contributing to only 42 % of them meet the WHO PA guideline (Liang et al., 2020). Jago et al. (2017) also concluded in a cross-sectional study to assess the extent to which PA engagement differs inside and outside the school for 8-9-year-old children, that PA participation in these two settings is associated with greater PA and reduced sedentary times among both boys and girls.

The sitting time measured for Saudis disabled aged above 15 years indicated a sitting time of 6.1 h/day (Zahra et al., 2022). In another observational accelerometer study that assessed PA to measure seasonal variations, Sit et al. (2019) reported that the children's MVPA represented approximately an average of 4.5 % of their school day, indicating more activity in winter whereas their sedentary times did not show any seasonal difference. According to Lobenius-Palmér et al. (2017), based on an accelerometer-assessed PA and ST in a youth disability study, older children and girls were found to contribute to less PA. A review and meta-analysis of how PA changes from adolescence to early adulthood reported that MVPA objectively measured decline was 1.9 min/day (Corder et al., 2019) and MVPA were found stable between ages 7 and 15 years in a longitudinal cohort study in North-East England (Farooq et al., 2018). A longitudinal study by Jago et al. (2020) measured UK children's mean minutes of MVPA and sedentary times based on accelerometer measurements at ages 6,9 and 11. This study examined the association of body mass index (BMI) with changes in children's PA and sedentary time and reported that MVPA declines by 2.2 min/day/year, with a steeper decline at weekends and sedentary time increases on average at a rate of 12.9 min/day/year for all children (Jago et al., 2020).

Although existing evidence does not support the effectiveness of strategies to reduce SB in children with disabilities, according to Ganz et al. (2020) in a review study, many national and international initiatives have been launched and aimed at reducing the global prevalence of insufficient PA by 2030 among adolescents and adults: More Active People for a Healthier World, KSA: Vision 2030). These initiatives among many others are a new global action on PA that includes targets of relative reduction (10 % by 2025 and 15 % by 2030) of the global prevalence of insufficient PA by 2030 (WHO, 2018-a; KSA Vision 2030, 2016).

2.5 Physical Activity Participation and Measurement

PA participation and performance among disabled children is a complex construct due to several interrelated factors. The individual variability of children with their differences in abilities, preferences, and limitations influences their participation and a wide spectrum of physical activities (sports, play, daily tasks, and exercise routines), require different skills and capacities. These activities are specifically classified in the Youth Compendium of Physical Activities (Butte et al., 2018).

2.5.1 Physical Activity Participation

PA participation can be defined in alignment with the International Classification of Functioning, Disability and Health (WHO, 2001) as the execution of recurrent tasks in daily life. The framework provided by the ICF allows for capturing performance linked to individual capabilities, especially when these tasks are undertaken under supervised or accommodated conditions to compensate for the children's capabilities and functional limitations. The challenge lies not only in identifying which specific tasks are beneficial and preferable for different children to enhance participation but also in effectively gauging their limitations in PA due to participation restrictions. Understanding their lack of autonomy in daily life is crucial in this measurement. Consideration is given to the frequency of access to these tasks to mitigate the impact of limitations on PA engagement in the context of conceptualised optimal participation to determine and reach optimal recreation and leisure participation as a measure of the individualised self-engagement of the children in their environmental interactions (Kang et al., 2014). Additionally, the measurement process considers the varying degrees of severity and types of impairments, acknowledging the differences in capabilities among these groups (Michelsen et al., 2013). The challenge is to determine a measurable index of PA participation and performance to being sufficiently physically active to meet the international PA guidelines (WHO, 2022). These guidelines cannot be met due to various barriers and facilitators associated with participation in PE lessons PAs and recreation programs/facilities (Rimmer et al., 2004).

2.5.2 The School, Family and Community Settings

Despite the implementation of PA promotion strategies and programs that can be assessed in various ways, this evaluation must be conducted from the perspective of the target audience (school children's classes, activity groups, family and community children groups). This requirement is supported by the Community Focused Schools model that facilitates the access of disabled children to a coherent range of appropriate PAs delivered with personal learning and practice plans. The use of this model is based on making the community resources and facilities available to local families and schools, the school resources and facilities available to local families and communities, and/or attracting community resources onto the school site to enhance the children's PA participation. It extends the spectrum of PAs to include curricular and extra-curricular, and mural and intra-mural activities. It supports both the non-curricular and the socio-ecological approaches to increase PA in youth (Jago & Baranowski, 2004). It reinforces the children's social learning and interaction and the capture of the mutual impact of the socio-environmental factors on PA participation.

King et al. (2003) reported that children with disabilities can show lower participation in ordinary leisure and recreation activities at home and in the community. Although schools worldwide are unfortunately providing less PA (Aubert et al., 2018), they are an attractive setting to promote children's PA (McDonald et al., 2015) and have a variety of PAs and opportunities that include rehabilitation sessions, organised activities (indoor and outdoor), PE lessons, recess, and after school programs. More importantly, they are ideal locations for children with disabilities to increase their PA participation and performance and diminish sedentary time (Sit et al., 2019).

2.5.3 Physical Activity Measurement

The definition of the PA characteristics and their measurement in disabled children have received significant research attention, insisting on the need for an objective, accurate, valid and reliable assessment based on activity real-time monitoring that enables an appropriate interpretation of the outcomes (Rowlands & Eston, 2007) and an effective assessment of PA strategies and interventions (Hinckson & Curtis, 2013). Monitoring PA in free-living conditions using accelerometry is a valid approach to assessing the duration of PA intensity levels and gaining in-depth insights into PA behavioural changes (McGarty et al., 2014; Fullerton et al., 2017; Lobenius-Palmér et al., 2018).

There are several advantages to the use of this approach, although there are some limitations and challenges. The advantages are the ecological validity of the comprehensive assessment with reduced reactivity of the participants monitored for a long period whereas compliance and adherence and technical limitations can pose serious interpretation challenges such as the detection of non-wear times or the recording of excessive values beyond their range of recorded values, particularly the Sum Vector of Magnitude (SVM) in GENEActiv accelerometers. SVM represents the total magnitude of acceleration across all three axes (x, y, and z) of the accelerometer and corresponds to the overall intensity of movement or PA recorded by the accelerometer. The accelerometer calibration and the raw data validation can have significant effects on the quality and validity of results produced, which researchers should be more aware of.

PA participation can be measured by focusing on the objectively measured traditional performance-based aspects that include frequency, duration and intensity or relying on alternative participation subjective perception measures of engagement, involvement, inclusion and enjoyment (Ross et al., 2016). Objective measures based on accelerometery have been recommended for activity patterns and intensity (Rowlands et al., 2007; Reilly et al., 2008). Accelerometers can accurately distinguish SB and MVPA (Evenson et al., 2008). Accelerometer intensity cut-points for different body attachment locations have been validated for different age groups (Phillips et al., 2013; Schaefer et al., 2014; Duncan et al., 2020) and these locations were established for different types of PAs (Duncan et al., 2019). However, no GENEActiv intensity cut-points have been validated for disabled children and adolescents and also for adolescents and young people, posing the problem of which threshold to use to distinguish between the different PA intensity levels.

2.5.4 Physical Activity Guidelines

Monitoring disabled children's PA inside and outside of school is necessary to track their PA behaviour change assessed using the corresponding specific-population group PA guidelines which are associated with substantial health benefits and used to support the design and implementation of policies, programme planning, and guides. The WHO released the last PA guideline for disabled children and adolescents aged 5-17 years, indicating that they should

> "*do at least an average of 60 minutes per day of moderate-to-vigorous intensity, mostly aerobic, physical activity, across the week, incorporate vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone, at least 3 days a week, and limit the amount of time spent being sedentary, particularly the amount of recreational screen time*" (WHO, 2022, p. 60).

These guidelines are a daily recommendation and do not specify whether it is 60 minutes of MVPA every day of the week. They lack the details of the amount of MVPA on what are the different ways this may be achieved during a week in terms of frequency, duration and intensity of PA that are recommended for disabled children and adolescents to undertake to benefit their health.

Smith et al. (2022) co-produced an infographic that communicates the evidence-based UK recommendations, that children with disability aged 5 to 17 years should engage in MVPA intensity of mostly aerobic PA between 120 and 180 minutes per week, doing

> "*challenging but manageable strength and balance-focused activities on average 3 times per week"* (p.20) achieved in different ways: for example, 20 minutes per day or

40 minutes 3 times per week. The review that produced this infographic provided a detailed comprehensive overview of the existing evidence-based health benefits of PA for four different groups of disabilities versus several types of PA, and the number of quantitative studies addressing intellectual disabilities (65) and hearing impairments (3) represented 50 %, in informing the review. However, it is crucial to note that the disability severity was not included in the review and only one study related to intellectual disability concerned KSA whose PA guidelines addressed sedentary recreational screen time and sleep duration.

2.5.5 Applicability of the UK CMO Guidelines in a Saudi Arabian Context

The UK Chief Medical Officers' (CMO) Guidelines for physical activity are widely regarded as evidence-based recommendations grounded in comprehensive reviews of international research on PA and health. For children and adolescents, the CMO Guidelines recommend at least 60 minutes of moderate-to-vigorous physical activity (MVPA) per day, along with activities to develop strength and bone health across the week.

Although developed within the sociocultural and environmental context of the United Kingdom, these guidelines have global resonance and are frequently adopted or referenced as international benchmarks. They are aligned with recommendations from global authorities such as the World Health Organization (WHO), which makes them particularly useful for cross-national comparisons and standard-setting in research.

In the context of a study conducted in Saudi Arabia, especially one focused on CAWD, the use of the UK CMO Guidelines serves several key purposes:

a) International Comparability: Using a globally recognized benchmark allows findings to be interpreted relative to international standards, facilitating comparison with studies conducted in the UK, Europe, or other countries using similar PA thresholds.

b) Scientific Rigor: The CMO Guidelines are underpinned by rigorous evidence synthesis, offering a robust standard for assessing adequacy of PA levels, even when national guidelines may be under development or less specific (as has historically been the case in some Middle Eastern countries).

c) Policy Relevance: Although cultural, environmental, and infrastructural factors differ significantly between the UK and Saudi Arabia (e.g., climate, gender norms, PE curricula), the guidelines still offer a valuable aspirational target for health promotion. Their use may highlight disparities in PA participation and prompt context-specific adaptation in policies and interventions.

d) Challenges in Local Adaptation: While the UK CMO Guidelines are useful for benchmarking, their direct application must consider local socio-cultural factors, educational frameworks, and accessibility issues, particularly for CAWD. For instance, gender segregation in schools, climate restrictions on outdoor activity, and societal perceptions of disability may impact feasibility.

In summary, the UK CMO Guidelines are highly applicable as an international reference point for studies in Saudi Arabia, especially for structuring data collection, analysis, and interpretation in line with globally accepted PA standards. However, local adaptation and contextualization remain crucial to ensure relevance and effectiveness of PA interventions derived from these benchmarks.

2.6 Physical Activity Accelerometer-Based Studies on CAWD

Disabled children are known to face obstacles to PA participation and performance and their activity domains are not well characterised due to the different forms of disability that make it difficult to meet the requirements of each domain. This underlines the lack of consistent research protocols for measuring the PA domains with accelerometers although the measurement of the PA's different activities (SB, light PA, moderate PA, and vigorous PA) can be effectively performed. Issues with the amount of time participants wore the accelerometer have been solved using external strategies to maximize wear time and obtain higher compliance rates (Leung et al., 2017). The monitoring period depends on the accelerometer specifications and the monitoring frame duration of the PA level. The monitoring frame duration for reliable estimates of the different PA levels are respectively: SB 3 days, light and moderate PA 2 days, and vigorous PA 6 days (Dillon et al., 2016).

Several studies based on the use of the accelerometer to measure PA levels among children with disabilities have found that the 60 min per day of moderate-to-vigorous physical activity recommended is met by only a very small proportion of children (Einarsson, et al., 2015; Lobenius-Palmer et al., 2018). That work also identified that schools and special education settings remain a highly appropriate place to increase PA participation and levels (Sit et al., 2019). Efforts are needed to identify factors that influence PA and the sedentary time of special needs children to better support the design of effective interventions, insisting on the importance of providing technical support and training through local and national networks, online learning, disability associations, schools and community (Rimmer & Marques, 2012).

A study by Sit et al. (2019) examined the PA of children with physical disabilities (PD) and associated environmental and behavioural factors at home and school. The results found that seasonal PA level variations have been measured and have been found higher in winter, especially during recess and lunchtime, but without finding any difference in sedentary time, and overall, typically inactive and spent little time in MVPA. Children in the study by Sit et al. (2019) were more active at home in the presence of their father, at school before classes, and during recess and lunch breaks.

2.7 Methodological Approach to Physical Activity Promotion

A methodological approach is crucial to the design of effective CAWD PA-promoting strategies. Of great importance to PA participation is the development of the child's readiness and motivation to improve their PA behaviour which can be characterised by several observational factors such as time, psychological state, fear, enjoyment and other behavioural emotional factors that represent the difficulty accessible child's inner. The PA support framework provides an understanding of the impact of these factors on the child's PA behaviour which is essential to promote positive changes and support them during and after the readiness and motivational transition stages. This support aims at addressing negative (fear, stress, frustration, boredom) and positive (fun, enjoyment, satisfaction) observational factors and the perceived PA participation barriers and facilitators based on their specific needs to promote long-term PA engagement by assisting them to be aware of the PA benefits and understand that PA has more pros than cons. During the transition stages, the disabled child often must be supported by parents, peers, the school and health practitioners to improve self-efficacy. That is needed to enable the building confidence and increasing motivation to effectively address PA challenges and participation barriers, develop and maintain a PA routine, and positive PA behavioural change to encourage regularly sustained participation based on objectively-measured intensity levels and their duration. These measures need to be interpreted in the context of the transitional stages to monitor the direction of change of the PA behaviour and review the PA promoting strategies accordingly. These transitional stages and the strategies collaborative review are iterative steps in the longitudinal process that sets incremental realistic PA targets prescribes a curriculum of gradual PAs and defines validation steps in the context of the transtheoretical framework stages to define PA norms and standards for the different population groups.

2.7.1 Methodological approaches

Methodological approaches are required to translate the conceptual framework insights into strategic plans elaborated in action plans in the form of processes aimed at dealing with the various PA challenges and barriers faced by disabled children. These are used in conjunction to match individual ability limitations, support from family, peers, teachers and PE staff, environmental modifications for better accessibility and broader inclusion, and technological devices to enhance PA measurement and support PA engagement. The use and application of theories for the design of PA-promoting strategies aim at improving the effectiveness of the associated plans and programs for PA behaviour change.

2.7.2 Global School and Community-based Approach

Global school and community PA programs and interventions are elaborated using social cognitive, social learning and sports theories, evidence from meta-analysis, systematic review, interventional and observational studies, and input from stakeholders to support behavioural change promotion in the context of PA promotion using a strong foundation based on different types of contextual evidence and data quality variations. They involve collaboration between researchers, schools and community members using enhanced collected shared data and aggregated ranks (associated with weighted scores based on voting and/or domain evidence) of policy and strategy choices to address real schools and community concerns, identify priorities and take into account the cultural sensitivity including religious and other specific context aspects prevailing within the different disabled population groups from diverse communities. They rely on collaborative group support involving family, peers, PE teachers and health practitioners to suggest increased reach and more sustained, segmented and specific audience-based intervention solutions promoting determined PA behaviour change.

These global school and community PA programs are required to follow four methodological steps: needs assessment, program design, implementation planning, and evaluation. They benefit from the use of social marketing for PA promotion including the publicising of wellness and PA behaviour change and the organisation of targeted social media campaigns for parents or educational videos for teachers and also, community events to create a fun and social environment for PA through campaigning to promote PA health benefits and programming group sports days. Additionally, they require setting measurable, achievable and desirable goals according to individual PA progression plans, relying on continuous comprehensive monitoring that supports the evaluation of the strategy plan implementation. Furthermore, emphasising the role played by social support, positive reinforcement and other facilitators in addressing the personal and socio-environmental barriers, synthesising the relevant strong evidence to produce the knowledge evidence-base.

2.7.3 Technology-Based Approach

The promotion of PA is made easier by the emergence of technological devices and applications which enable the monitoring of PA levels, energy expenditure, sleep patterns and additional health behaviour patterns such as heart rate and blood pressure. Whether these devices are wearable activity or fitness tracker devices, they can be interconnected and provide real-time monitoring and feedback, contributing to increasing PA levels (Fergusson et al., 2022). Used as a strategy to complement and enhance the traditional PA provision, devises can be a motivational tool for effective health behaviour change and self-monitoring (Michaelsen & Esch, 2023).

They enable elaborate personalised workout plans and exercise routines setting relevant tracking features to evaluate gained effort and PA targets. Devices can be set to issue reminders to maintain a PA engagement routine and share data with health practitioners and achievements with family and peers. Of great benefit to these devices is the increased motivation induced by gamification apps, virtual reality (VR) and augmented reality (AR). These devices are built to support the increase of individuals' intrinsic motivation and desire for achievement, providing gaming, exercise and social networking platforms for making PA more engaging and enjoyable and enhancing motivation and adherence to exercise routines through health and sports advice, fitness and sports communities programs virtual competitions and achievements rewarding. The simulation of various PAs, environments, and engagement scenarios using VR and AR, extends the support for individual or family home workouts providing the possibility of a personalised approach that caters to individual needs and releases environmental constraints (Qian et al., 2020; Rutkowski et al., 2020).

Although the use of these devices is globally increasing, it is essential to avoid the total dependence that might lead to an over-reliance and a sort of PA isolation, missing non-tracked important PAs, being supervised, observed and encouraged or the importance of professional guidance provided by health and sports specialists and PE and PA support staff. We should also not also forget the costs associated with devices as well as people's confidence to use them. Such criticality is warranted because costs and confidence can restrict the usage of devices.

2.7.4 Policy and Environmental Approach

Although the individual dimension of PA has been extensively examined in academic research and non-governmental organisations' health programs, there is an increasing interest in developing and implementing crucial strategies for promoting PA at the population level using the policy and environment approach to reduce the individual and social burden of PI (Saudi Vision 2030; 2016; Kamada, 2020). This methodological approach focused on adapting the physical and social environments to globally cater to the different population's PA needs, providing accessible sports facilities and fields, appropriate types of equipment and adapted facilities to give everyone the chance to actively engage regularly in PAs.

Disabled children must be well-represented in the community in which school policy plays a preponderant influence on the mental and physical development of children, introducing and maintaining curricular and extra-curricular PAs in the form of PE lessons, recess time and PA programs, and participating in extramural sports events and competitions. On the other hand, environmental policy insists on the provision of safe and reachable spaces for PA, such as parks, playgrounds, walking trails, and bike lanes, accessible for different ability groups. The organisation in the community of sports and PA events supported by effective and segmented programs is essential to address and reduce disparities to access a regular and health-beneficial PA. These programs include walking groups, fitness classes, and sports leagues. Of similar importance in catering to these specific PA needs and reducing PA disparities is the encouragement of active transportation options such as walking and cycling to increase PA and reduce air pollution.

The environmental policy requires the provision of the needed financial resources to put in place all the physical and environmental changes and support the social behaviour change. It advises and regulates healthy nutrition and beverages in schools and elsewhere to raise PA health benefits awareness and maintain an ideal weight. Collaborations between schools, families, community members, and local educational, health and sports authorities are essential for this policy advocacy which requires a rich and balanced group support interaction to help drive policy change for the creation and maintenance of PA-appropriately built environments that support active living.

2.7.5 Framework- Methodological Approach Integration

The complexities involved in designing evidence-based PA promotion strategies require a more comprehensive understanding of the different frameworks and methodological approaches to effectively integrate theory with intervention design to better conceptualise the PA behaviour change (Sallis et al., 2016). Of importance in this integration is the comprehensive understanding of the psychological processes underlying behaviour change and maintenance in a specific population group (Kwasnicka et al., 2016). The maintenance of the change is based on the combination use of interdependent quantitative and qualitative data to support the integration of diverse data sources and analytical approaches and address common research questions and hypotheses (Bazeley, 2012).

Integration requires the provision of a data and group support system to create evidence-based knowledge that explains the PA behaviour changes of the different population groups. This knowledge is supported by multi-level data analysis and iteratively links qualitative and quantitative data expressing the impact or no impact of perceived PA barriers and facilitators on PA participation and performance, This reflects the iterative process of PA knowledge translation, synthetisation, dissemination and aggregation and the mediation and moderation analysis between the different stakeholders when establishing evidence or testing hypotheses involving multiple influence variables, and moving from evidence to practice for the development, implementation, evaluation and review of PA strategies and interventions (Dobbins et al., 2009; Hayes, 2017). This iterative process can be an essential component of integrated knowledge translation (IKT) as part of the collaborative process used by academic researchers to produce and share knowledge in the domain of sports, exercise and health sciences. This “knowledge” is made accessible not only to academic researchers, but also to health practitioners, policymakers and institutions at the different stages of the research process (Smith et al., 2023).

The generation and sharing of knowledge between researchers and stakeholders are crucial and requires a selection of an appropriate data analysis method to eliminate subjective biases and establish clear cause-and-effect relationships between SEM factors and PA behaviour. Of great importance in the elaboration of these relationships is the careful validation of influence associations using SSFGD supported by intelligent group decision support systems

(IGDSS) to collaboratively incorporate positive experiences and beliefs to validate the research findings and draw robust and meaningful conclusions. The SEM factors and PA behaviour must be measurable and quantified accurately for a reliable robust analysis.

2.7.6 Semi Structured Focus Group Discussions (SSFDG)

The exploration and refinement of the understanding of the relationships identified through multi-level data analysis is a collaborative process that requires an iterative complex data-driven facilitation to reach an agreement among the researchers, practitioners and stakeholders. Of great importance in this process is the conversational nature of the focus group discussion to ensure the participants' inputs and transcripts are accurate (Smith & Mc Gannon, 2017). SSFGDS allow for a deeper and more nuanced understanding of how various factors influence PA behaviour changes when monitored in free-living conditions and objectively measured using accelerometry. SSFGDs is a qualitative research method that can be used to explore and refine the understanding of complex topics like factors influencing PA behaviour in disabled children (Liamputtong, 2011). This understanding is the result of an iterative and collaborative sequential multi-stage process aimed at defining the measurable study variables of PA participation and performance and interpreting the result of their measurement to refine the understanding of PA behaviour change in PA promotion. Morgan (1997) highlighted the importance of a collaborative approach in FGD and how to facilitate effective group interaction. Promoting PA has been explored in qualitative focus group studies examining influences on current and future PA Participation (Carlin et al., 2015) and the needs, barriers and facilitators (Boman & Bernhardsson, 2023).

Pope (2000) suggested group discussions can be used to inform the development of instruments for data collection to develop questionnaires with closed-ended questions to measure, for example, the identified PA-related constructs. The study variables are determined by eliciting the characteristics of PA behaviour change of disabled children and their intra and inter-personal factors that include family and social environments. These characteristics are translated into open-ended questions to comprehensively understand the relevance of various constructs for PA participation and performance to select from the different conceptual frameworks explored above.

Mays & Pope (1995) advocated validation in qualitative research through stakeholder experiences and beliefs. The group interaction between researchers and the stakeholders supports the discussion about the importance of the constructs as perceived PA barriers or facilitators, their potential influence on PA behaviour change and their modelling to define a measurable variable expressed in one or several closed-end questions that compose the different PA-domain questionnaires. Data collection and multi-level analysis are performed to produce the statistical data needed to infer the existence of potential causal links between the different study variables and elaborate the association between the different PA constructs validated in SSFGDs by examining the produced data and the stakeholders' experiences and beliefs. Of great importance in the validation of results is confirming the reliability and accuracy of data and conclusions at the five dimensions of triangulation to avoid biases, and errors and strengthen the credibility of PA-promoting strategies on PA participation and performance. These dimensions are data source, methodology, investigator, theory and time, and their principles have been used in both qualitative and quantitative health research (Vigurs, 2009).

2.7.7 Intelligent Group Decision Support Systems (IGDSS)

The collection and multi-level analysis and validation of the data involved in the development of PA-promoting strategies based on integrating the intra and inter-personal factors at the SEM five levels of influence results in a huge amount of data that requires elaborated and integrated means for storage, analysis, interpretation and sharing. It requires a collaborative and technology-driven approach implemented through IGDSSs that combines collaborative decision support systems and technology-aided group decision-making. IGDSSs combine decision support systems with data mining techniques and enhanced and integrated data management and analysis capabilities and group interaction features for the support of SSFGDs facilitation and the generation of evidence-based knowledge that deeply explains PA behaviour changes needed to develop PA-promoting strategies. The use of IGDSSs in public health has been examined in system review studies to support crowdsourcing and consensus-based collaborative decision-making in multi-participant environments (Ciurea et al., 2019), prescribe personalised, and quantitative exercise (Sun et al., 2021), identify strategy and intervention targets (Ciurea et al., 2019; Sun et al., 2021), predict aspects of BA behaviour (Yoon et al., 2015;) and support objectively measured activity through sensing devices, and integration with theoretical frameworks for health behaviour change (Triantafyllidis et al., 2018). Additionally, IGDSSs support the clustering approach to model and analyse changes in PA behaviours based on pre- and post-assessments using accelerometry data (Diaz et al., 2020). Of great importance in using IGDSSs is the identification of trends, patterns and barriers to PA participation and performance within the different study population groups using data analytics and predictive modelling based on the implementation of intelligent algorithms and real-time monitoring and feedback. Additionally, the use of IGDSSs can facilitate communication and collaboration during the facilitation process of SSFGDs by enabling stakeholders to share information, discuss options, weigh trade-offs and reach consensus on PA-promoting strategies, foster community engagement and social support to share experiences, resources and tips, and create activity and support groups to strengthen social bonds and cohesion for facing group PA barriers and challenges. The support of the technology-based approach through the provision of gamification apps, virtual reality (VR) and augmented reality (AR) further enhances the need for using IGDSSs to effectively and widely promote PA.

2.8 Research Aims and Objectives, and Questions

2.8.1 Research Aims and Objectives

This research aims to enhance the CAWD's physical and mental development by increasing their objectively measured PA and fitness levels by promoting PA in Saudi middle schools using adaptive and flexible PA participation strategies. The research aims and objectives are:

1) Address the knowledge gap:
    a) Investigate the perceived barriers and facilitators of PA participation among CAWD
    b) Examine the established causal influence of SEV on objectively measured PA participation and levels.
2) Establish whether CAWD are sufficiently active and reach the 120 to 180 minutes across the week of moderate and vigorous PA (MVPA) as recommended in the United Kingdom PA guidelines.
    a) Objectively measure the MVPA of CAWD for 7 days (5 school days and 2 weekend days) using a wrist accelerometer and run 2 sessions of 10 semi-structured PAs.
    b) Download the accelerometer raw data and data calibration and filtering.
    c) Calculate PA levels.
    d) Identify trends of behavioural change.
3) Analyse the associations between SEV and PA participation and levels in CAWD.
    a) Use appropriate questionnaire data to incorporate the CAWD SEV data to determine their PA correlates.
    b) Identify the CAWD PA correlates.
    c) Examine the complex interplay of multiple factors across different levels of influence.
4) Develop evidence-based PA-promoting strategies:

a) Create validated, reviewed, and refined evidence-based knowledge for PA-promoting strategies.
b) Ensure that recommended PA strategies are contextually relevant and practically feasible.

5) Leverage technology for a holistic approach:
   a) Utilise intelligent group decision support systems for large-scale data storage, validation, and analysis.
   b) Employ intelligent models and algorithms to identify and interpret complex patterns and relationships among SEV.
   c) Use group support aids to enhance semi-structured focus group discussions (SSFGD) and capture stakeholders' preferences, perceptions, and experiences.
   d) Gather and produce the school PA and PE corporate knowledge needed to design and implement school PA and PE curriculum policies and help families to support their children in PA engagement.
6) Enhance PA participation and disability rights:
   a) Develop and implement evidence-based, contextually relevant PA-promoting strategies for CAWD.
   b) Contribute to enhanced PA participation, increased PA levels, and advanced disability rights.

2.8.2 Research Questions

The following research questions address the identified knowledge gaps and support problems in promoting PA among CAWD, to enhance their health and well-being.

- Q1: What are the barriers and facilitators of PA participation among children and adolescents with light intellectual disabilities or mild hearing impairments? This question addresses the need to understand the factors influencing PA participation in this population.
- Q2: What is the amount of PA CAWD do in and outside of school and how do their objectively measured PA levels compare to MVPA recommended guidelines and similar measurements elsewhere? This question addresses the need to understand the CAWD PA participation and levels.
- Q3: How do socio-ecological variables (SEV) influence objectively measured PA participation and levels in this population? This question focuses on the causal influences of SEV on PA participation and levels.

- Q4: What are the trends of PA behavioural change through the causal influence links between SEV and PA participation and levels in this population? This question aims to identify the complex interplay of multiple factors across different levels of influence, as mentioned in the study.
- Q5: Based on the study results, what are the recommended school-based strategies and policies that enable overcoming most of the barriers to PA and PE participation and engagement for children with disabilities in the educational setting in the Region of Taif (KSA)?

2.9 Significance of the Study

This study addresses the lack of comprehensive understanding of individual challenges and barriers CAWD face during their PA participation, which hinders the validity and effectiveness of PA-promoting strategies. The study's significance contributes to the production of evidence-based knowledge and contextually relevant PA-promoting strategies tailored to the specific needs of CAWD in various settings. The study's findings will have important implications for practice and policy, providing insights into the barriers and facilitators to PA participation in this population. The study's results help inform stakeholders to collaboratively develop more effective interventions contributing to improved health and well-being outcomes. Furthermore, the study's use of IGDSS will demonstrate the effectiveness of this approach in enhancing the development and implementation of PA-promoting strategies. This will have significant implications for the field of PA promotion, as it will provide a new tool for stakeholders and policymakers to develop and implement more effective interventions.

Overall, the study's significance lies in its potential to contribute to the advancement of knowledge in the field of PA promotion among CAWD and to inform the development of more effective interventions that can improve health and well-being outcomes for this population.

2.10 Conclusion

2.10.1 Literature gaps

There is scarce literature on children’s PA and SB in KSA and no objectively measured PA of children with a disability. Nothing was reported about the daily analysis of PA levels mainly the MVPA, sedentary and sleep times inside and outside the school, PE curriculum and the type of PAs planned in PE lessons for disabled children. PA strategies and interventions were developed for the global population rather than at the individual and school levels.

There are several problems reported in the literature. Firstly, there are limitations in all the children's PA studies for not developing PA multidimensional measures needed to assess and understand the complex PA behaviour changes of children with disabilities at the five influence levels of the SEM. This is crucial to examine the dynamic relationship between multidimensional environments and PA engagement (Zhang et al., 2022). Some studies about Saudi children used non-validated instruments and lacked comprehensive measures (Al-Nozha et al., 2007; Al-Othman et al., 2012). Secondly, the extraction of data from different measurement research studies does not always provide significant sample characteristics to logically compare the PA and SB correlate influences (Al-Kutbe, 2017). Thirdly. the evidence for PA and SB is established only for small population groups in a region, making it difficult to generalize the evidence to the rest of the Kingdom and for a long period (Al-Hazzaa, 2018). Finally, the difficulty of performing full reliability and validity measurements is accentuated by the different measurement instruments available. Chien et al. (2014) reported children's participation measures differences using ICF in a comparative content review. They suggested that these differences require consideration when using different measures and instruments. The role assigned to schools to promote inclusive children PA with the support of PE teachers and peers, family, and other community entities is not properly understood despite the several PA initiatives undertaken in the last two decades (AlMarzooqi, 2017; Alahmed, 2019). Jago et al. (2023) suggested that greater consideration must be given to the school context in the design, implementation, monitoring and analysis of school-based PA strategies to help overcome existing limitations in the design of effective PA interventions.

Of importance in associating appropriately the PA benefits to effective strategies and interventions, is the need for exercise practitioners, local educational and health authorities and schools to require and use implementation strategies taking advantage of available evidence-based practice in PA participation strategies collaborative implementation, exercises guidelines and prescription (Smith & Phoenix, 2019). Although the SEM approach provides an effective way to explore the different factors that influence children's PA, the absence of agreed and accepted measurement methods for each factor of the complex PA SEM can complicate the measurement of the factor and its interaction with other factors. This can affect the inference validity of the factors' influence over time, suggesting the development of longitudinal design and objective repeated measurements of PA levels (Li & Moosbrugger, 2021). The findings of research studies undertaken in KSA and other countries in the Middle East are difficult to compare because of their design differences (Al-Hazzaa, 2018). Finally, PA action plans are not adequately resourced, monitored and enforced for full PA participation (Ginis et al., 2021).

2.10.2 Summary of Findings

There is a clear gap in the systematic review of conceptual and methodological approaches to elaborate the comprehensive understanding of the complex and changing PA behaviours of the different disabled children population groups and their objective measurement of PA participation and intensity levels inside and outside school. This gap indicates the absence of an integration link between PA measurements and correlates and their analysis towards the elaboration of a qualitative PA analysis needed to understand, explain and predict PA behavioural changes. The design and implementation of PE and PA strategies must be based on reversing negating changes to create more active families, schools and communities that enable disabled children and young people to get more physically active.

Rigorous study designs and advanced methods of PA assessment are required, to enhance existing knowledge and understanding of not only how much PA Saudi children participate in, but also where and when they can be physically active. Such research will be instrumental in outlining and informing future health policies and interventions, aimed at tackling PI within a country such as KSA, in which currently children are among being less active and more obese.

2.10.3 Implications for Policy, Practice, and Future Research

Of importance in effectively and accurately assessing PA levels intensity of specific-population groups considered in this research and others, is the need to address, in future research, the issue of specific-population group PA intensity measurement compared to PA guidelines for the same population category. The complex question is whether it is more appropriate and valid to use the same intensity cut points for all the disabled children and adolescent population groups and use specific-population PA guidelines or the other way round or a validated intensity cut-points system per specific-population category and their corresponding PA guidelines. Further research is needed to examine the long-term effectiveness of PA-promoting strategies in line with the use of integrated technology and more comprehensive integrated frameworks and methodological approaches to enhance PA support and engagement, improve PA practice, track progress over time and support evidence-based policy-making. This effectiveness needs to be assessed in terms of cost-effective health benefits and the reduction of individual limitations not only for children with mild intellectual disability and hearing impairment but also for the different disability groups with different severity levels.

Further investigation needs to focus on the socio-environmental factors that influence PA behaviour change when considering cultural and religious differences between communities and geographical differences between urban and rural locations using a multi-level policy approach to ensure that PA promotion strategies can inform the development of targeted interventions for the implementation of evidence-based practices.

Chapter Three: Methodology and Method

3.0 Chapter overview

This chapter is structured into five sections. In the first section, I present the chapter overview before establishing, in the second section, the philosophical foundations of the study. The third section describes the research design process supported by a sequential mixed methods approach structured into two phases: a quantitative and qualitative analysis. The fourth section presents the quantitative analysis (Phase 1) structured into three sub-phases. First, I establish the research foundation and elaborated on the study's development tools. Then, I highlight the research fieldwork concerned with collecting the primary data, including the questionnaires' data and the accelerometers' raw data, and finally, the collected data analysed. The fifth section presents the qualitative data analysis structured into four sub-phases, which consist of interpreting the quantitative findings including PA levels plausible and their associations with SEV factors of influence, capturing and integrating the quantitative findings with qualitative data representing the stakeholders' PA perceptions and experiences to create the evidence-based knowledge for choosing inclusive and tailored PA-promoting strategies to enhance PA participation and increase performance among CAWD.

3.1 Research Philosophical Foundation

3.1.1 Ontology

This research adopts a post-positivist perspective to explore PA participation challenges among CAWD, acknowledging that PA levels and SEV influences exist as an objective reality, though only partly knowable. Combining a realist ontology with a dualist epistemology acknowledges that while reality exists independently, our knowledge of it remains imperfect but can approximate the truth through rigorous methodological approaches (Bhaskar, 2020). While objectively measured PA levels are real, they may be misinterpreted due to complex SEV influences and varying stakeholder perceptions. Recognising PA behaviour and its independent existence, the study integrates both subjective and objective realities to deepen insights into PA correlates through iterative analysis (Smith & McGannon, 2018). The complexity of integrating multiple stakeholder perspectives highlights the need for understanding the diverse realities shaping PA-promoting strategies (Monforte, Smith, & Smith, 2022). Starting with a cross-sectional design, the study aimed to evolve into a longitudinal approach for a richer understanding.

3.1.2 Epistemology

The study follows a dualist epistemology, acknowledging the inherent uncertainty in PA measurement and SEV data (Krauss, 2005). While empirical data and statistical analysis enhance reliability, knowledge about CAWD PA remains incomplete and shaped by diverse interpretations. The iterative approach accounts for evolving SEV factors, incorporating stakeholder perspectives to refine understanding and increase the findings' practical relevance.

3.2 Methodology, Axiology, Rhetoric, and Logic

This study integrates methodology, axiology, rhetoric, and logic to structure its design, focusing on sampling and inference (Park & Artino, 2020).

3.2.1 Methodology

The sequential mixed methods approach detailed in Section 3 emphasises a systematic empirical focus. Fieldwork was consistent across genders, disabilities (light intellectual disability and hearing impairment), and age groups (12–14, 15–17, and 18-21), using standardised environments and stakeholder groups.

3.2.2 Axiology

Efforts to minimise bias included objectively measured PA levels, SEV modelling, and incorporating stakeholder expertise (Abdelazeem et al., 2022). Protocols enhanced coherence, and FGDs helped reduce subjective interpretation. Stakeholder perspectives were integrated iteratively, refining evidence-based PA insights.

3.2.3 Rhetoric

Findings were communicated using precise language and statistical analysis via IGDSS, aligning with post-positivist values emphasising objectivity and clarity (Hyland, 2008).

3.2.4 Logic

The study used deductive reasoning to test SEV influences and inductive reasoning to explore PA behaviour patterns (Trochim, 2006). Power analysis revealed limitations for individual groups, but combining data improved statistical power. The sequential mixed methods approach added robustness, fitting the post-positivist framework by blending empirical data with qualitative insights.

3.3 Methodological Rigour

To ensure high-quality and trustworthy research, multiple strategies were employed throughout the study's design and implementation (Smith & McGannon, 2018; Smith & Sparkes, 2016).

3.3.1 Credibility of Findings

Methodological triangulation using sequential mixed methods enhanced credibility, combining quantitative and qualitative data (Creswell & Plano Clark, 2017). FGDs allowed stakeholders to interpret quantitative results, using collaborative tools like IGDSS to build consensus and enrich findings (Tashakkori & Teddlie, 2003).

3.3.2 Validity, Reliability and Bias Minimisation

Strict data collection protocols and validated measurement tools minimised errors (Trost, McIver & Pate, 2005). Objective PA measurement through accelerometers in comprehensive activity monitoring improved validity, while multi-level statistical analysis ensured reliable associations between PA levels and SEV factors (Hox, 2010). Combining systematic data and stakeholder insights reduced researcher bias (Smith & McGannon, 2018).

3.3.3 Consistency and Coherence

A sequential explanatory mixed methods design (Flick, 2018) ensured consistency across research phases, integrating quantitative and qualitative findings coherently (Guetterman, Fetters, & Creswell, 2015). This design, which first employs quantitative analysis to identify CAWD PA participation barriers, challenges and facilitators to establish the study foundation followed by qualitative inquiry to explain underlying factors, is best suited for understanding the reasons behind statistical results. Triangulation validated findings and resolved discrepancies, maintaining methodological coherence (Smith & Sparkes, 2016).

3.3.4 Ethical Consideration

Ethical rigour was maintained through risk assessment, ethical approvals, and involving stakeholders in validating findings (Creswell & Poth, 2017). Stakeholder feedback during FGDs ensured respectful and accurate representation of their insights (MacDonald, 2012).

3.3.5 Adaptability and Reflexivity

The research design was flexible, allowing iterative refinements as new information emerged (Ivankova, Creswell, & Stick, 2006). A longitudinal approach is suggested for future studies to capture evolving PA behaviour dynamics (Ployhart & Vandenberg, 2010).

3.4 Sequential Mixed Methods

3.4.1 The Design Process

I used a sequential mixed methods design to combine quantitative data analysis in Phase 1 with qualitative insights in Phase 2. The cross-sectional study components allowed an in-depth exploration of PA participation over time, repeating over time the primary and secondary data analysis in a longitudinal design in future work. The quantitative phase provides measurable insights into PA behaviours and environmental factors. The qualitative phase added a nuanced understanding of the lived experiences of key stakeholders, including children, parents, caregivers, and school and healthcare providers, highlighting the role of an intelligent group decision support system to support data collection, analysis and integration. I structured the research design process in phases and subphases highlighted in Figure 3.1.

- **Cross-Sectional Study:**

I designed a primarily cross-sectional study to collect data at a single point in time to analyse various variables. I structured the study design into two main phases: quantitative analysis (Phase 1) and qualitative analysis (Phase 2).

- **Longitudinal Study:**

I expanded the research design structure to allow for potential longitudinal study components in a research's future work to extend the research by collecting data at multiple points over time to refine and validate the study’s findings and statistically generalise its applicability to other disability types and regions in the Kingdom. Overall, this robust integrated approach offers a comprehensive understanding of PA participation among Saudi CAWD leveraging multiple sources and types of data.

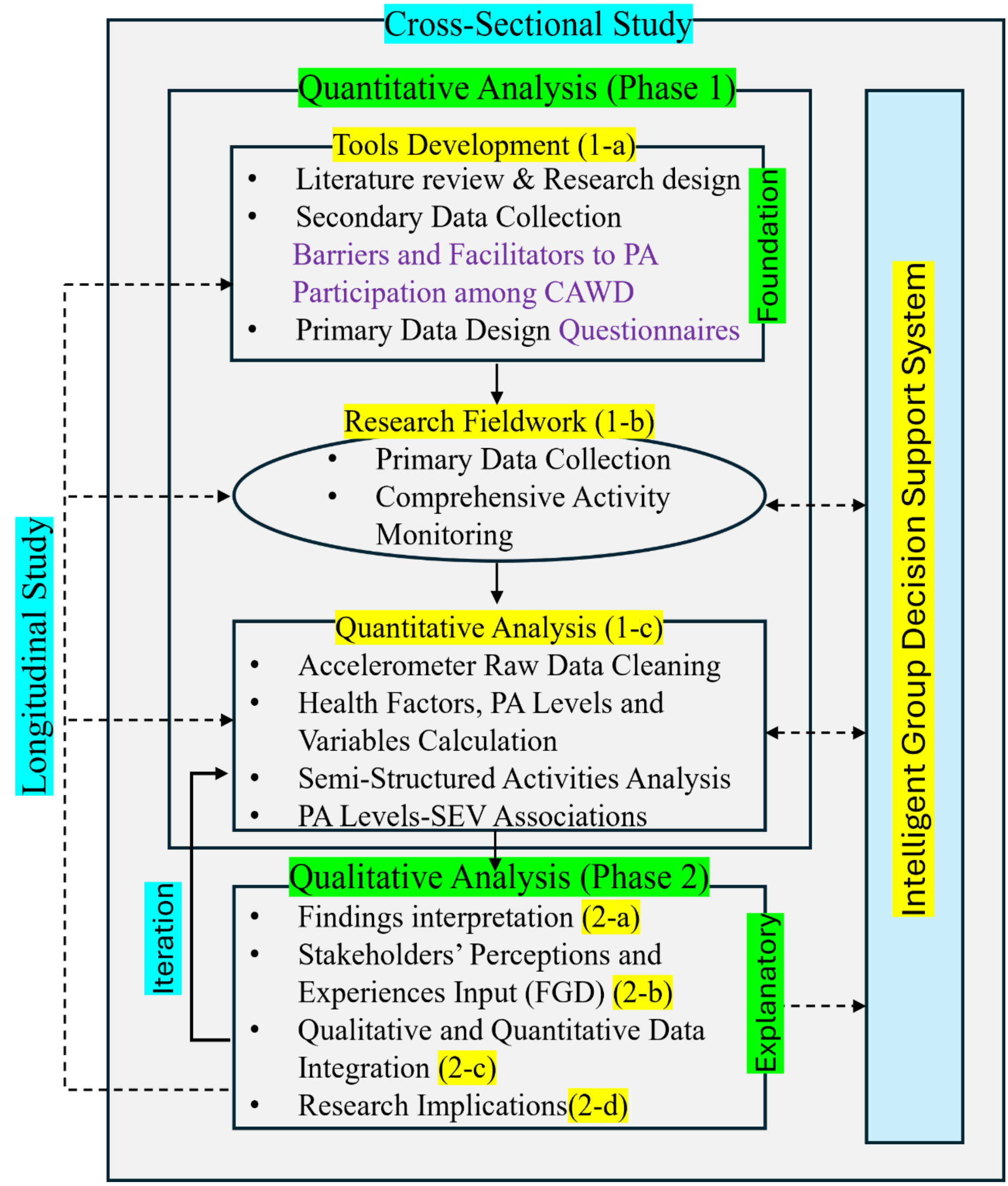

Figure 3.1: Sequential Mixed Methods Approach for PA-Promoting Strategies among CAWD.

3.4.2 The Data Analysis Approach

The data analysis framework in Figure 3.2 show the sequential mixed methods approach. The integrative analysis phase prepares the quantitative findings for in-depth explanatory analysis. It bridges the foundation (subphase 1-a) with the subsequent explanatory phase by solidifying quantitative findings and setting the stage for interpretation, contextual understanding, and data integration.

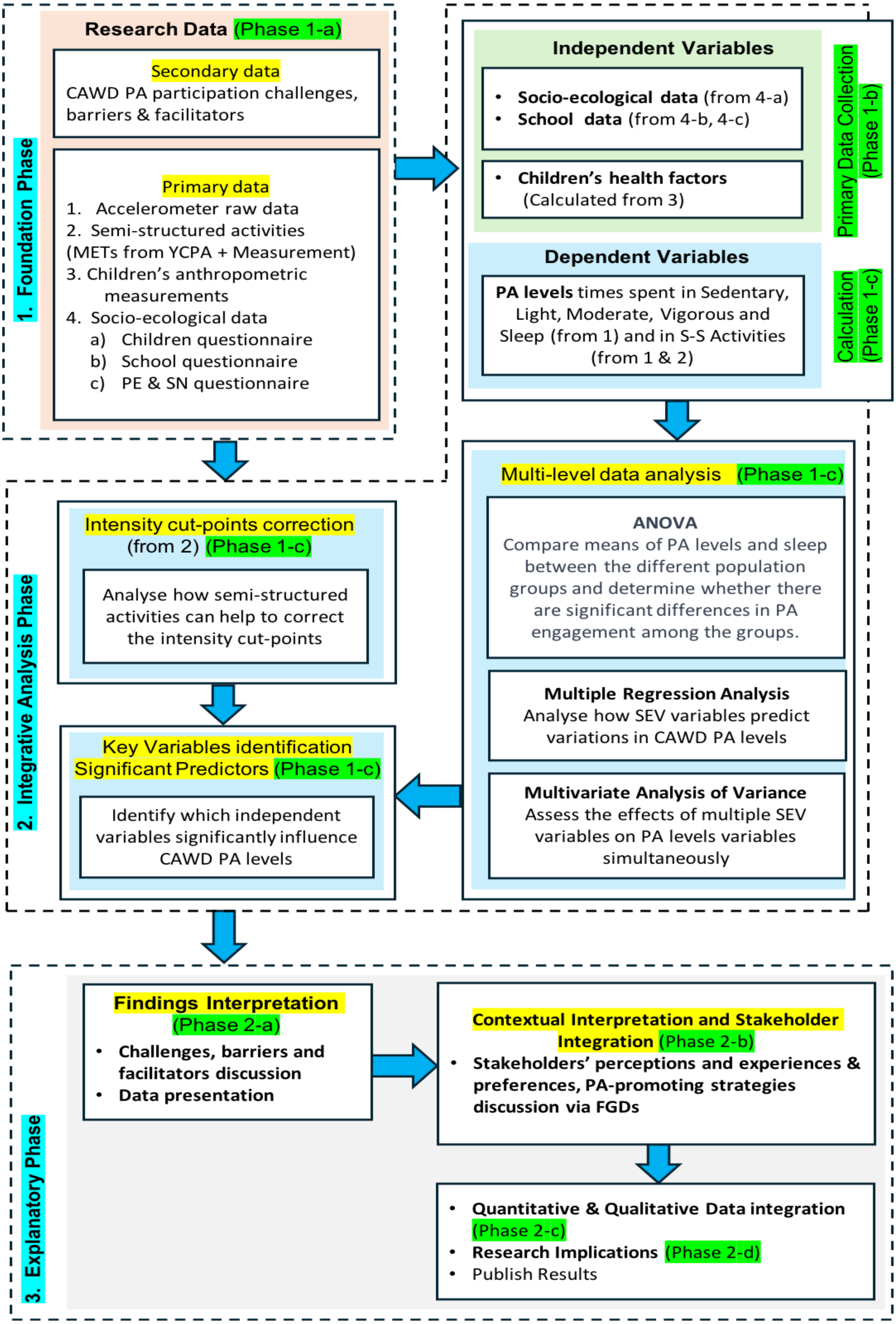

Figure 3.2: Data Analysis Framework.

3.5 Quantitative Analysis (Phase 1)

I structured the quantitative analysis into multiple subphases, labelled in Figure 3.1 as 1-a, 1-b, and 1-c. These subphases represent different steps aimed at elaborating the research foundation, designing tools, conducting fieldwork, and performing data analysis.

3.5.1 Foundation and Tools Development (1-a)

I elaborated in this preparatory sub-phase on the research foundation as the necessary preparation phase for the quantitative research. I included the following key components.

3.5.2 Literature Review

Informing the research design, I thoroughly reviewed existing studies in sports and particularly PA among children and adolescents, particularly among those with a disability in the social context of Saudi Arabia. I also read the domain-published literature in books, papers and other media, delimitating the research area I aimed to investigate. I identified the knowledge gaps in PA-promoting strategies among Saudi CAWD, emphasising what caused PA initiatives to be ineffective and unsuccessful. I established the research questions inherent to thoroughly understand challenges, barriers and facilitators to PA participation in varied settings, use objectively measured PA and SEV to determine the factors of CAWD PA participation to influence and integrate the stakeholders' perceptions and experiences to explore specific and critical PA participation variables and produce evidence-based knowledge for the development and evaluation of appropriate and effective PA promoting strategies among this population. I used the framework to guide both the tools development and data collection processes.

3.5.3 Secondary Data Collection

I also collected and analysed secondary data from different existing sources including previous studies, public health records, and survey data to inform the research design, tool development, and the study context. I used manual coding and thematic analysis to examine the key challenges and barriers CAWD faced in PA participation. I identified and explored comprehensive factors influencing PA levels at home, outside and in school. In addition, I explored the various facilitators that informed worldwide successful strategies in enhancing PA-promoting strategies among this population. I identified key variables used to construct the identified barriers and facilitators necessary to elicit the tools' development requirement to determine the corresponding specifications and guide the design of the required data collection tools. Finally, I refined the critical variables to be measured in the primary data collection phase, examining their additional background information. including their frequency of use in systematic review studies related to the thematic categories listed in Table 3.1.

3.5.4 Secondary Data Analysis

I conducted the secondary data analysis through several key steps to extract meaningful insights from the various sources to feed the research design. These steps included organising and preparing the data, categorising them per relevance to challenges, barriers and facilitators to PA participation among CAWD as structured in the PA SEM shown in Figure 3.3, the PA objective measurement and the influence of the SEV on PA levels, emphasising the importance of the difference worldwide and KSA. The main steps are presented below.

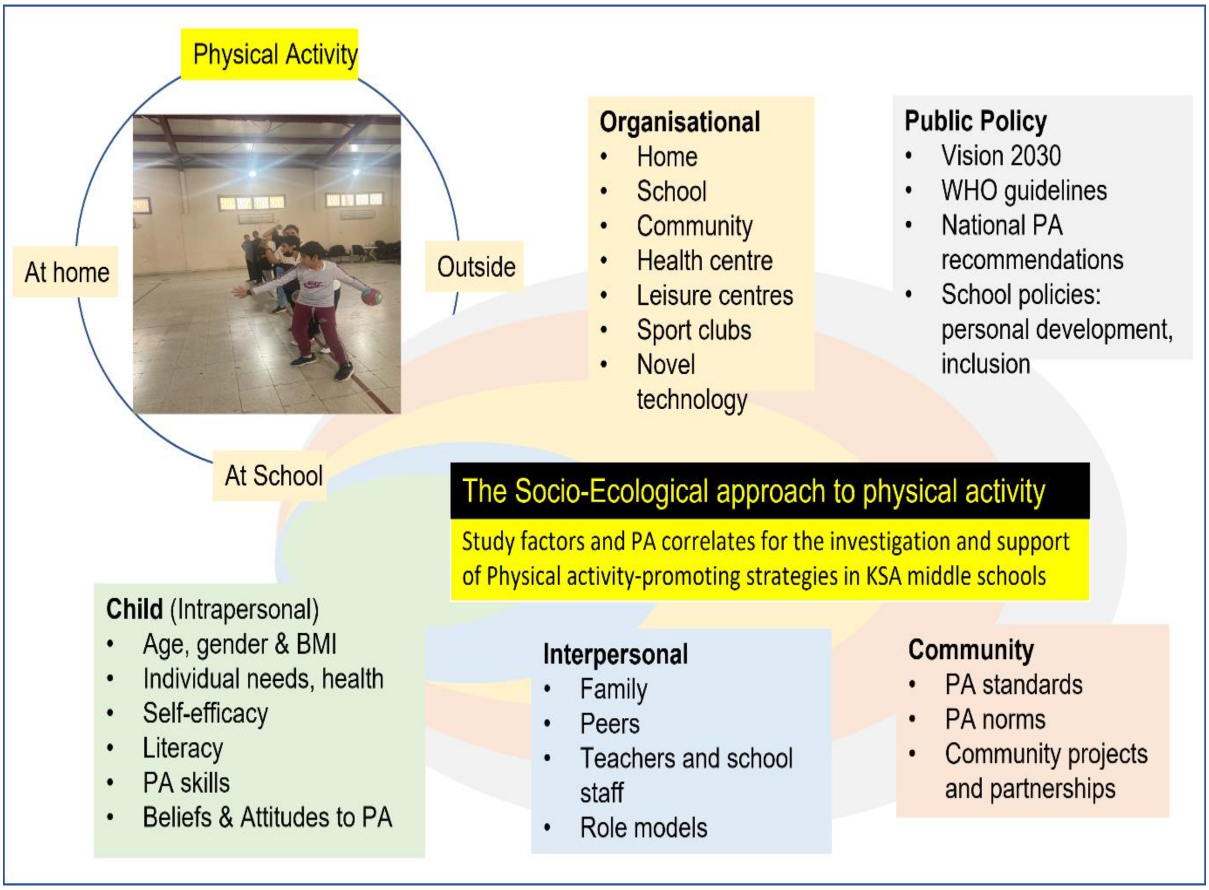

Figure 3.3: Socio-Ecological Model of PA

This model shown in Figure 3.3, is based on the assumption that "PA is a health behaviour that represents the interaction of the person and his or her social and physical environments".

a) Deductive Thematic Analysis

I explored a list of topics highlighted in Table 3.1 that helped create a comprehensive understanding of the challenges and opportunities for increasing PA participation among CAWD in order to help with developing an interview guide and make sense of the data.

Table 3.1: List of thematic categories.

Frequency	Theme
57	T1: Barriers and facilitators to PA Participation in CAWD
43	T2: PA promoting strategies for CAWD
122	T3: Objectively measured PA in CAWD
37	T4: PA behaviour change in CAWD
9	T5: PA initiatives and programmes for CAWD
9	T6: PA for Saudi CAWD
78	T7: PA correlates in CAWD
7	T8: Sequential mixed methods for exploring PA participation barriers and facilitators
10	T9: Impact of PA on mental health and Well-being in CAWD
1	T10: Role of family and caregivers in promoting PA in CAWD
17	T11: School-based PA interventions for CAWD
40	T12: Adaptive physical education and sports for CAWD
1	T13: The role of healthcare professionals in encouraging PA in CAWD
2	T14: Technological innovations in promoting PA for CAWD
59	T15: Social inclusion and PA in CAWD
3	T16 : Cultural influences on PA participation in CAWD
25	T17: Gender differences in PA participation among CAWD
8	T18: Long-term benefits of PA in CAWD
3	T19: Environmental and accessibility factors affecting PA in CAWD
2	T20: The role of peer support in promoting PA among CAWD
1	T21: Policy and legislation impact on PA for CAWD
3	T22: Socioeconomic status and its influence on PA participation in CAWD
11	T23: Psychological barriers to PA participation in CAWD
28	T24: Community-based PA programs for CAWD
9	T25: Parental attitudes toward PA for CAWD
22	T26: Motivational factors for physical activity in disabled children
1	T27: PA training for teachers and coaches working with CAWD
0	T28: The role of physical literacy in PA participation among CAWD
10	T29: Transportation barriers and PA participation in CAWD
0	T30: Parental overprotection as a barrier to PA in CAWD
97	T31: The influence of disability type on PA participation
1	T32: The role of funding and resources in supporting PA for CAWD
0	T33: Influence of media and representation on PA for CAWD
11	T34: Strategies to enhance PA participation in CAWD

I sorted the data into thematic categories: challenges and barriers to PA participation, factors influencing PA levels (home, school, and outside), and facilitators of successful PA-promoting strategies as highlighted in Table 3.2. Using a deductive thematic analysis approach, with a pre-defined focus, I explored patterns and themes emerging from the data related to the challenges faced by CAWD in PA engagement. I systematically identified PA promoting strategies components listed in Table 3.3, including environmental, social, and individual barriers, facilitators like policy interventions, parental involvement, and school support systems following the PA socio-ecological model (Bronfenbrenner, 1979). I contextualised the identified themes within the specific challenges of CAWD in participating in PA in the Saudi context.

Table 3.2: PA participation barriers and facilitators per socio-ecological level of influence.

Socio-Ecological Level	Barriers	Facilitators
Individual level	Physical limitation Psychological factors Awareness and knowledge	Personal interest Skills and abilities Health benefits
Inter-personal level	Family support Peer interaction Support constraints	Social support Role models Inclusive attitudes
Organisational level	Facilities and equipment accessibility Program availability Staff training	Inclusive programs Trained personnel Resources
Community level	Infrastructure Community awareness Transportation	Community support Partnerships with schools Sports and PA events
Policy level	Legislation funding Funding Advocacy	Inclusive policies Funding and grants Awareness campaigns

Table 3.3: Strategy Components Associated with Themes.

N.	Strategy	Theme	Action
1	Education and Awareness	T1, T2	Raising awareness about the specific needs Reduce misconceptions & societal attitudes Empower families, peers, educators, and communities
2	Facilities Accessibility	T19	Facilitate access to sports facilities, parks, and recreational spaces Improve accessibility of sports environments
3	Family and Community Engagement	T10	Offer encouragement and logistical support Strengthen family and community engagement & reduce isolation
4	Inclusive Activity Programming	T5, T4	Focus on inclusivity to break down social and environmental barriers & Integrate adaptive activities Encourage long-term behaviour change,
5	Peer Support and Monitoring	T20, T4	Foster inclusion, motivation, and a sense of belonging & Provide social reinforcement
6	Personalized Goal Setting	T4	Prompt behaviour change tailoring PA goals Cater to individual capabilities, preferences, and needs, Foster long-term behaviour change
7	Policy and Advocacy	T7, T5	Access to resources - Inform societal attitudes legal protection - Provide the necessary adaptations and support systems
8	Role Model and Visibility	T15	Show that participation is possible & enhance social inclusion Inspire confidence & reduce feelings of isolation
9	Skill Development and Training	T12, T14	Develop physical skills through adaptive training programs - Promote self-efficacy Offer tailored skill development opportunities

b) Cross-comparison and Variables Identification

I compared and refined the identified themes uncovering any discrepancies or inconsistencies and performing a cross-comparison of the data across different contexts, settings and disability types examining several data sources and research studies. I repeated this step twice to refine the findings and identify critical strategies highlighting the importance of their impact on PA participation and associated links of influence as indicated in Table 3.4. I then translated the identified strategies and multiple links into critical variables for modelling the PA objectively measured, health factors and the children's personal, familial, school and community environmental factors of PA participation and performance influence. I assigned action links to the strategy components relevant to the research focus, ensuring that key barriers and facilitators were consistently captured across multiple data links. Based on global strategies used successfully in enhancing PA participation among similar populations.

Table 3.4: Impact links of PA-promoting strategies.

N.	Strategy	Impact	Multiple links
1	Education and Awareness	Reinforces	Inclusive Programming
		Empowers	Family and Community Engagement
		Supports	Policy and Advocacy
2	Facilities Accessibility	Enhances	Inclusive Activity Programming
		Supports	Family and Community Engagement
		Promotes	Role Models and Visibility
3	Family and Community Engagement	Strengthens	Inclusive Activity Programming
		Connects with	Peer Support and Monitoring
		Advocates for	Policy and Advocacy
4	Inclusive Activity Programming	Provides Opportunities for	Peer Support and Monitoring
		Supports	Personalised Goal Setting
		Strengthens	Skill Development and Training
5	Peer Support and Monitoring	Enhances	Inclusive Activity Programming
		Motivates	Personalised Goal Setting
		Increases	Role Model and Visibility
6	Personalized Goal Setting:	Connects with	Skill Development and Training
		Motivates	Family and Community Engagement
		Informs	Policy and Advocacy
7	Policy and Advocacy	Supports	Facilities Accessibility
		Strengthens	Role Model and Visibility
		Enhances	Skill Development and Training
8	Role Model and Visibility	Motivates	Peer Support and Monitoring
		Informs	Education and Awareness
		Supports	Family and Community Engagement
9	Skill Development and Training	Enhances	Inclusive Activity Programming
		Supports	Personalised Goal Setting
		Connects with	Peer Support and Monitoring

I also examined the frequency and relevance of the identified variables in systematic reviews and case studies to determine which variables were most critical and how they had been used in previous research which helped shape the design of data collection tools.

c) **Variable Refinement and Categorisation**

I refined and categorised the key variables necessary for understanding the influence on PA levels of the barriers and facilitators of PA participation among CAWD. These categories included personal factors, environmental access, parental attitudes, social support, and school-based and community programs. I used insights from this analysis to design the questionnaires needed for primary data collection, ensuring that the identified barriers and facilitators were accurately captured, modelled and measured.

Overall, I used the deductive thematic analysis to guide the development of a conceptual framework for the primary data collection subphase. This framework highlighted the most important PA participation variables of influence characteristic of the barriers and facilitators CAWD faced when engaging daily in PAs. The secondary data analysis provided a strong foundation for refining the research tools and ensuring that the primary data collection was well-targeted and comprehensive.

3.6 Phase 1 Sampling process

3.6.1 Recruitment

After receiving ethical approval from both Durham University and Taif University, I visited 10 secondary schools in Taif City after being granted by the GDET access to identify those interested in participating in the research study. I required the schools to be broadly representative, including boys and girls of different age groups and with mild intellectual disability or hearing impairment. I thoroughly examined their interest in looking at the children's PA levels to meet the international guidelines, the current school situation in terms of place of PE and PA in the children's curriculum and developing a strong vision for PE and PA practice in the context of implementing the Saudi Vision 2030 by adopting effective PA-promoting strategies to enhance PA participation and increase performance. I concluded that the schools with light intellectual and mild impairment disability types requiring light support were particularly more representative of the selection criteria and showed a high degree of homogeneity, making them ideal for the study. Disabled people requiring only light support, which does not severely impact their ability to follow the general PA curriculum, enabled this group to meet the research study inclusion criteria. This also allowed for a more consistent examination of PA levels and their relationship with the socio-ecological factors targeted in the research and a valid comparison of the various CAWD population groups in different settings such as home, school and outside.

3.6.2 Population Sampling Frame and Size

Four secondary schools were selected among all those invited through the General Directorate of Education in Taif (KSA) and positively responded to their participation in the study. Each selected school was asked to form a team participating in assisting the researcher, taking part in the survey as school managers or PE and SN heads and teachers and sitting in the stakeholder's board. The schools' characteristics are highlighted in Table 3.5.

In these schools, classes were organised according to the ratio "number of CAWD per SN support staff and the type of support required (light, moderate or intense)". Classes with moderate and intense support had fewer children. I selected the school participants based on the classes requiring light support and the number of accelerometers available for the study (17). This number was limited because I could not afford to purchase more as I paid for them and my university offer did not include bench fees.

Table 3.5: Study population characteristics and participants.

Secondary School Name	Code	School				Participants	
		Disability Type (*)	Gender	No. of Classes	Pop.	CAWD	%
Hittin	S1	LID.	Boys	4	26	17	65,38
Al-Rayyan	S2	MHI	Boys	3	16	12	75.00
MS 34	S3	MHI	Girls	6	42	17	40.48
MS 10	S4	LID	Girls	3	17	17	100.00
Total 4 schools	S1, S2, S3, S4	LID MHI	Boys Girls	16	101	63	62.34
Total Taif Schools			Boys Girls		210 95	29 34	13.81 35.79

(*) LID.: Light intellectual disability MHI.: Mild Hearing Impairment

Overall, I considered in the quantitative phase, two groups of participants in the primary data collection including children and the school management and PE and SN heads and teachers. The first group included 63 disabled children with a mild intellectual disability or hearing impairment attending along with their able (non-disabled) peers in the same Taif-City secondary schools. The second group included 5 participants per school (head of management, PE and SN heads and teachers). All the participants met the inclusion criteria of being a CAWD with light support required for the first group or a school stakeholder for the second group.

Table 3.6: Demographic data for CAWD participants in primary data collection.

Population group	Gender	Disability	Number	Age		Group observation
				Mean	S. D	
S1	B	LID	17	16.10	1.32	Oldest
S2	B	MHI	12	14.66	1.50	Youngest
S3	G	MHI	17	15.65	1.99	Slightly older average
S4	G	LID	17	15.53	0.87	Slightly older average
Boys	B	LID MHI	29	15.45	1.53	Oldest
Girls	G	LID MHI	34	14.59	1.86	Youngest
I.D	B, G	LID	34	14.76	1.67	Youngest
H. I	B, G	H. I	29	15.24	1.85	Oldest
All	B. G	LID MHI	63	14.98	1.76	

As shown in Table 3.6, the differences in mean ages and variability across the different population groups provided valuable insight into how each group represented distinct age segments, offering a nuanced interpretation of age-related PA dynamics.

3.6.3 Primary Data Design – Questionnaires

Data from different sources including accelerometer raw data and child and family, school and teachers were integrated using the PA socio-ecological model structure illustrated in Table 3.2 for the design of questionnaires (See Appendices A) and the data collection recommendations of the ISCOLE protocol. This was followed by designing the tasks for objectively measuring the children's PA by attaching accelerometers on their non-dominant wrists, taking their anthropometric measurements and running 2 consecutive days a set of 10 semi-structured activities. The primary data collection tools including questionnaires and methods were refined emphasising the potential risks inherent to the fieldwork and the handling of the research data.

A research risk assessment was conducted and appropriate strategies were selected to mitigate or reduce the potential fieldwork and data handling risks. I conducted a research fieldwork risk assessment by examining potential risks and ethical issues, designed an information pack and produced a data management plan. I applied for ethical approval from Durham University and Taif University to undertake the research fieldwork, and this application was approved. I also successfully applied for the authorisation to grant access to four secondary schools in Taif City by the General Directory of Education in Taif (GDET). These approvals enabled me to undertake the research study fieldwork.

3.7 Intelligent Group Decision Support System (IGDSS)

I integrated an IGDSS into the research design framework to support both the quantitative and qualitative phases of the research study and integrate iteratively their data using data analytics, and collaborative facilitation and decision-making tools. I elicited the system requirements and elaborated the specifications as highlighted in Table 3.7, to support researchers and stakeholders throughout the research process and enhance collaboration. I involved a third party in the technical co-development of the system.

Table 3.7: Intelligent Group Decision Support System Specifications.

Requirement	IGDSS Specifications
Enhanced data management, analysis and integration	• Data input, storage, cleaning and validity check • PA levels and sleep calculation • Statistical analysis • Systematic collection of stakeholder inputs • Real-time communication • Voting mechanisms and Consensus-building features
Data-driven decision making	• Aggregating stakeholder inputs • Ranking preferences • Ensuring all perspectives are considered
Collaboration and consensus building	• Facilitating strategy elaboration and analysis • Improving the consensus-building process
Transparency and accountability	• Archiving discussions, votes, and outcomes • Documenting and tracking focus group discussions • Making decision processes accessible and reproducible
Tailored solutions	• Well-informed and broadly supported • Tailored to CAWDs specific needs
Validity and reliability	• Providing a structured framework for decision-making • Enabling comprehensive data analysis • Facilitating consensus among diverse stakeholders

3.8 Research Fieldwork (1-b)

I undertook the research fieldwork by visiting 4 secondary schools in Taif City (KSA) after obtaining ethical approvals from Durham University and Taif University, and authorisation to access these schools from the GDET. I requested the appointment of a school research assistant to liaise with children, parents and carers, school management, SN and PE heads and teachers. I developed clear instructional materials (participant information pack, measurement manuals and checklists) and fieldwork risk assessment for the assistants to reference during the fieldwork. I trained school research assistants to liaise with children, parents and stakeholders.

I appointed a female research assistant to liaise with appointed school female research assistants as males were not permitted to do this. I deployed the study-designed data tools and methods via the school research assistants and collected data directly from them.

3.8.1 Research Assistant Appointments

a) School Research Assistant Training

I provided comprehensive training to the school research assistants to ensure they were fully prepared to conduct the fieldwork, i.e., understanding, coordinating, supervising and reporting. I thoroughly explained the content of the questionnaires and data collection tasks. I included mock sessions and role-playing exercises in this training, followed by constructive feedback about any aspect of the research study to ensure their readiness. I trained assistants on using specific research tools (questionnaires) and technology (accelerometers and anthropometry measurement tools) for measurement, monitoring and data entry systems emphasising the importance of maintaining accuracy and confidentiality and ensuring all data were correctly logged and organised.

b) Girls' School Research Appointment

I appointed a female to undertake on my behalf the research fieldwork in girls' schools as males were not allowed in. I included this appointment in the ethical approval application. I trained the schools' female research assistants via Microsoft Teams (as described in section 3.8.1) to understand, coordinate and supervise the fieldwork in girls' schools emphasising the importance of practical issues and ethical considerations. I assessed the result of this training using my three daughters playing the role of participants, repeating the entire process twice and the outcome was satisfactory.

3.8.2 Primary Data Collection

The training for data collection procedures included the following key components:

a) Participant Informed Consent

I provided detailed guidance for approaching and engaging participants in the research study, ensuring informed consent from children and their guardians was voluntarily given, and following ethical research protocols. I explained the importance of maintaining participant confidentiality and data integrity and following the correct procedures for recording and storing primary data.

b) Anthropometric Measurements

I trained the assistants in taking accurate measurements of weight, height (both standing and sitting), girth circumference, and skinfold thickness (listed in Table 3.8), ensuring informed consent for children and following standardised protocols described in CDC guidelines for "Body Measurements (Anthropometry)". I conducted practical, hands-on sessions with the assistants, using calibrated tools such as stadiometers, non-stretchable tape measures, and skinfold callipers to ensure measurement techniques and data collection were understood and successfully and consistently repeated.

Table 3.8: List of anthropometric measurements.

1 Neck	5 Thigh	9 Shoulder Skinfold	13 Calf Skinfold
2 Arm	6 Weight	10 Abdominal Skinfold	14 Standing Height
3 Waist	7 Biceps Skinfold	I1 Iliac Crest Skinfold	15 Sitting Height (Adjusted)
4 Hip	8 Triceps Skinfold	12 Thigh Skinfold	16 Sitting Height

c) Accelerometer Attachment

The assistants were shown how to correctly attach accelerometers to the children's non-dominant wrists, ensuring they were positioned securely and comfortably to minimise disruption to their daily activities. They were instructed on how to explain the purpose and use of the accelerometers to the children and troubleshoot any potential issues during the seven-day monitoring period keeping a log of accelerometer issues.

d) **Facilitating Semi-Structured Activities**

I provided a detailed overview of the 10 semi-structured activities chosen from the YCPAs and listed in Table 3.10, to be conducted with the children over two consecutive days, with five-minute break between activities. These semi-structured activities were used in previous studies (Mackintosh et al., 2012; Kracht et al., 2024) to validate intensity cut-point thresholds for the different intensity level groups. I used the same MET intensity level thresholds for the 15-18 and 19-21 age groups (the latter is not included in the YCPAs), assuming that METs do not change drastically between the different age groups as highlighted in Table 3.9.

The validated intensity thresholds are sedentary activities (< 1.5 METs), light activities (≥ 1.5 to < 3 METs), moderate activities (≥ 3 to < 6 METs) and vigorous activities (>6 METs). I also provided the assistants with practical training to facilitate these activities, ensuring they could engage the children effectively and safely, guide instructions and discussions, and encourage active participation while keeping the sessions on track. I also provided guidance on managing group dynamics by fostering inclusive participation, balancing group sizes to encourage peer support, and using clear communication strategies to accommodate diverse needs. To ensure child safety, I advised on risk assessments, supervision ratios, and implementing safeguarding protocols, such as designated safe spaces and emergency response plans. Additionally, I recommended adapting activities based on children's age and abilities by modifying movement intensity, providing visual and verbal cues, and offering individualised support where necessary to promote engagement and accessibility for all participants.

Table 3.9: List of semi-structured physical activities and METs values.

Activity	6-9 Years old	10-12 Years old	13-15 Years old	15-18 Years old
a) Lay supine	0.8	0.8	0.8	0.9
b) Seated DVD viewing	1.5	1.5	1.4	1.4
c) Playing a virtual sport (Dance)	5.5	5.0	4.8	4.8
d) Overarm throwing and catching using the dominant hand	3.8	3.5	3.5	3.5
e) Underarm throwing and catching using the dominant hand	3.3	3.2	3.1	3.0
f) Instep passing a football	4.1	4.2	4.0	4.0
g) Slow walk (35 m/minute)	2.5	2.6	2.4	2.4
h) Fast walk (70 m/minute)	4.3	4.4	4.2	4.2
i) Slow run (100 m/minute)	7.0	7.0	6.7	6.7
j) Medium run (150 m/minute)	5.0	5.1	5.0	5.0

3.9 Quantitative Analysis (1-c)

Quantifying the number of data points corresponding to each aspect of the questionnaires allows for an objective assessment of their relative emphasis and importance within the study. By identifying which elements receive greater representation, the analysis highlights key themes and priorities in school PE and PA management. This approach also ensures a balanced interpretation of the dataset, helping to determine whether certain aspects are under- or over-represented, thereby guiding nuanced conclusions and targeted recommendations for policy and practice.

3.9.1 Questionnaires

I used a data-driven approach to analyse the components' data rate of the questionnaires in the primary data collection related to the child or the school they attend. Each data corresponds to a SEV factor that aligns with the research questions, or a code used to identify the child's population group. The school code is associated with a disability type as schools are mono-disability type. In this analysis, I assessed the distribution or weight of specific sections or components, analysing the number of data or SEV factors to investigate how the questionnaires are structured to measure different constructs representing insights into how participants perceived challenges, barriers and facilitators to CAWD's PA participation inside and outside the school, and what conclusions can be drawn from these weights. The weights in terms of component richness were interpreted, linking how the structure (number of data) influenced the challenges, barriers and facilitators' investigation depth. The quantitative statistical analysis of the questionnaires' responses including frequency, mean, and variance is developed in Chapter 5 (Quantitative Analysis - Part II).

- **Child questionnaire**

The child questionnaire includes three groups of data: anthropometric measurements, socio-demographic and environmental data, and accelerometer wearability assessment data listed in Table 3.10. The 63 study participants fully completed the questionnaire.

- **Anthropometric measurements**

These measurements help calculate health factors to derive a highly elaborate and personalised profile of the child's health, offering insights into their association with PA levels and guiding PA interventions for PA interventions and exercise prescription. "Skinfold" and "Girth Circumference" components equally hold (43.48 %) an exhaustive list of data required for the health factors calculation.

- **Socio-Ecological Data**

These data including the child's possible health issues, and correspond to the socio-demographic and environmental data encompassing the broad factors affecting the child's PA behaviour beyond anthropometric measurements, aligning with the SEM framework that considers multiple levels of influence (individual, family, community, society and policy) on PA levels. Family. (34.16 %), access to facilities and activities and school and community support (29.93 %), feelings and behaviours (19.37 %), and disability (16.55 %) were specifically investigated, indicating their relative importance in PA participation.

Table 3.10: Child questionnaire.

Entity	Questionnaire	Component	Number of Data	%	%
Child (n=63)	Anthropometric Measurements (n=1) Data: 23 % : 6.75	Date of Birth & Gender, School	3	13.04	
		Weight & Heights	3	43.48	
		Girth Circumference	7		
		Skinfold	10	43.48	
	Socio – Ecological Data (n=1) Data: 284 % : 83.29	Disability	47	16.55	
		Family & Household	31	10.92	34.16
		Lifestyle	34	11.97	
		Support	32	11.27	
		Feelings & Behaviour	55	19.37	
		Activities & Facilities	56	19.72	29.93
		School & Community Support	29	10.21	
	Child (n=1) Data: 34 % 9.97	Accelerometer Wearability	34	11.97	
Semi-Structured Activities (n=4)	Session (n=1)	Session Details	19		

- **Accelerometer Purpose**

Accelerometers are tracking devices used in PA research to objectively measure movement patterns, which are converted into quantitative data and interpreted for PA classification (sedentary, light, moderate and vigorous) using intensity cut points.

- **Accelerometer Wearability Assessment**

Assessing accelerometers' wearability helps improve their effective use and accurate and reliable data collection among CAWD, paying attention to purpose, FAQ and how to wear the device (32.35 %), wear of the device (32.35%) and the child's feeling and comfort wearing the device (35.30 %).

3.9.2 School questionnaire

The inclusion of both school PE and PA management data alongside PE and SN heads' and teachers' responses ensures a comprehensive understanding of the institutional context influencing PA participation. By collecting input from school leadership and educators directly involved in PE and SN education, the questionnaire captures both policy-level and practice-level insights. Fully completed responses across all schools enhance the dataset's reliability, allowing for consistent comparisons and a robust analysis of school-based PA management and support. The school questionnaire includes two groups of data: school PE and PA management and the PE and SN heads and teachers' data listed in Table 3.11. The school management, PE and SN heads and teachers fully completed the questionnaire in each school.

Table 3.11: School questionnaire.

Entity	Questionnaire	Component	Number of Data	%	%
Schoo l (n=4)	School (n=1)	Identification	8		
	Management (n=1) Data: 332 % 53:46	General Information	35	10.54	
		PE Staff	45	13.55	37.74
		PE Policy	19	5.72	
		PE Promotion	25	7.53	
		Training	33	9.94	
		PA Policy	38	11.45	43.38
		PA Promotion	16	4.82	
		PA Evaluation	49	14.76	
		PA Activities & Facilities	41	12.35	
		Government Support	21	6.33	
	Teacher & Assistants (n=5) Data: 289 % 46:54	Profile	25	8.65	
		Priorities	19	6.57	
		Children's PE Behaviour	26	9.00	47.77
		PE Lessons	29	10.04	
		PE Evaluation	29	10.04	
		PE Measurement	25	8.65	
		Training	29	10.04	
		PA Activities & Facilities	26	9.00	37.01
		PA Promotion	28	9.69	
		PA Practice	53	18.34	

The school management team and staff's perceptions of PA and PE were fully investigated to comprehensively understand challenges, barriers and facilitators to PA participation among CAWD inside the school. School management places higher importance on promoting PA (43.48%) compared to teachers and support staff (37.01%), suggesting that their relatively higher emphasis on PA promotion is due to the implementation of the Saudi Vision 2030 and could be due to the perception that PA is part of a holistic strategy for improving students' health and well-being, requiring policy change and resource allocation. On the other hand, teachers and support staff prioritise supporting PE (47.77%) more than school management (37.34%), suggesting that their role is more directly involved in the delivery of PE rather than general PA promotion, as part of their day-to-day responsibilities, providing quality PE lessons that meet curriculum standards.

3.9.3 Accelerometer Raw Data Validity

This process of raw data validity provides a clear basis for identifying and excluding non-wear data based on abnormal temperature ranges. In the raw data, I identified temperature values for the 1-s epoch and filtered temperature values outside the 26°C–40°C range to identify and exclude non-wear data based on abnormal temperature ranges. I classified epochs with continuous non-wear candidates. Similarly, I identified SVM extreme values (< 1 and > 99 g). These values are shown in Table 3.12.

Table 3.12: Filtered temperature values outside the 26°C–40°C and SVM > 99.

		Temp	Temp	Temp	Temp	SVM LV	SVM HV
	Rec.	<25 °C	< 26°C	> 38°C	> 40°C	< 1	> 99
Max	604799	236052	299268	52587	46245	349375	9685
Mean	575682	5538	11920	1006	758	153829	1294
SD	87251	29873	41423	6629	5825	118179	1507
%		0.96%	2.07%	0.17%	0.13%	26.72%	0.22%
S1C13	604799	0	354	3951	753	150917	762
S1C09	594737	236052	299268	0	0	326107	2588
S2C04	604799	5736	28581	52587	46245	331903	1635
S1C10	592964	87	978	102	0	326107	9685
S3C14	604799	1572	4554	0	0	349375	565

Temperature readings below 26°C or above 40°C and low SVM values (zero or near-zero activity) are likely due to non-wear situations (Vert et al., 2022). They represent an average of 2.07 % of the total volume of the readings. Although SVM high values compressed at a 1-s epoch (> 99 g) account for 0.22 %, their negative impact on the PA assessment is absorbed by the readings' compression in a 60-s epoch. SVM low values compressed at a 1-s epoch (< 1 g) account for 26.72 % and include readings of non-wear situations, sleep and sedentary activity.

3.9.4 Activity Monitoring

The accelerometer activity monitoring resulted in data recorded for the 63 participants. These data were analysed per child and population group as illustrated in Table 3.13, Table 3.14 and Table 3.14. In the range values data analysis, I focussed on identifying non-wear situations, SVM and near-body temperatures low and high values affecting the processing, analysing, and interpreting the accelerometer data to quantify PA patterns and intensities. This analysis included examining the number of accelerometer readings and non-wear times, compressed to a 60-s epoch and the number of SVM high values (>99 g) compressed to a 1-s epoch.

Table 3.13: Detail of the data recording per participant.

SVM high values, recorded and wear times

School: Hittin

Code	SVM HV	Recorded	Non-Wear	Wear	J HH Mn
S1C01	1522	1399	0	1399	0 23 19
S1C02	2078	10034	0	10034	6 23 14
S1C03	2236	10028	0	10028	6 23 8
S1C04	1110	4389	0	4389	3 1 9
S1C05	2420	10054	0	10054	6 23 34
S1C06	2143	10011	0	10011	6 22 51
S1C07	329	10081	0	10081	7 0 1
S1C08	1881	10097	0	10097	7 0 17
S1C09	2588	10012	1923	8089	5 14 49
S1C10	9688	9982	0	9982	6 22 22
S1C11	1578	10002	0	10002	6 22 42
S1C12	4146	10013	0	10013	6 22 53
S1C13	762	10179	0	10179	7 1 39
S1C14	2038	10005	0	10005	6 22 45
S1C15	1755	8714	0	8714	6 1 14
S1C16	1158	8725	0	8725	6 1 25
S1C17	2248	9958	0	9958	6 21 58

School: Al-Rayyan

Code	SVM HV	Recorded	Non-Wear	Wear	J HH Mn
S2C01	498	9901	0	9901	6 21 1
S2C02	2199	7310	0	7310	5 1 50
S2C03	1669	10179	79	10100	7 0 20
S2C04	1635	10179	11	10168	7 1 28
S2C05	2697	10179	0	10179	7 1 39
S2C06	2982	9406	0	9406	6 12 46
S2C07	3244	10179	0	10179	7 1 39
S2C08	2247	10179	0	10179	7 1 39
S2C09	1511	6737	0	6737	4 16 17
S2C10	1330	10179	0	10179	7 1 39
S2C11	2009	10179	15	10164	7 1 24
S2C12	1273	9438	0	9438	6 13 18

School: MS-10

Code	SVM HV	Recorded	Non-Wear	Wear	J HH Mn
S3C01	440	7107	0	7107	4 22 27
S3C02	1004	10179	18	10161	7 1 21
S3C03	2064	10179	0	10179	7 1 39
S3C04	279	10179	0	10179	7 1 39
S3C05	653	10179	0	10179	7 1 39
S3C06	319	10179	0	10179	7 1 39
S3C07	1248	10179	0	10179	7 1 39
S3C08	1162	10179	0	10179	7 1 39
S3C09	3606	10179	0	10179	7 1 39
S3C10	1217	10179	0	10179	7 1 39
S3C11	576	10179	0	10179	7 1 39
S3C12	681	10179	0	10179	7 1 39
S3C13	2306	10179	0	10179	7 1 39
S3C14	565	10179	0	10179	7 1 39
S3C15	560	10179	0	10179	7 1 39
S3C16	1633	10179	0	10179	7 1 39
S3C17	227	10179	16	10163	7 1 23

School: MS-34

Code	SVM HV	Recorded	Non-Wear	Wear	J HH Mn
S4C01	152	10179	141	10038	6 23 18
S4C02	95	10179	2130	8049	5 14 9
S4C03	174	10179	1366	8813	6 2 53
S4C04	2	10179	2573	7606	5 6 46
S4C05	16	10179	7452	2727	1 21 27
S4C06	1236	10179	155	10024	6 23 4
S4C07	23	10179	1260	8919	6 4 39
S4C08	97	10179	960	9219	6 9 39
S4C09	97	10179	5159	5020	3 11 40
S4C10	105	10179	5159	5020	3 11 40
S4C11	157	10179	0	10179	7 1 39
S4C12	15	10179	6529	3650	2 12 50
S4C13	33	10179	5176	5003	3 11 23
S4C14	82	10179	1030	9149	6 8 29
S4C15	1423	10179	116	10063	6 23 43
S4C16	658	10179	710	9469	6 13 49
S4C17	1	10179	5129	5050	3 12 10

For accurate PA classification across its different categories, wear times must be compatible with the minimum monitoring periods. Additionally, the SVM extreme values' upper threshold must align with the maximum body acceleration among disabled children, ensuring the data reflects true activity levels. Furthermore, wear times must be homogenous across the different CAWD population groups to allow valid comparisons of PA levels. According to The International Physical Activity and the Environment Network (IPEN), the required monitoring periods for a valid PA classification are at least 10 hours of valid wear time per day and several days per PA intensity category: Sedentary**:** 3–4 days, Light Activity**:** 4–7 days, Moderate Activity**:** 4–7 days and Vigorous Activity**:** 7 days.

Table 3.14: Summary of the data recording per population group.

School	Number of days of activity monitoring								
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
S1	1	0	0	1	0	0	12	3	17
S2	0	0	0	0	1	1	3	7	12
S3	0	0	0	0	1	0	0	16	17
S4	0	1	1	4	0	2	8	1	17
Total	**1**	**1**	**1**	**5**	**2**	**3**	**23**	**27**	**63**
%	**1.59%**	**1.59%**	**1.59%**	**7.94%**	**3.17%**	**4.76%**	**36.51%**	**42.86%**	**100.00%**

As highlighted in Table 3.14, PA classification cannot be performed at least for the sedentary intensity (4.77 % of participants), light and moderate (12.71 %) and vigorous (57.14 %) when considering the lower number of required monitoring days for each category. Using the lower threshold may have led to reduced reliability of estimates, decreased validity of the data, impact on population-level comparison, loss of sensitivity to different activity intensities, and statistical power and generalisability. The classification could not be performed for the sedentary intensity (12.71%) and light, moderate and vigorous (57.71%) when the upper threshold was used. Based on the conclusion of this analysis, I used 6 days as a safe monitoring period corresponding to a valid PA classification for 79.37 % of the participants. This choice is a practical solution that balances the need for sufficient data with participant compliance. According to Dillon et al. (2016), six days is consistent with literature recommending 4 to 7 days as optimal for capturing habitual PA behaviour. These findings underscore the importance of considering both the number of monitoring days including school days with and without running semi-structured activities and weekend days to accurately assess habitual PA patterns.

Table 3.15: Summary of the recorded data per population group.

		Recorded		Non-Wear Time		High Values		Wear time	
Group	Size	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
All	63	9694.32	1454.26	747.73	1751.15	1363.17	1466.62	8946.59	2110.74
S1	17	9543.65	1398.2	113.12	466.4	2376.82	2063.13	9430.53	1435.24
S2	12	9526.92	1210.66	8.75	22.7	1963.17	743.09	9518.17	1205.72
S3	17	10166	53.6	2	5.66	1196.94	916.12	10164	53.38
S4	17	10166	53.6	2641.41	2537.39	380.12	646.4	7524.59	2523.54
ID	34	9867.82	1026.92	1381.41	2205.08	1269.91	1815.71	8486.41	2247.36
HI	29	9803.24	974.09	183.28	960.36	1426.52	957.18	9619.97	1314.72
Boys	29	9534.76	1300.54	248.41	1012.53	2120.17	1697.9	9286.34	1551.79
Girls	34	10179	0	1325.85	2214.8	679.97	808.06	8853.15	2214.8

Data from Table 3.15 indicate that S1, S2 and S3, gender and disability groups are fairly similar for wear times.

3.9.5 Semi-Structured Activities

Semi-structured activities described in section 3.8.2-d (Primary Data Collection), were performed by all 63 CAWD participants in two runs on consecutive school days under the supervision of the PE and SN heads. Their recording was included in the 7-day comprehensive activity monitoring. Although no wearing issues were reported by the PE and SN staff, no recording (1.59 %), non-wear situations or no activity performed (4,76 %) were found in the accelerometers' raw data analysis as highlighted below in Table 3.16.

Table 3.16: Semi-structured activities monitoring.

SSA	Day 1	Day 2
NR	1	1
%	1.59	1.59
LM/NWS	0	6
%	0	4.76
S1C01	NR	NR
S1C07	✓	Sed/NWS
S1C10	✓	Sed/NWS
S2C10	✓	Sed/NWS
S2C11	✓	Sed/NWS
S2C12	✓	Sed/NWS
S3C02	✓	Sed/NWS
NR: No Recording		
Sed/NWS	Sedentary or Non-Wear Situation	

Although the semi-structured activities protocol was followed emphasising how and when they were performed during the monitoring period, ensuring consistency in data collection across participants, I observed as can be seen from Figure 3.3, that some semi-structured activities' duration was sometimes extended, overlapping with the activity break due to the children being carried away, enjoying the exercises.

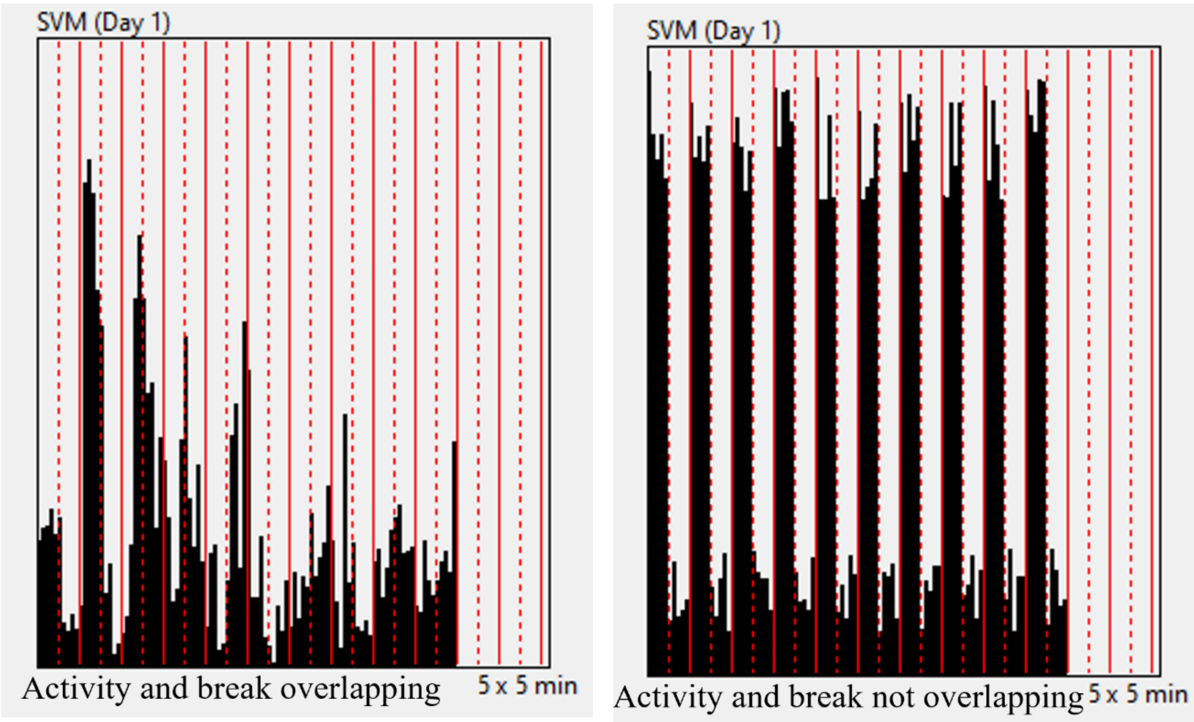

Figure 3.4: Semi-structured activities and breaks overlapping.

I used moving averages and time-based segmentation consistent with methods for normalising and extracting interpretable metrics from raw accelerometer data (Bai et al., 2014), Aimed to mitigate the impact of varying durations and focus on the activity's core intensity, I used time-normalised averaging for extended periods for the intensity cut-point validation in the context of the duration variability of the activities, implementing the following 4 steps:

– I segmented each activity into time-based windows of 5-minute intervals, identifying intensity fluctuations over longer periods and mitigating the impact of varying durations, focusing on the activity's core intensity regardless of how long the children engaged.

– I calculated the average intensity per activity using only the pre-planned time duration of 5 minutes, ignoring any data from the extended periods and normalising the duration back to the original protocol to prevent unusually high or low intensities from prolonged activities from skewing results.

– I used a moving average of intensity across consecutive time intervals of 1 minute throughout the activity period to balance any intensity peaks due to excitement by lower-intensity periods, helping validate the cut-points within time-based windows.

– I used the conversion table based on the MET's values of the semi-structured activities as defined in the Youth Compendium of PAs (Butte et al., 2018) and their objectively measured average SVM, to determine the real activity intensity as illustrated in Figure 3.4. This conversion aligns with PA research established methodologies using a conversion table based on the MET values of semi-structured activities, as defined in the Youth Compendium of Physical Activities, alongside their objectively measured average SVM, to determine the actual activity intensity (Kozey et al., 2010).

Youth Compendium of Physical Activities (YCPAs)

Activity & Code	MET for age groups		
	10-12	13-15	16-18
Marching 75m /min (10300X)	4.10	4.20	4.40
Catch And Throw Balls Jumps (10420X)	6.10	6.20	6.40

Intensity level MET – SVM correspondence

Intensity level	MET	SVM (Philips ICP)
Sedentary	≤ 1.5	<7
Light	1.5 to 2.99	7 to 19
Moderate	3 to 5.99	20 to 60
Vigorous	≥ 6	> 60

SVM extreme values correction

Any SVM extreme value recorded while a semi-structured activity was performed will be corrected to the average between the lower and upper SVM threshold corresponding to the MET of the activity for the appropriate age group.

Figure 3.5: Conversion of semi-structured activities' SVM into MET's values.

3.9.6 Physical Activity Levels

I used the intensity cut points validated per 1-s epoch by Phillips et al. (2013) for the non-dominant wrist and the age group 8 to 14 years old, to calculate the children's PA levels. These are Sedentary: < 7, Light: 7 to 19, Moderate: 20 to 60 and Vigorous: > 60. No studies that validated intensity cut points for children over 14 could be found. PA classification often varies with age due to various influencing factors including physiological differences between younger and older adolescents, PA age decline that starts gradually in early, mid and late adolescence, and disability limitations and developmental changes, including body composition, metabolic rate, and movement efficiency. I considered 2 hypotheses for PA classification for CAWD over 14 and compared the results to address Research Question 2, whether the WHO PA guidelines (WHO, 2022) were met. These are:

- Use the same intensity cut-point thresholds for all the CAWD age groups as used in several PA measurement studies, and
- Use a ± 5 % and ± 10 % incremental/decremental adjustment to the Phillips' intensity cut-point thresholds for older adolescents (15–18) and young adults (ages up to 21) to address the listed-above variability factors of the PA classification.

However, the incremental/decremental adjustment by 5% and 10% can be seen as somewhat subjective in the CAWD PA classification. Although various personal and environmental factors can lead CAWD to exert differently in the 2 semi-structured activities runs, the increment/decrement was expected to be refined for each age group among the participants.

I used this practical approach to accommodate the CAWD's MVPA for similar activities while comparing the age group MET's differences with the results of the semi-structured activities analysis. The applied intensity cut-point thresholds for the 15-18 and 19-21 age groups were adjusted as highlighted in Table 3.17.

Table 3.17: Incremental and decremental adjustments for intensity cut points.

	Physiological Differences		Age decline	
	Age: 19-21	Age: 15-18	Age: 15-18	Age: 19-21
Intensity Threshold	-10%	-5%	5%	10%
7	6.3	6.65	7.35	7.7
19	17.1	18.05	19.95	20.9
20	18	19	21	22
60	54	57	63	66

3.9.7 Statistical Analysis

I used the SACYPPADD research software program to support the statistical analysis outlined below and to export data on PA levels, health factors, and SEV to Excel for the required tests.

a) **Descriptive Analysis**

I used descriptive statistics (Mean, Variance, Standard Deviation, Skewness and Kurtosis) to analyse the CAWD's PA levels, health factors and SEV for all the population groups (All children, S1, S2, S3 and S4, Boys and Girls, light intellectual disability (LID) and Mild Hearing Impairment (MHI)). This analysis aimed to understand the population characteristics, assess data distribution and variability, identify outliers and data quality, and compare across various population groups. I classified all the quantitative and qualitative variables, first as dependent or independent, second as normally distributed or not and last into 3 categories: ordinal, continuous (interval and ratio) and categorical (nominal or binary) to help identify which test is the most robust and suitable for their statistical analysis. The Shapiro-Wilk test was used to evaluate if a sample's distribution does not deviate from normal (data normally distributed or not).

b) Means and Proportions Analysis

Various tests to compare means and proportions across independent population groups were conducted. These tests were.

- The Independent Samples t-Test (data normally distributed) and the Mann-Whitney U Test (data not normally distributed) to compare means across 2 independent groups (Boys and Girls, LID and MHI).

- The One-Way ANOVA Test (data normally distributed and variances are roughly equal) and the Kruskal-Wallis Test (data not normally distributed or unequal variances) was used to compare means across 3 or more independent groups (Schools: S1, S2, S3 and S4, and Age Groups: 12-15, 16-18, 19-21). Post Hoc Tests were conducted to determine when specific groups differ when obtaining a significant ANOVA result.

- I used the Chi-Square Test of Independence to compare proportions across groups when addressing Research Question 2: proportion of CAWD meeting PA guidelines in different population groups.

a) Multivariable Comparisons Analysis

- I used Analysis of Covariance (ANCOVA) to compare group means while controlling for one or more covariates (e.g., comparing PA levels by age group, controlling for BMI).
- A Multivariate Analysis of Variance (MANOVA) was used to compare multiple dependent variables simultaneously across groups (e.g., PA level, BMI, and metabolic rate across age groups).

b) Associations Analysis

Associations between PA levels, health factors, and socio-ecological variables were established by using the following statistical tests and analyses:

- A correlation analysis to investigate a linear relationship between continuous variables using Pearson Correlation (data normally distributed) and Spearman Rank Correlation (data not normally distributed or includes ordinal variables) was conducted.
- A Chi-Square Test of Independence for categorical variables was used to establish whether there's an association between PA level categories (e.g., Sedentary, Light, Moderate, Vigorous) and categorical health factors or socio-ecological variables (e.g., gender, income level).
- I conducted a regression analysis using Multiple Linear Regression to assess the relationship between PA levels (as a continuous dependent variable) and multiple health factors and socio-ecological variables (as independent variables), adjusting for confounding factors.

3.10 Qualitative Analysis (Phase 2)

The focus shifts in Qualitative Analysis (Phase 2), from quantitative data analysis to a deeper exploration from Phase 1, of associations between PA levels and potential influencing factors including health factors and SEV, creating a complementary understanding of the challenges, barriers and facilitators to PA participation among the various CAWD population groups.

3.10.1 The Qualitative Analysis Process

3.10.2 Findings Interpretation (2-a)

The quantitative findings from Phase 1 were interpreted as described in Section 4.6, to help contextualise the numerical data and identify areas that need further qualitative exploration. I followed the steps outlined below in the statistical analysis framework to understand both PA correlates and predictors and generate broad CAWD PA patterns or trends, which may highlight gaps or areas that needed further exploration or future research.

a) Review Descriptive Statistics

I interpreted descriptive statistics (mean, variance, standard deviation, skewness, and kurtosis) for stakeholders to clarify PA levels, health factors, and SEV characteristics across CAWD groups (e.g., all children, S1-S4, boys and girls, LID and MHI). Mean and median values were compared to assess central tendencies and identify variations in PA levels, health indicators, and SEV among groups. Standard deviation analysis highlighted variability within study groups, examining differences across disabilities, genders, and schools. Skewness and kurtosis helped detect non-normal distributions that might impact analyses, and I addressed outliers to minimise measurement errors affecting subsequent results.

b) **Interpret Means and Proportions Analysis**

A proportion analysis was conducted to determine and understand statistically significant differences in health factors, PA levels and engagement, and SEV across independent groups, such as boys vs. girls or LID vs. MHI or schools or age groups. I deducted practical implications from this analysis, discussing the proportion of CAWD meeting the PA guidelines possibly explained by numerous reasons (e.g., health status, family, peers and school support, school resources, age-related activity decline).

e) **Multivariable Comparisons Analysis**

I conducted this analysis to understand the key influencing covariates for PA levels and associated health and SEV on group comparisons and to interpret complex relationships among multiple dependent variables. To generate a more nuanced understanding of PA variations by gender, age, disability type or school, I assessed whether adjusting for covariates (e.g., Health factors and SEV) affected the interpretation of group differences in single or group primary variables including PA participation and engagement. I also analysed whether certain groups experience differences across multiple health dimensions or a group of SEVs. Covariates were controlled for when predicting PA levels to estimate the effect of group membership on PA levels after adjusting for other factors.

d) **Associations Analysis**

I investigated relationships between PA levels, health factors, and SEV using association analysis to determine the strength and direction of linear relationships between continuous variables (PA levels) and health and SEV factors to highlight key relationships with a strong positive correlation, and categorical associations to reveal plausible CAWD PA determinants and explore possible explanations. A regression model was used to understand how various health and SEV factors jointly predict PA levels and identify significant PA level predictors for improving PA participation in various settings. More specifically, I used the following:

- **Linear Relationships:** I first focused on investigating the strength and direction of linear relationships between continuous variables such as PA levels (measured in intensity categories: sedentary, light, moderate, and vigorous) and health-related factors (e.g., body mass index (BMI), lean body mass, resting metabolic rate, etc.). By calculating correlation coefficients, I was able to identify strong positive, negative, or weak associations. For example, I assessed whether higher BMI correlates with lower PA levels and how factors such as lean body mass is related to more frequent engagement in MVPA.
- **Key Relationships:** The analysis also aimed to identify any strong correlations between PA levels, health factors and SEV. For instance, I looked at whether specific health metrics, such as lean body mass or waist-to-hip ratio, are positively associated with higher MVPA levels, suggesting that certain health factors may promote more active behaviour.
- **Categorical Relationships:** In addition to continuous variables, I examined categorical relationships, particularly how demographic and SEV (e.g., age, gender, disability type, school environment, family support) interact with PA levels. This allowed me to identify patterns in how different groups engage in PA. For example, I looked at how children with LID compared to those with MHI in terms of their participation in different activity intensities.
- **Determinants of PA Participation:** By performing categorical association tests (e.g., chi-square tests, t-tests), I was able to reveal possible determinants of PA participation that might be specific to CAWD, such as the role of school support or family involvement. For instance, I explored whether certain types of schools or family structures are more conducive to higher PA levels among CAWD.
- **Predictive Modelling:** To understand the combined impact of health and socio-ecological factors on PA levels, I employed regression analysis. Multiple regression models were used to determine how various health and SEV factors together predict PA participation, accounting for potential confounding variables.
- **PA Level Predictors:** Through this approach, I was able to pinpoint specific health factors (such as basal metabolic rate or waist-to-hip ratio) and SEV components (such as school environment, PE resources, and family support) that significantly predict PA levels,

offering valuable insights into how to promote PA among CAWD. For example, I found that having access to inclusive PE programs or higher family engagement in PA might be strong predictors of increased MVPA.

e) Synthesising Findings Across Analysis Types

I integrated the quantitative findings from all analyses to provide a comprehensive understanding. I used a Cross-Analysis Comparison to compare findings from means/proportions analysis, multivariable comparisons, and associations analysis. I identified patterns by looking for recurring trends across analyses to help guide CAWD PA recommendations. I examined limitations (subjective cut-point adjustments, measurement limitations) and confounding factors that may affect the interpretation and discussed how confounding factors influencing both independent and dependent variables, were managed in the analysis.

By synthesising these findings, the association and regression analyses provided a comprehensive understanding of the various factors that influence PA behaviour in CAWD, highlighting the importance of addressing both health-related factors and socio-ecological influences to foster inclusive and sustainable PA engagement.

f) **Contextual Interpretation and Recommendations**

I provided stakeholders with actionable insights and contextualised the findings within the broader research objectives and existing literature to ensure that the findings were not only presented in isolation but were also framed within the broader research objectives, the specific context of the study population, and the existing body of PA participation knowledge. For example, I discussed the implications, explaining how the results contribute to understanding PA levels and health and SEV factors in CAWD, making recommendations for school-based PA-promoting strategies and relating findings to previous measurement studies on PA objective measurement among the various population groups, noting any similarities, differences, or contributions to the field.

3.10.3 Sequential integration

After analysing the findings from the first sub-phase (2-a), I focused on the second sub-phase (2-b) to explore how significant or insignificant PA level differences across different age, gender, disability, and school groups might be further examined using stakeholders' perceptions and experiences input to understand underlying contextual factors and explore options for PA-promoting strategies.

3.10.4 Stakeholders' Perceptions and Experiences Input (2-b)

After collecting the quantitative data, Focus Group Discussions (FGD) were conducted to gather diverse perspectives and experiences from stakeholders and share the understanding of the barriers and facilitators for PA CAWD in a way that quantitative data alone cannot provide. The recruitment and participation of stakeholders is discussed in section 5.2. Stakeholders brought in real-life perceptions and experiences that may explain trends observed in the quantitative data analysis. I ensured that all relevant aspects of PA participation among CAWD were thoroughly explored, and the FGDs were organised into specific thematic groups. I organised sessions with school staff to focus on PA and PE policies, curriculum integration, available resources, and how these factors affect PA opportunities for CAWD. I brought in separate discussions with both school representatives and teachers, children and parents, and health practitioners to provide insights into the level of support for PA participation, whether in school or at home, discussing health limitations and status and potential PE and PA benefits, identifying potential facilitators and obstacles in both settings. This segmentation allowed stakeholders to collaboratively contribute with real-life perceptions and experiences on issues like school environments, family support systems, and community resources to better understand the barriers and facilitators to being active. Additionally, the focused structure of the FGDs encouraged participants to discuss each topic in depth, fostering a nuanced understanding of trends seen in the quantitative data and enriching the findings with context-specific insights.

3.10.5 Qualitative and Quantitative Data Integration (2-c)

I synthesised quantitative findings from Phase 1 with qualitative insights from stakeholders to deepen my and the stakeholders' understanding of PA patterns and their contextual influences among CAWD for the various population groups (age, gender, disability, and school) inside and outside the school. I used quantitative analyses, including descriptive and multivariable comparisons, to identify PA correlates and predictors across population groups, highlighting areas for further investigation and future research. Building on these findings, I used FGDs to provide qualitative context, revealing barriers and facilitators through real-life perspectives of school staff, parents, and health practitioners. This mixed-methods integration is considered essential for exploring complex behaviours such as PA participation in children with disabilities, as it combines measurable patterns with lived experiences to produce actionable insights (Creswell & Plano Clark, 2017). I used the stakeholders' input to address factors such as school policies, family support, and resource availability, explaining observed trends and suggesting targeted PA-promoting strategies. Including stakeholder perspectives is particularly valuable in disability research, as it enhances relevance and co-produces knowledge that supports inclusive intervention design (Oliver et al., 2019). I used this integrated approach to inform recommendations for more inclusive and supportive PA environments tailored to CAWD needs and choose effective, adaptive, supportive and inclusive PA-promoting strategies.

3.10.6 Explanatory Role (2-d)

I employed the qualitative phase in an explanatory capacity, clarifying or expanding upon results from Phase 1, helping explain the findings' underlying reasons and offering a more comprehensive understanding of the data. I ensured that the research does not only rely on numbers but also on stakeholders' input and real-world experiences, making the findings more applicable and grounded in the lived experiences of the CAWD population (Beames et al., 2021).

3.11 Sampling process

3.11.1 Recruitment

All participants were required to provide their consent to participate. To facilitate recruitment, the PE and SN teachers were asked via the school-appointed research assistant to recruit 3 children and 3 parents to join the stakeholders in FGDs, with the aim to capture a broad spectrum of perspectives on PA engagement and lived experiences within each category. Guided by the phase 1 quantitative results, a purposive sampling strategy was used to select 3 children and 3 parents, ensuring representation across a range of PA performance levels (low, average, and high) among the children and a range of PA support levels (poor, average, and good) among the parents. This approach ensured that the sample included children with varied levels of PA engagement and outcomes, making it possible to explore factors that may contribute to or hinder active participation. The sample also included parents who demonstrated varying levels of PA support for their children, expecting their participation in FGDs could reveal diverse attitudes, resources, and potential barriers to supporting PA in the home and community environment.

3.11.2 FGD Participants

The selected FGD participants highlighted in Table 3.18, support a balanced approach, with representation from school management, health professionals, educational staff (PE and SN teachers), and families (parents and children). Each group contributes collaboratively unique insights, enriching the study's perspective on PA participation and support across different levels of involvement, perspectives, experiences and expertise.

Table 3.18: School focus group discussion composition.

	School Management	Health Practitioner	PE	SN	Parents	Children	Total
Head	1		1	1			
Teacher			1	1			
Total	1	1	2	2	3	3	12

3.11.3 FGD Sessions

I leveraged the composition of the stakeholders to address each issue with the most relevant insights from each group to form a holistic understanding of PA and PE inside and outside the school. Table 3.19 illustrates how each stakeholder group contributed to addressing these specific issues using the quantitative findings and the group support provided by the research software SACYPPADD. The FGDs were audio-recorded and organised by gender groups (Boys: S1 and S2 and Girls: S3 and S4) in 2 sessions (FGD1 and FGD3). The sessions were held in S1 and S3 for 90 minutes in 2 consecutive days, allowing a 15-minute break. They were moderated by myself (boys' schools) and the female research assistant (girls' schools).

Table 3-19: Focus Group Discussion sessions.

Profile	FGD1 (a)	FGD1 (b)	FGD1 (c)	FGD2 (d)	FGD2 (e)	FGD2 (f)	Focus
							(a): General PA assessment (b): Outside PA (c): Inside-setting PA-PE (d): PA & PE curriculum (e): School Policies (f): Aggregation
Facilitator	✓	✓	✓	✓	✓	✓	
Researcher	✓	✓	✓	✓	✓	✓	
Children	✓	✓	✓			✓	
Parents	✓	✓			✓	✓	
SMT				✓	✓	✓	
Teachers	✓		✓	✓		✓	SMT: Senior Management Team; Teachers: PE & SN; HP: Health Practitioner
HP	✓	✓	✓				

a) FGD Session 1:

– **General PA Assessment (a)**

FGD helped the health practitioner provide insights on overall health impacts and assessed children's PA levels based on health factors (e.g., BMI, ideal weight), SN and PE Teachers offered specific data on children's performance, engagement, and challenges within PA activities, and parents and children to share information on children's PA preferences and habits outside of school, helping to contextualise school-based PA in their daily routines. FGD also helped assess the accelerometer wearability among the different CAWD groups.

– **Outside PA (b)**

FGD helped parents provide perspective on access to PA resources outside school, such as parks, extracurricular sports, or neighbourhood play, and any barriers to participation, children offered first-hand accounts of their experiences and preferences for outside PA, including what activities they have enjoyed and how often they participate, and the health practitioner discuss the role of community health resources or local facilities that support outside PA.

– **Inside-Setting PA-PE (c)**

FGD helped PE Teachers provide direct insight into structured PE lessons, indoor PA practices, and constraints such as equipment and space limitations, SN Teachers offered perspectives on how PE and PA are adapted for CAWD, highlighting any challenges or modifications needed for inclusivity, and children described their experiences with PE classes, noting what they have found engaging or challenging, and how these activities compare with their other PA experiences.

b) FGD Session 2

– **PA and PE Curriculum (d)**

FGD helped PE Teachers provide a detailed understanding of the curriculum, discussing any gaps, strengths, or needed updates based on their direct teaching experiences, SN Teachers offered insights into how the curriculum meets the needs of children with diverse abilities, suggesting possible improvements for inclusivity, and School Management (Head) discussed how the curriculum aligns with the school's educational goals, resources, and policies, as well as any future directions for PA and PE programs.

– **School Policies (e)**

FGD helped School Management (Head) discuss current policies on PA and PE, including schedules, resource allocation, and safety regulations, and highlight how these policies support or limit PA and PE initiatives, the health practitioner offered suggestions on how policies might better support CAWS health, for instance, by addressing breaks, recess times, and outdoor access, and parents provided feedback on school policies from a family perspective, noting any policies they have found supportive or restrictive to their child's PA participation.

– **Aggregation (f)**

FGD helped each group among all stakeholders: contribute their unique insights to form a holistic understanding of PA and PE at the school. The School Management and PE/SN Teachers synthesised the academic and structured components of PA programs, the health practitioner linked health outcomes to the PA opportunities and gaps identified and, finally, parents and children validated findings from a user perspective, offering real-world insight into how policies and curricula affect the CAWD PA engagement.

3.11.4 FGD questions

After thoroughly reviewed and analysed the quantitative data, I carefully designed open-ended questions for each FGD session. My goal was to ensure the questions were clear, concise, and aligned with the research objectives while fostering meaningful and reflective dialogue among participants. To maintain focus and encourage in-depth discussions, I condensed the core inquiries into five key questions, specifically tailored to address the purpose of each FGD session. Additionally, I incorporated three summary questions to synthesize key insights regarding CAWD PA participation, ensuring relevance to both stakeholder perspectives and the overarching research goals. These summary questions also helped establish associative links between different components of PA-promoting strategies.

To facilitate rich, nuanced discussions, I framed the questions in a way that encouraged participants to share their opinions, attitudes and lived experiences. I also developed probing follow up questions to prompt deeper elaboration when necessary. To explore hypothetical scenarios such as the influence of physical development and age-related decline on PA levels and participation I integrated scenario-based questions, which allowed stakeholders to consider and discuss potential real-world applications and challenges.

Before each FGD session, I prepared and organised all relevant quantitative data corresponding to each discussion topic. Additionally, I developed a structured discussion guide, which was strictly followed to ensure consistency across sessions. To refine the questions and enhance their clarity and effectiveness, I conducted a pilot focus group session. Feedback from this session was instrumental in adjusting the wording, sequencing, and structure of the questions, ensuring they maximised stakeholder engagement and yielded relevant, high-quality data.

3.12 Reporting and Infographics

3.12.1 School reports

The quantitative findings were systematically reported to participating schools using the school report (Appendix 26) to inform them of the observed PA patterns, MVPA levels, and identified socio-ecological influences specific to their student populations. Tailored reports were generated for each school, presenting key data points such as:

- MVPA Levels by Age, Disability and Gender: Comparative analysis of MVPA levels inside and outside school, highlighting potential disparities and areas for intervention.
- School-Based vs. Outside-School PA: Analysis of PA participation across structured and unstructured contexts, identifying opportunities to enhance school-based PA programs.
- Socio-Ecological Variables: Presentation of relevant socio-ecological factors influencing PA participation, including family and school support, school facilities, and peer engagement.

Infographics and data visualisations were employed to simplify complex statistical findings, making the information more accessible and actionable for school administrators, PE teachers, and support staff. Additionally, in-person meetings and follow-up discussions were conducted to clarify findings, answer questions, and align on potential strategies to promote PA within each school setting.

3.12.2 Infographics

To effectively communicate the quantitative findings to stakeholders, a series of infographics was developed to visually summarise key data points, patterns, and trends. The infographics were designed to present complex statistical results in an accessible, user-friendly format, facilitating a clear understanding of MVPA levels, gender and age differences, and the influence of socio-ecological variables across school and non-school settings.

The infographics were structured to:

- Highlight MVPA levels across schools, gender, disability (LID and MHI) and age groups (12–14, 15–17, and 18–21 years) and compare inside-school versus outside-school activities.

- Illustrate group-based differences in PA participation, underscoring the more equitable nature of school settings across population groups in the context of of all PA patterns.
- Present key findings related to school-based PA programs and the varying activity patterns observed across schools.
- Include stakeholder feedback, incorporating qualitative insights to contextualise the quantitative findings.

These infographics were shared during the stakeholder meetings, accompanied by a brief verbal explanation to guide interpretation and foster discussion. The visual format facilitated engagement and ensured that the key messages were effectively communicated to diverse stakeholders, including school staff, parents, and health practitioners.

3.13 Data Analysis

I employed the qualitative phase in an explanatory capacity, clarifying or expanding upon results from Phase 1. This qualitative analysis helped explain the quantitative findings' underlying reasons and offered a more comprehensive understanding of the data. I ensured that the research does not only rely on numbers but also on stakeholders' input and real-world experiences, making the findings more applicable and grounded in the lived experiences of the CAWD population.

Institutional policies restricted the transcription of the audio recordings from the Focus Group Discussions (FGDs), as schools did not permit the production of full transcripts. Consequently, I adhered to these guidelines and employed comprehensive notetaking directly from the recordings. This method required meticulous and systematic documentation to capture key points, thematic content, and participant interactions essential for analysis. Access to the audio recordings was granted under strict confidentiality, and any use outside the school setting would require authorisation from the General Directorate of Education of Taif, Kingdom of Saudi Arabia. Using this access and the Structured Note-Taking Framework, I developed detailed working notes, applying a systematic approach ensuring all critical insights from the FGD sessions were accurately recorded. I followed the specific steps outlined below.

a) **Initial Listen-Through**: I listened to the audio recordings twice at school without taking notes to fully remember the FGD session, get a holistic understanding, identify key moments and create a mental representation of the discussion.

b) **Segmenting the Audio Recording**: I broke down the audio recordings into segments corresponding to each question and the resulting discussion using timestamps to facilitate referencing. I repeatedly listened to each segment until I had thoroughly understood and accurately interpreted the content needed for the analysis.

c) **Identify Key Themes**: I focused on capturing the main ideas, themes, or insights emerging from the question and the resulting discussion between the FGD session stakeholders. I grouped similar ideas under thematic headings including CAWD challenges, barriers, facilitators, perceptions, or suggestions.

d) **Capture Participant Dynamics**: I noted who speaks, agreements or disagreements, and any notable changes in tone or emphasis among the stakeholders to understand the session group dynamics and the context of the discussion.

e) **Summarising:** I summarised the FGD session discussions at the end of each session to synthesise the question and discussion content and understand the overall narrative of the FGD session.

f) **Collaborative Notes Review:** I reviewed the content of my notes collaboratively with the school-appointed research assistant to refine my initial notes for clarity and completeness and ensure that key insights and supporting details were easy to locate. Working with the research assistant helped me to deeply understand the local context and the cultural nuances in the data, especially given that the discussions were in Arabic.

3.14 Rigour and Quality Criteria

To enhance the rigour and quality of this research, I have adopted the following criteria: (i) The research addresses the significant issue of CAWD PA participation, a subject of both societal and academic importance, (ii) comprehensive data collection methods were employed, including quantitative analyses and FGDs, to capture diverse perspectives and ensure depth in the findings, and employing triangulation to validate findings and ensure robustness (iii) internal consistency tests, methodological triangulation, and statistical validation techniques were applied to ensure findings accuracy (iv) techniques such as member checking were used to validate findings, ensuring that interpretations accurately reflected participants' experiences and perspectives, (v) standardised data collection and independent verification (vi) the study contributes to existing literature by providing insights into PA behaviours among CAWD and offers practical recommendations for stakeholders, (vii) ethical standards were upheld, including obtaining informed consent from participants and ensuring confidentiality throughout the research process, and (viii) the study's design, methodology, and analysis are coherently aligned with the research objectives, ensuring a logical flow and consistency throughout.

3.15 Conclusion

In this chapter, I outlined the methods employed to provide a nuanced understanding of PA behaviours among CAWD. By integrating quantitative and qualitative approaches, the research was designed to capture both objective data and the rich, context-specific insights offered by stakeholders. The quantitative analyses established foundational trends and identified key PA correlates and predictors, while the qualitative findings added depth, revealing underlying factors and experiences that influence these patterns. Through sequential integration and an explanatory approach, this mixed-methods framework offered a robust analysis, ensuring the research findings were well-grounded in both empirical evidence and real-world perspectives.

The chapter emphasised the importance of methodological rigour, data triangulation, and the strategic use of stakeholder input to address the complex and multifaceted nature of PA participation in CAWD. Ultimately, this integrated analysis not only enhances the validity and reliability of the research but also informs practical, evidence-based strategies for promoting inclusive and supportive PA environments. The next chapter will focus on presenting and discussing the key quantitative findings, drawing connections between the data analysis and the overarching research objectives, and offering actionable recommendations for improving PA engagement among CAWD.

Chapter Four: Quantitative Analysis - Accelerometery Data and PA Levels

4.0 Introduction

The quantitative analysis developed in this chapter provides a comprehensive and evidence-based assessment of PA levels among CAWD, combining robust data processing techniques with descriptive statistics to compare the different population groups. This chapter highlights objectively measured PA levels among CAWD using the raw data recorded by GENEActiv accelerometers for the 7-day activity monitoring. These measures helped assess adherence to international PA guidelines and assess variability across various population groups (schools, gender, disability and age) to understand their differences.

This chapter starts by giving an overview of the research data that reflect the challenges, barriers and facilitators of PA identified in this study among Saudi CAWDs. These data were analysed and structured into data components or structures resulting from the questionnaires and the accelerometers' raw data. The PA metrics calculation process is then described in this section after detailing the raw data processing preparation. The next sections cover the different aspects of PA levels analysis including the global MVPA analysis, MVPA inside and outside school, PA levels and sleep, health factors and semi-structured activities. In these sections, descriptive statistics provided an overview of PA levels, revealing average intensities and variations across various population groups. The last section concludes that further analysis of PA levels and health factors must be conducted to assess the influence of socio-ecological variables on CAWD PA behaviour, identifying and measuring their PA correlates. This statistical testing is the second part of the quantitative analysis developed in the next chapter (Chapter 5)

These different analyses aim to assess the CAWDs' PA guidelines compliance, evaluate the relative importance of MVPA inside and outside school and compare the MVPA global levels to other PA levels (sedentary and light intensities) and sleep. The findings from the quantitative chapters (Chapters 4 and 5) provide key background for the qualitative analysis of the stakeholders' group discussions.

4.1 Raw Data Overview

Understanding the challenges, barriers, and facilitators of PA participation among CAWD required collecting comprehensive data across multiple socio-ecological levels about the child, parents, the school and the socio-educational environment. This included individual-level factors such as demographic, anthropometric, psychological attributes, self-reported health, and motivation toward PA. Interpersonal data captured family, peer, and parental influences, while organisational data encompassed school culture, teacher attitudes, sports facilities, and structured PA opportunities. Community-level data highlighted environmental factors, transportation, and access to recreational spaces, while policy-level data addressed school PA guidelines and community active living initiatives. Together, these data provided a holistic perspective to inform targeted strategies for improving PA engagement. The collected research data comprises the socio-ecological variables and the accelerometers' raw data.

4.2 Socio-Ecological Variables

The socio-ecological framework guided the data collection process to capture a comprehensive understanding of the factors influencing CAWD's PA behaviour. This approach emphasizes the importance of considering how factors from different levels interact and influence each other, and assessing their changing impact due to temporal and contextual factors (Bronfenbrenner, 1979; Sallis et al., 2006). Data were gathered across the five levels of influence illustrated in Table 4.1 and formatted or structured in data components listed in Table 4.2

Table 4.1: Socio-ecological data collection framework for CAWD's PA participation.

SEM Level	Data
Individual	Demographic, anthropometric and personal attributes Psychological factors Self-reported health status Self-efficacity and motivation towards PA engagement
Interpersonal	Information on family Parental attitudes towards exercise and involvement in their child's PA Parental support, role modelling and peer attitudes and encouragement Support from friends and family Role model and peer influences
Organisational	School culture and norms around PE Teacher attitudes and behaviours toward PA School and community sports facilities, Child's participation in school-based PE and PA programs, Availability of intra and extracurricular sports activities. Quality and frequency of structured PA opportunities inside and outside the school
Community	Environmental factors and neighbourhood characteristics Transportation Perceived safety of the area, availability of parks and playgrounds, and access to recreational facilities
Policy	School PA policy and guidelines Community initiatives promoting active living

4.3 Data components

These collected data were structured into data components listed in Table 4.2.

Table 4.2: Data components for CAWD's PA participation.

Child data	School data	PE and SN teachers' data
1. Anthropometry	1. PE policy and promotion	1. Profile
2. Disability	2. PA policy and promotion	2. Priorities
3. Lifestyle	3. PA evaluation	3. Children's PE
4. Activities and facilities	4. PA facilities	4. PE lessons
5. Support to PA participation	5. Training	5. PE evaluation
6. Feelings and behaviour	6. Government support	6. Training
7. School and community support		7. PA measurement
8. Accelerometer wearability		8. Facilities
9. Semi-structured activities		9. Promoting PA
10. Physical fitness		10. PA practice
11. Accelerometer raw data		

4.3.1 Accelerometer Data

The raw accelerometer data collection and processing emphasising the importance of valid measurement tools through device calibration, correct device placement, effectively following the monitoring protocols and adherence to wear time requirements. This processing includes the data download, epoch conversion, outlier detection and sensitivity analysis to ensure clean, reliable and accurate input for analysis and valid PA measurement. The cleaning concerns removing artifacts, comparing data consistency across sessions and different time points, identifying non-wear periods and handling missing or implausible values such as SVM high values.

4.3.2 Physical Activity Monitoring

The GENEActiv accelerometer was selected for monitoring PA over 7 days due to its validated accuracy, comfort, and suitability for CAWD. Key reasons include: (i) proven accurate for measuring PA intensities in children and adolescents, using Philips et al. (2013) validated cut-points for 1-second epochs, (ii) wrist-worn placement is less intrusive than hip-worn devices, ensuring higher adherence over 7 days, particularly for CAWD, and leading to higher compliance and better data quality compared to other placements, (iii) allows 24-hour wear, capturing both PA and sleep patterns while detecting a broader range of upper-body movements, (iv) can be worn during activities like showering and swimming, reducing data loss and ensuring continuous monitoring, These features make GENEActiv an ideal choice for ensuring accurate, reliable, and participant-friendly PA assessment in a study.

The GENEActiv accelerometer was placed on the non-dominant wrist to capture a wide range of movement data in structured and unstructured activities, confirming consistency across activities. The accelerometer data was generated from the 7-day continuous comprehensive PA monitoring of the CAWD covering weekdays and weekends. This approach captures habitual activity, including school sessions, recess, semi-structured activities and free-living conditions.

4.3.3 Data Download and Conversion

The accelerometer data download, extraction and conversion into compressed epoch, and metrics calculation (wear times, PA levels and sleep times) are outlined in Figure 4.1. The accelerometer records 1 dataset every 10 milliseconds. The accelerometer raw data is extracted from the device into a "File.bin" format using the Data Extractor Function of the GENEActiv PC Software developed by" ActivInsights Ltd".

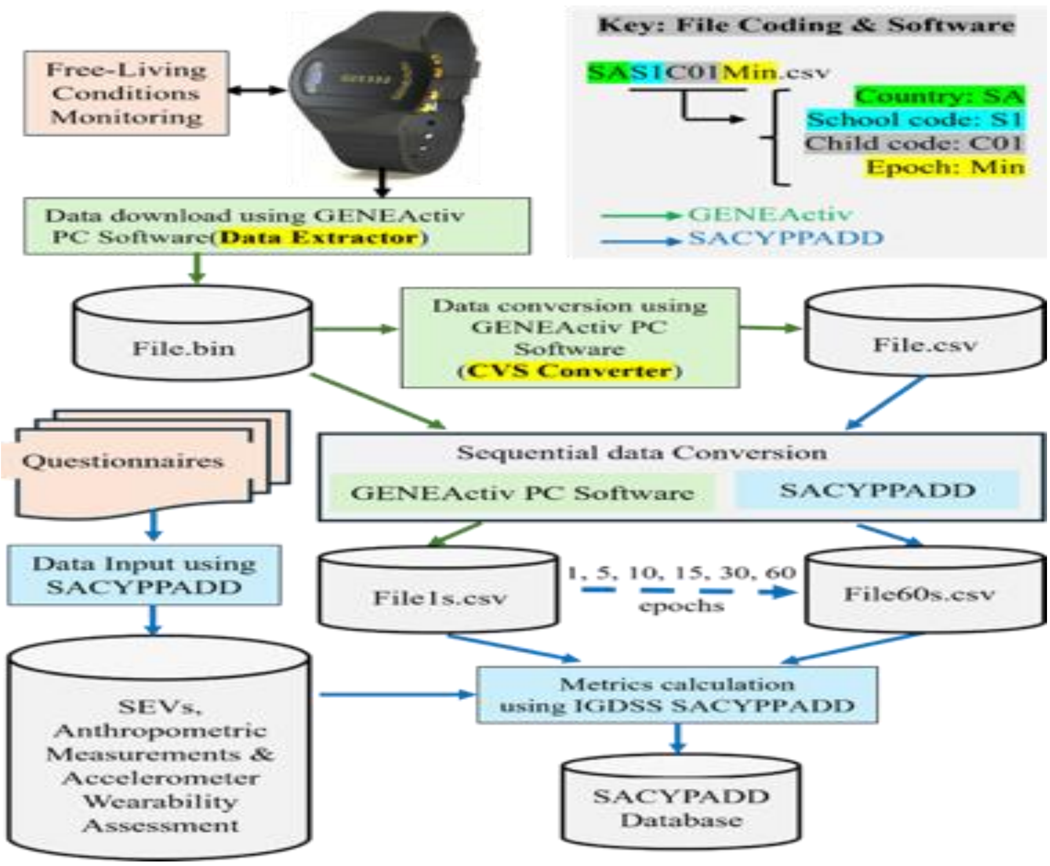

Figure 4.1: Procedure of data collection, download, conversion, storage and integration.

Table 4.3: Raw data and epoch-compressed calculated data.

Column	Raw Data file.csv	Epoch Compressed file1s.csv file60s.csv
A	Time stamp	Time stamp of epoch end
B	X axis (g)	Mean x axis
C	Y axis (g) -8g to +8g	Mean y axis
D	Z axis (g)	Mean z axis
E	Light level (lux) 0 to 300,000 lux	Mean lux
F	Button (1/0)	Sum of button press time
G	Temperature (◦C) -40°C to +85°C	Mean temperature
H	-	Sum of vector
I	-	X axis standard deviation
J	-	Y axis standard deviation
K	-	Z axis standard deviation
L	-	Peak lux
Near body temperature: Wear detection (30 to 40°C) and Non-wear (<30°C)		
Light level: Indoor (0-100 lux), Outdoor (100-10,000 lux) Sunlight (>10,000 lux)		
Raw data were aggregated into larger epochs. (1-second and 60-second)		

This file is converted into a "File.csv" format using the GENEActiv PC Software CSV Converter Function. "File.csv" is then transformed into compressed epochs of 1, 5, 10, 15, 30 or 60-second files (File1s.csv, …, File60s.csv) averaging the temperature and light measures and summing the SVM values using the epoch conversion function of both software: GENEActiv PC or the research-developed software SACYPPADD.

The data structure of the converted files (File.csv, File1s.csv, …, File60s.csv) is illustrated in Table 4.3.

4.3.4 File Coding

The converted files into compressed epochs (File1s.csv, …, File60s.csv) were coded using a coding system for organising and identifying files before their transfer into the research study database using SACYPPADD. The coding system illustrated in Figure 4.1, integrated the country, school and child identification data, emphasising that the child's identity is anonymised using a sequential number. Space or Min indicates the epoch: 1 or 60 seconds.

4.4 Metrics Calculation Process

4.4.1 Epoch Length

The choice of epoch length (1, 5, 10, 15, 30 or 60 seconds) in accelerometer-based PA studies, is critical for accurately classifying PA into different intensity levels (sedentary, light, moderate, and vigorous). Trost et al. (2005) examined the impact of epoch length on accelerometer-based PA and concluded that shorter epochs (e.g., 1–5 seconds) are better suited for capturing rapid fluctuations in PA (e.g., children's spontaneous activity), and longer epochs (e.g., 30–60 seconds) may smooth out intensity variations, potentially underestimating vigorous activity and overestimating sedentary time.

The compressed epoch length refers to the time interval used to aggregate the SVM for analysis. The rapid changes in the children and adolescents' movements, the sporadic and intermittent nature of their activity and the MVPA short bursts suggest shorter epochs allow better PA intensity classification especially since the intensity cut-point used was validated at 1-second epoch and provide more precise activity classification and a high-resolution analysis of the data and maintain consistency with the validation study (Phillips et al., 2013).

4.4.2 Raw Data Filtering

Before accurately classifying PA, it is necessary to filter the raw accelerometer data (File1s.csv) by removing non-wear times using standardised protocols. Non-wear times refer to periods when the CAWD is not wearing the accelerometer device. Wrist-worn devices can detect more subtle movements, potentially reducing the risk of misclassifying wear time as non-wear time. Integrating near-body temperature (≥ 32 °C and < 40 °C) with SVM (>0) helps distinguish between wear and non-wear times. Non-wear can correspond to brief inactivity (e.g., resting) or actual removal of the device, posing the problem of determining the specific duration. This problem was solved by applying algorithms that detect prolonged periods of near-zero SVM combined with temperature drops.

4.4.3 Physical activity Classification

Classifying PA requires using intensity cut-point thresholds to delimit the different activity intensity levels when interpreting the SVM measured in g corresponding to gravitational acceleration. These SVM measures were compressed in a 1-s epoch as these levels were validated for the non-dominant wrist (Phillips, 2023) at 1 second for the following levels: Sedentary (< 7g), Light (7 to 19.9 g), Moderate (20 to 59.99 g) and Vigorous (> 60 g). However, these cut-point thresholds were validated only for the 8 – 14 age group, requiring adapting intensity cut-points validated for younger children to older children and adolescents, particularly given the complexities of disability and age-related changes in PA. Below is a procedure for correcting the intensity cut-point thresholds for older children and adolescents, providing structured scenarios for PA classification, recognising age-related variability and flexibility for age-broad range using an incremental adjustment strategy based on a mathematically simple and transparent method for extrapolating cut-points, avoiding excessive complexity. Although the method assumes a consistent relationship across all individuals, which may not hold for some disabilities, the adjustment introduces a dynamic scaling based on age, ensuring that older adolescents experience larger nonlinear increases or decreases in intensity cut points than younger ones applying the following increment factor to reflect enhanced physical capacity or PA age decline:

Adjustment Factor (per year) = ±5% × (10 % × Age) Formula 4.3

Or **Adjustment Factor (per age group) = ±5% × (10 % × Average of Age Group)**

Five scenarios are proposed to explore the implications of different assumptions, ensuring that results can be compared and interpreted within a robust framework and cover the entire age range (12–21).

- Scenario 1: Apply the same intensity cut points for the entire age range (12–21).
- Scenarios 2 and 3: Apply the assumption of proportional physical development with age for older children and adolescents, as they generally experience during adolescence, increases in muscle mass, strength, and motor skills, which can enhance their ability to generate higher movement intensities.
- Scenarios 4 and 5: Apply the assumption of PA age decline aligning with disability-reduced abilities. PA decline decreases muscle mass, strength, and motor skills, which can reduce their ability to generate higher movement intensities.

These assumptions can be applied individually to CAWD or age groups (15 to 17 and 18 to 21). The intensity cut-point lower and upper threshold adjustments are calculated using Formula 4.3 and illustrated in Table 4.4.

Adjusted Threshold = Original Threshold ± Adjustment Factor (Formula 4.4)

Table 4.4: Example of intensity cut point threshold adjustment.

Age: 16 years old Adjustment factor: ±5% × 10 % × 16

Intensity level	Scenario 2		Scenario 4	
	Lower Threshold	Upper Threshold	Lower Threshold	Upper Threshold
Sedentary	> 0.99	<7.60	>0.99	<6.44
Light	>7.59	< 21.60	>6.43	<18.40
Moderate	>21.59	<65	>18.39	<55.20
Vigorous	>64.99		>55.19	

4.4.4 Sleep Times

The sleep times were calculated by combining the SVM threshold ≤ 1 g with X, Y and Z accelerations using the arm elevation angle ≤ 5 ° and a sleep window of 5 minutes to validate the sleep period time. The function of the angle between the arm and a reference plane (e.g., the horizontal plane) is illustrated in Formula 4.5.(van Hees et al., 2018) The PA classification and sleep times calculation algorithms were implemented in the research software SACYPPADD.

$$\textbf{Angle (°)} = \tan^{-1}\left(z/\sqrt{x^2+y^2}\right) \times 180/\pi \qquad \text{(Formula 4.5)}$$

4.5 Global MVPA Analysis

This analysis addresses the second research question (see Chapter 2) of whether CAWDs in this study meet PA guidelines. This assessment evaluates the MVPA levels recorded from accelerometer data from 7 days of activity monitoring. The UK PA guideline is 120–180 minutes of MVPA per week and calculating the total weekly MVPA duration is the most direct way to assess compliance which can be examined using various methods developed below.

4.5.1 MVPA levels

The total weekly MVPA duration shown in Table 4.5, is calculated by averaging the 5 scenarios described above.

Table 4.5: MVPA duration per CAWD.

School 1		School 2		School 3		School 4	
Child	MVPA	Child	MVPA	Child	MVPA	Child	MVPA
1	4	1	36	1	18	1	207
2	204	2	293	2	43	2	152
3	45	3	39	3	25	3	144
4	154	4	59	4	11	4	130
5	132	5	336	5	7	5	110
6	21	6	99	6	61	6	136
7	84	7	224	7	266	7	105
8	14	8	250	8	53	8	116
9	64	9	64	9	340	9	73
10	158	10	66	10	54	10	124
11	50	11	105	11	115	11	69
12	318	12	88	12	125	12	131
13	127			13	354	13	93
14	108			14	33	14	170
15	54			15	116	15	91
16	18			16	60	16	177
17	36			17	277	17	90

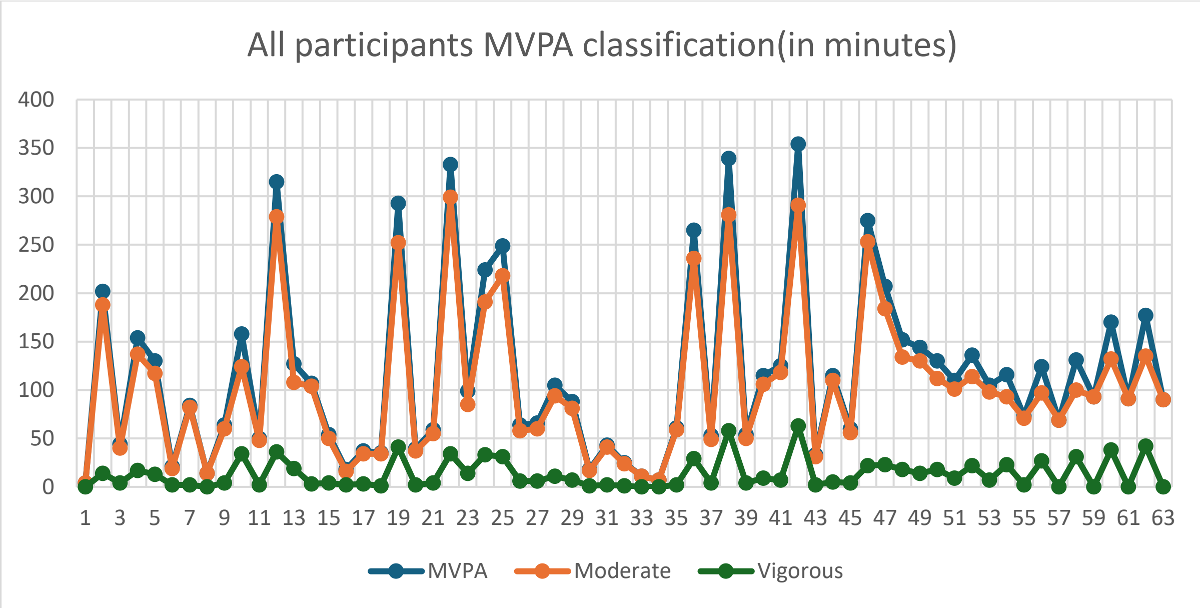

Figure 4.2: All children's MVPA classification.

4.5.2 PA Guideline Compliance per Scenario

The weekly MVPA durations are segmented into five classes (≥240, ≥180, ≥120, ≥60, and ≥0 minutes) to assess compliance with CAWD UK PA guidelines. Using Phillips intensity cut points validated for ages 8–14 and extrapolated to ages 15–21, the frequency of compliance is calculated for each class across multiple PA classification scenarios. The first three thresholds (≥120, ≥180, and ≥240 minutes) were summed to determine the number of CAWD meeting the guidelines (120–180 minutes per week) as highlighted in Table 4.6.

Table 4.6: PA guideline compliance distribution across scenarios

Scenario	1	2	3	4	5	
MVPA (minutes)	Philips	Physical. Development SYA	Physical. Development AGA	Age Decline SYA	Age Decline AGA	Average
> 240	8	6	6	8	8	8
> 180	3	5	4	3	3	3
> 120	13	10	11	16	16	13
> 60	19	19	19	20	20	19
> 0	20	23	23	16	16	20
Total	63	63	63	63	63	63
≥ 120	24	21	21	27	27	24
%	38.1	33.33	33.33	42.86	42.86	38.1
SYA: Single-Year Adjustment				AGA: Age Group		

By considering different PA classification scenarios such as physical development adjustments, and PA age decline, the analysis captures the variability in guideline compliance due to physiological and age-related differences. The segmentation into five thresholds provides detailed insights into the distribution of MVPA levels among CAWD, highlighting differences beyond simple compliance/non-compliance. The first three thresholds align with the PA guideline's 120–180 minutes/week range and provide a straightforward metric for compliance.

4.5.3 Analysis

The compliance rates across the five scenarios range from 33.33% to 42.86%, with an average compliance rate of 38.10%. Scenarios 4 and 5 yield the highest compliance rates (42.86%), suggesting a more favourable classification approach for identifying CAWD meeting PA guidelines. In contrast, scenarios 2 and 3 report the lowest compliance rates (33.33%), indicating a stricter classification or adjustment that reduces the number of children meeting the threshold.

4.5.4 Observations and Interpretations

The average compliance rate of 38.10% aligns with an overall benchmark (Guthold et al., 2020), highlighting that less than 20 % of adolescents worldwide meet the recommended PA guidelines of 120–180 minutes per week, while Wouters et al., (2019) reported 47%. These variations reflect the influence of different classification methods and assumptions on guideline adherence, emphasising the importance of refining age-specific PA intensity thresholds to ensure accurate assessment. This refinement is supported in this study by the monitoring of 10 semi-structured performed on 2 consecutive days to establish a correspondence between SVMs and METs defined in the Youth Compendium of Physical Activities. Demographic and socio-ecological variables are integrated later in this analysis to provide additional insights into the observed differences and address Research Question 3.

4.5.5 PA Guideline Compliance per MVPA Levels

Considering the PA guideline compliance frequency across population groups including school, gender, disability type, and age group is critical to identify disparities among CAWD, evaluate PE and PA policies and PA programs effectiveness, and encourage inclusive PA participation. These can highlight (i) institutional or environmental factors influencing PA levels, such as the availability of facilities, quality of PE programs, or socio-economic differences. (ii) PA participation patterns inherent to cultural norms, societal expectations, or physiological factors, (iii) barriers or facilitators to PA participation, such as mobility challenges or differing support needs, and (iv) trends over developmental stages, such as declines in PA levels during adolescence or differences in PA preferences and abilities across ages. The MVPA guideline compliance frequency per population group is detailed in Table 4.7.

Table 4.7: MVPA guideline compliance frequency per population group.

Group	≥ 240	≥ 180	≥ 120	≥ 60	≥ 0	Total	Global ≥ 120	%	Mean/min	St Dev
All Children	8	3	13	19	20	63	24	38.10%	116	88.93
S1	1	1	4	3	8	17	6	35.29%	93.59	81.72
S2	3	1	0	5	3	12	4	33.33%	138.33	106.13
S3	4	0	1	4	8	17	9	52.94%	115.18	117.47
S4	0	1	8	8	0	17	9	52.94%	124.53	37.6
Boys	4	2	4	8	11	29	10	34.48%	112.1	93.51
Girls	4	1	9	12	8	34	14	41.18%	112.1	86.01
LID	1	2	12	11	8	34	15	44.12%	109.06	64.58
MHI	7	1	1	9	11	29	9	31.03%	124.76	111.56
12-14	1	2	8	11	5	27	11	40.74%	113.67	64.36
15-17	6	1	4	8	11	30	11	36.67%	120.83	106.74
18-21	1	0	1	1	3	6	2	33.33%	100.67	97.76

4.5.6 Analysis

The overall compliance rate for meeting the PA guidelines in this study across all children is 38.10%, indicating that a significant proportion of CAWD fall short of the recommended activity levels. When broken down by population groups, the following patterns emerge. The compliance rates across schools varied widely, ranging from 29.41% to 52.94%. School 4 exhibits the highest compliance (52.94%), suggesting a more conducive environment for meeting PA guidelines, such as better resources, policies, or engagement in PA. In contrast, School 3 had the lowest compliance (29.41%), highlighting potential barriers to PA participation that may require targeted interventions. Boys had a compliance rate of 34.48%, while girls showed a slightly higher rate at 41.18%. This difference suggests possible variations in activity preferences, social encouragement, or opportunities between genders, with girls in this population demonstrating marginally better adherence to the guidelines.

CAWDs with a light intellectual disability showed a significantly higher compliance rate (44.12%) compared to those with a mild hearing impairment (31.03%). This disparity may reflect differences in how the CAWD limitations affect PA participation, and adaptive opportunities or support provided to these groups. Compliance declined with age: 40.74% for the youngest group, 36.67% for the middle group, and 33.33% for the oldest group. This trend aligns with established research (Fox et al., 2019; Kemp et al., 2019) that PA levels typically decrease during adolescence, potentially due to changing priorities, reduced structured opportunities, or increasing academic and social demands.

4.5.7 Observations and Interpretations

The study results underscore that the variability in compliance rates suggests that factors such as school policies, gender norms, disability-specific barriers, and age-related trends significantly influence PA participation. Focused strategies are needed to address the gaps, particularly in underperforming schools, among certain disability types, and as children age.

4.5.8 PA Guideline Compliance per Session Duration

This analysis examines the number of days participants engage in PA and the duration per session to assess activity patterns (e.g., whether PA is spread evenly across the week or concentrated on certain days). Although the examples provided in the PA guidelines (e.g., 20 minutes per day, 40 minutes 3 times per week) are illustrative rather than prescriptive, these patterns can guide how PA might be distributed and provide additional insights into the regularity of activity, focusing on whether the weekly total meets the target as the most accurate assessment. The PA Guideline compliance per session duration detailed in Table 4.8 illustrates the frequency of CAWD engaging in varying session durations across different numbers of sessions per week.

Table 4.8: PA Guideline compliance per session duration.

Duration	n=8	n=7	n=6	n=5	n=4	n=3	n=2	n=1	n=0	Total		
										CAWD	Sessions	%
< 20 min	24	6	3	5	9	10	4	2	0	63	353	57.77%
≥ 20 min	0	2	4	10	9	5	3	6	24	63	151	17.38%
≥30 min	0	0	2	4	4	5	1	2	45	63	67	9.33%
≥ 40 min	0	0	0	2	4	3	1	3	50	63	40	6.14%

4.5.9 Analysis

There is a clear dominance of short sessions (< 20 Minutes): 353 sessions (57.77%) fall into the "< 20 minutes" category, highlighting that a large majority of PA sessions are short. This aligns with findings from the session distribution highlighted in Table 4.8 and suggests that shorter bursts of activity are more feasible or accessible for this population. The analysis shows some uptake of moderately sustained PA (moderate engagement in 20–40-minute sessions) where 151 sessions (17.38%) are in the "≥ 20 minutes" category and 67 sessions (9.33%) in the "≥ 30 minutes" category indicate a further drop-off in session frequency, reflecting the challenge of maintaining PA beyond the initial 20 minutes. There is minimal participation in longer sessions (≥ 40 Minutes) with only 40 sessions (6.14%) of "≥ 40 minutes," underscoring the rarity of prolonged physical activity sessions and highlighting a significant gap in meeting sustained activity thresholds. The "< 20 minutes" category dominates, with 24 children completing 8 sessions and 6 completing 7 sessions during the week. This indicates that short-duration activities are the most common across the population in this study.

However, while prevalent, these sessions fell below the recommended thresholds for contributing significantly to PA guideline compliance, suggesting a need to encourage longer activities. In the "≥ 20 minutes" category, the number of children with 8 sessions drops to 0, but 2 children achieve 7 sessions, and 4 children achieve 6 sessions. This shows some success in sustaining moderate activity durations but with a steep decline compared to shorter sessions. The "≥ 30 minutes" category sees a further reduction, with a maximum of 2 children completing 6 sessions per week, indicating that sustaining activities of this length remains challenging for most. The "≥ 40 minutes" category shows the lowest engagement, with only 2 children achieving 5 sessions per week and even fewer at higher session counts. This highlights the significant gap between current activity patterns and the levels needed to meet international PA guidelines.

4.5.10 Observations and Interpretations

These findings highlight that most children engage in shorter sessions, underscoring the need for PA programmes targeting session duration to improve guideline compliance. Encouraging progression from shorter sessions to ≥ 20-minute durations could serve as an achievable intermediary step toward the goal of ≥ 40-minute sessions. Schools and other environments should aim to create conditions that foster longer, more consistent PA sessions. There is a need for structured activity programs to introduce activities designed to gradually increase session durations, particularly focusing on moving children from < 20-minute to ≥ 20-minute sessions.

Addressing barriers to sustaining longer durations, such as fatigue or lack of motivation, especially for CAWD with more limitations involves promoting increased session duration using preferred activities, providing adapted individualised support and conducting ongoing monitoring to track changes in session durations and frequency, and effectively evaluate the CAWD PA participation.

4.6 MVPA Inside and Outside the School

4.6.1 Global MVPA Times Inside and Outside School

This analysis examines MVPA levels inside and outside school highlighted in Table 4.9, to provide insights into how different environments contribute to children's PA participation, helps identify disparities, and informs targeted strategies to support CAWD in meeting PA guidelines effectively. It is essential to contextualise MVPA levels as the school provides a structured environment where children participate in PE classes, recess, and extracurricular activities through school-based programs that contribute to overall PA. Additionally, less structured activities voluntarily chosen and performed outside the school setting in sports clubs or at home can be a necessary complement to increase and enhance their PA participation. It is essential to ensure that all environments contribute equitably to total MVPA.

Table 4.9: MVPA inside and outside the school.

	Total MVPA		Inside School MVPA		Outside School MVPA		Percentage	
Group	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev	Inside S	Outside S
All	116.29	88.93	52.81	41.73	63.48	63.15	45.41%	54.59%
S1	93.59	81.72	30.94	33.55	62.65	63.76	33.06%	66.94%
S2	138.33	106.13	63.67	46.88	74.67	67.85	46.03%	53.98%
S3	115.18	117.47	36.18	40.88	79	83.66	31.41%	68.59%
S4	124.53	37.6	83.65	23.18	40.88	18.26	67.17%	32.83%
Boys	112.1	93.51	44.48	42.14	67.62	64.56	39.68%	60.32%
Girls	119.85	86.01	59.91	40.64	59.94	62.68	49.99%	50.01%
LID	109.06	64.58	57.29	39.01	51.76	47.48	52.53%	47.46%
MHI	124.76	111.56	47.55	44.82	77.21	76.24	38.11%	61.89%
12 – 14	113.67	64.36	66.04	41.04	47.63	39.64	58.10%	41.90%
15 – 17	120.83	106.74	45.77	41.87	75.07	73.2	37.88%	62.13%
18 – 21	100.67	97.76	29	27.94	71.67	89.62	28.81%	71.19%

4.6.2 Analysis

All children's MVPA mean in this study was 116.29 minutes per week, with substantial variability (SD = 88.89). Their MVPA was roughly split between outside school (63.48

minutes, 54.59%) and inside school (52.81 minutes, 45.41%). In the subgroups (S1–S4), S2 had the highest total MVPA (138.33 minutes/week), driven by higher inside-school MVPA (63.67) and outside-school activity (74.67) whereas S2 has the highest total MVPA (138.33 minutes/week), driven by higher inside-school MVPA (63.67) and outside-school activity (74.67). S4 shows a distinct pattern with the highest inside-school MVPA (83.65), likely due to structured activities. However, outside-school MVPA was relatively low (40.88). Regarding the gender differences, Girls performed slightly more weekly MVPA (119.85) than boys (112.1), especially inside school (59.91 vs. 44.48), and boys exhibit more MVPA outside school (67.62 vs. 59.94). The age category differences revealed that 12–14 years achieve higher inside-school MVPA (66.04), while 15–17 years demonstrated the highest total MVPA (120.83), particularly outside school (75.07), and 18–21 years showed the lowest total MVPA (100.67), indicating a decline with age.

Across the groups, the mean MVPA outside school was generally higher than inside school in most cases, with notable exceptions such as School 4 (Inside: 83.65 min, Inside: 40.88 min). The largest differences between outside and inside school occurred in School 3 (Inside: 36.18 min, outside: 79 min) and CAWD aged over 17 (Inside: 29 min, outside: 71.67 min), suggesting significant activity outside school hours for these groups. Standard deviations are consistently higher for MVPA outside school compared to inside school for most groups, indicating greater variability in MVPA levels outside school settings. Groups with high variability in MVPA outside school, such as CAWD over 17 (St. Dev: 89.62 min) and School 3 (St. Dev: 83.66 min), suggest various activity patterns among individuals. Some groups showed relatively balanced means for inside and outside school MVPA, such as Girls (Inside: 59.91 min, Outside: 59.94 min) and children with LID (Inside: 57.29 min, Outside: 51.76 min). These groups might maintain consistent PA levels regardless of setting. School 4 stands out with the highest inside-school MVPA mean (83.65 min) and relatively low variability (St. Dev: 23.18 min), indicating consistently high participation in school-based activities. Conversely, School 3 shows the highest outside-school MVPA mean (79 min) and the most variability (St. Dev: 83.66 min), suggesting that outside-school PA behaviour is less structured or varies based on individual opportunities.

4.6.3 Observations and Interpretations

i) Observations

The age category differences revealed a non-linear trend in MVPA levels. Specifically, children aged 12–14 years achieved the highest inside-school MVPA (66.04 min), while adolescents aged 15–17 years demonstrated the highest total MVPA (120.83 min), particularly outside school (75.07 min). However, among those aged 18–21 years, total MVPA dropped to 100.67 min. This pattern suggests that PA levels do not consistently decline with age across adolescence but rather increase into mid-adolescence (15–17 years) before declining in late adolescence and early adulthood (18–21 years). Therefore, the observed decline appears to begin from age 18 onward, rather than following a steady downward trend across all age groups. This pattern may reflect developmental or contextual shifts, such as increased independence and opportunities for PA in mid-adolescence, followed by reduced participation due to increased academic pressure, reduced structured PA opportunities, or transition out of school settings in late adolescence (18+).

I conducted the secondary data analysis through several key steps to extract meaningful insights from the various sources to feed the research design. These steps included organising and preparing the data, categorising them per relevance to challenges, barriers and facilitators to PA participation among CAWD as structured in the PA SEM shown in Figure 3.3, the PA objective measurement and the influence of the SEV on PA levels, emphasising the importance of the difference worldwide and KSA. The main steps are presented below.

ii) Interpretations

The data reveals variability in the proportion of MVPA performed inside compared to outside school across different population groups. Overall, across all children, 54.59% of MVPA occurs outside school, indicating a heavier reliance on out-of-school environments for meeting PA needs and 45.41% occurs inside school, highlighting the role schools play in supporting PA but also suggesting room for enhancing school-based activity programs. Regarding schools, S4 stands out with the highest proportion of inside-school MVPA (67.17%), potentially reflecting effective school-based PA programs or facilities, aligning with school-based PA interventions can lead to improvements in students' PA levels and fitness (Dobbins et al., 2013). Conversely, S3 shows the lowest proportion inside the school (31.41%), indicating a greater reliance on outside-school PA for this group, given that schools PA participation barriers include lack of time, lack of motivation, lack of support within the school environment that can lead to reduced participation in PA (Ferreira-Silva, 2022; APHA, 2019). Girls (49.99%) perform slightly more MVPA inside school compared to boys (39.68%), suggesting that school may be a more equitable environment for supporting PA among girls, and boys perform 60.32% of their MVPA outside school, indicating a greater involvement in extracurricular or unstructured PA settings. Children with LID (low intellectual disability) perform more MVPA inside the school (52.53%) than those with MHI (mild hearing impairment), who rely more heavily on outside-school activities (61.89%). This could point to differences in school-based PA accessibility or program inclusivity. Finally, younger children (12–14) perform 58.10% of MVPA inside the school, reflecting the structured opportunities provided by schools at this age. As children age, the proportion of inside-school MVPA decreases dramatically, with the 18–21 age group performing only 28.81% of their MVPA inside school. This decline may reflect reduced PE requirements or disengagement from school-based PA as students age.

These findings highlight the school's contributions in enhancing CAWD PA participation. Schools play a significant but varying role in supporting PA, with certain groups (e.g., younger children, and girls) depending more heavily on school-based activities. On the other hand, Outside-school opportunities are important since the analysis reveals that the majority of MVPA occurs outside school for most groups, emphasising the importance of accessible and inclusive community programs, particularly for older children and boys. Socio-cultural norms and environmental constraints often shape gender-based differences in PA participation. In Saudi Arabia, girls typically face more restrictions on gathering and playing outside compared to boys, limiting their opportunities for unstructured physical activity outside of school (Al-Hazzaa et al., 2011). Consequently, the school environment becomes a more equitable setting for girls to engage in physical activity, as it provides structured and supervised opportunities that may not be accessible outside of school. In contrast, boys may receive greater encouragement and face fewer restrictions, allowing them more freedom to participate in outdoor PA, contributing to higher MVPA levels outside of school (Moschny et al., 2011; Al-Eisa & Al-Sobayel, 2012). Efforts to improve PA levels should consider the specific needs of each group, such as enhancing school-based PA for schools with lower inside-school activity rates (e.g., S3) or supporting outside-school initiatives for older children and boys. This analysis underscores the need for a balanced approach, combining school-based programs with community and family-led initiatives to ensure all children meet PA guidelines.

4.6.4 MVPA Inside and Outside School

Analysing MVPA inside and outside school MVPA per the weekday subgroups (school days without and with semi-structured activities, weekend days) highlighted in Table 4.10, provides a comprehensive understanding of the PA patterns among CAWD, allowing for a detailed analysis of MVPA inside and outside school hours across distinct contexts. This analysis investigates the importance of school vs non-school contexts and structured vs. free-time PA. School days typically provide structured opportunities for PA, such as PE classes, recess, or semi-structured activities. Monitoring PA outside school hours, especially during weekends, helps capture unstructured or recreational PA behaviours. Understanding PA patterns by separating MVPA into inside- and outside-school contexts, helps assess how the environment and schedule influence PA levels. For CAWD, the school may provide more opportunities for PA compared to weekends, where barriers may be higher. Additionally, semi-structured activity sessions performed in a controlled environment during school days allow for standardised observation of PA behaviours and differences in a controlled setting. This is especially useful for understanding how CAWD respond to specific PA opportunities. Finally, analysing the MVPA achieved during these sessions helps evaluate the effectiveness of semi-structured activities in promoting PA and can guide future program designs for CAWD. It is important to note that including 5-minute breaks ensures that fatigue doesn't affect the subsequent activities, maintaining the purpose of activity measurement.

Table 4.10: MVPA inside and outside the school per group days.

Group	Statistical Variable	Total MVPA (in minutes)		School days without Semi-Str. Activities (in seconds)		School days with Semi-Str. Activities (in seconds)		Weekend Days
		Outside School	Inside School	Outside School	Inside School	Outside School	Inside School	
All Children	Mean	63.48	52.81	1713.86	1980.43	1333	1188.35	761.71
	St. Dev	63.15	41.73	1705.12	1743.36	1326.21	1009.71	757.83
S1	Mean	62.65	30.94	1691.47	1018.82	1315.59	837.65	751.76
	St. Dev	63.76	33.55	1721.39	1129.62	1338.86	969.7	765.06
S2	Mean	74.67	63.67	2016	2141.25	1568	1678.75	896
	St. Dev	67.85	46.88	1831.93	1883.67	1424.83	1027.41	814.19
S3	Mean	79.00	36.18	2133.00	1821.94	1659.00	349.41	948
	St. Dev	83.66	40.88	2258.72	2235.12	1756.78	475.28	1003.88
S4	Mean	40.88	83.65	1103.82	2987.00	858.53	2031.82	490.59
	St. Dev	18.26	23.18	492.97	980.35	383.42	493.90	219.1
Boys	Mean	67.62	44.48	1825.76	1483.28	1420.03	1185.69	811.45
	St. Dev	64.56	42.14	1743.02	1561.93	1355.68	1062.9	774.68
Girls	Mean	59.94	59.91	1618.41	2404.47	1258.76	1190.62	719.29
	St. Dev	62.68	40.64	1692.41	1799.38	1316.32	978.2	752.18
LID	Mean	51.76	57.29	1397.65	2002.91	1087.06	1434.74	621.18
	St. Dev	47.48	39.01	1281.98	1443.07	997.1	970.31	569.77
MHI	Mean	77.21	47.55	2084.59	1954.07	1621.34	899.48	926.48
	St. Dev	76.24	44.82	2058.44	2067.43	1601.01	993.85	914.86
12 – 14	Mean	47.63	66.04	1286	2347.15	1000.22	1615.07	571.56
	St. Dev	39.64	41.04	1070.15	1559.1	832.34	968.85	475.62
15 – 17	Mean	75.07	45.77	2026.8	1873.7	1576.4	872.73	900.8
	St. Dev	73.2	41.87	1976.47	1962.97	1537.25	909.67	878.43

18 – 21	Mean	71.67	29	1935	893.83	1505	846.17	860
	St. Dev	89.62	27.94	2419.82	656.13	1882.08	1113.51	1075.47

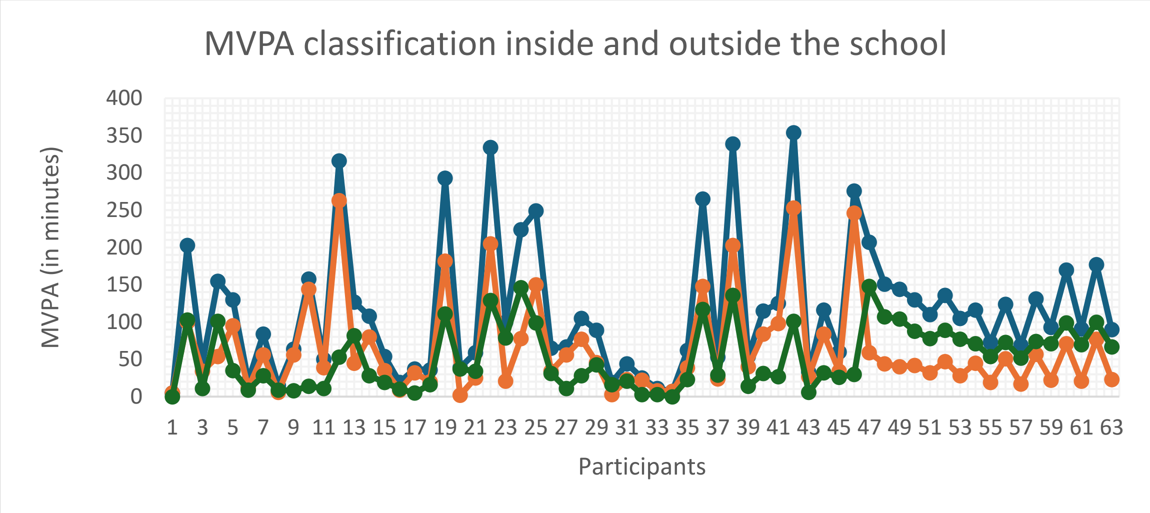

Figure 4.3: MVPA classification inside and outside the school.

4.6.5 Analysis

- **School Day MVPA Patterns**

In Normal School Days (Without Semi-Structured Activities), school days outside-school MVPA ranged widely across subgroups, with S3 (2133.00) and MHI (2084.59) achieving the highest levels, and inside-school MVPA is highest for Girls (2404.47) and the 12–14 age group (2347.15), likely reflecting structured school-based opportunities.

On the other hand, in School Days with Semi-Structured Activities, MVPA for semi-structured activities showed substantial variation: MVPA inside the school is highest for S4 (2031.82), emphasising the role of targeted interventions in this subgroup, and outside school is highest for S3 (1659.00), suggesting carryover effects of structured programs on non-school PA.

- **Weekend MVPA Patterns**

Weekend days showed consistently lower outside-school MVPA than school days and the MVPA average for All Children is 761.71, with notable variability (SD = 757.83). Regarding the school subgroup differences, S3 performs the highest weekend MVPA (948), while S4 has the lowest (490.59). For the age group trends, younger children (12–14) perform less weekend MVPA (571.56), while older groups, particularly 15–17 years (900.8), engage more.

4.6.6 Observations and Interpretations

Semi-structured activities significantly increase inside-school MVPA across all groups, particularly for S4 and younger children (12–14 years). Girls excelled in inside-school MVPA, possibly due to engagement in structured programs, while boys perform better in outside-school MVPA. An age-related decline is observed, MVPA declines with age, particularly for inside-school activity. This trend was most pronounced in the 18–21 age group, underscoring the need for age-adapted interventions. Regarding the schools' subgroups, S2 was the most active overall, while S4 showed high inside-school MVPA but low outside-school activity, indicating potential barriers to unstructured PA. The specific weekend behaviour is characterised by a lower weekend MVPA, highlighting an area for intervention, such as structured weekend programs, parental engagement initiatives, or community-based activities, particularly for subgroups like LID and younger CAWD, who show the least activity on weekends.

4.6.7 Implications and Recommendations

Groups with Higher Outside-School MVPA might be leveraging unstructured play or sports. The Investigation of the availability of opportunities and barriers to ensure equity across groups. There is a need to focus on low inside-school MVPA: Groups with lower inside-school means, such as CAWD older than 17 (29 min) and School 3 (36.18 min), may benefit from enhanced school-based PA programs or tailored interventions to boost engagement during school hours. Additionally, interpreting high variability is critical: groups with large standard deviations (e.g., children older than 17 outside school: 89.62 min) highlight disparities in access or motivation for PA, which should be addressed.

It is essential to target weekend PA interventions, focusing on unstructured opportunities for groups with lower weekend activity (e.g., S4, 12–14 years), expanding semi-structured activities for older groups to sustain inside-school MVPA and investigating barriers to outside-school activity for groups like S4 and children with lower socioeconomic access.

4.7 Physical Activity Levels and Sleep

Analysing PA levels and sleep times among CAWD, highlighted in Table 4.11, is crucial to identifying various personal, social, and environmental factors that act as barriers or facilitators to CAWD PA and highlighting the interplay between physical health, lifestyle behaviours, and the broader socio-ecological environment. This holistic perspective is essential for addressing PA participation disparities they face. The findings can inform public health policies and the development of inclusive recreational and educational programs. This ensures equitable access to resources that promote healthy lifestyles.

Table 4-11: Weekly sleep times and PA levels (in minutes).

Group	Variable	Age	Sleep	Sedentary	Light	Moderate	Vigorous	MVPA
All Children	Mean	14.98	3038.44	1890.38	1063.84	102.73	13.27	116
	St. Dev	1.76	626.96	1178.82	1423.22	75.97	15.08	88.93
S1	Mean	16	2691.24	1429.41	192	83.76	9.35	93.12
	St. Dev	1.32	717.98	1199.51	142.41	71.99	11.35	81.64
S2	Mean	14.67	2899.67	1599.08	261.58	122	15.83	137.83
	St. Dev	1.5	535.18	1282.1	185.57	92.16	14.58	106.25
S3	Mean	15.65	3122.88	1358.94	194	102.35	12.53	114.88
	St. Dev	2	619.54	806.45	139.41	99.28	19.69	117.5
S4	Mean	13.53	3399.18	3088.41	3371.82	108.47	16.12	124.59
	St. Dev	0.87	372.23	225.94	177.99	28.04	13.70	37.64
Boys	Mean	15.45	2777.48	1499.62	220.79	99.59	12.03	111.62
	St. Dev	1.53	646.53	1214.57	162.28	81.65	12.95	93.52
Girls	Mean	14.59	3261.03	2223.68	1782.91	105.41	14.32	119.74
	St. Dev	1.86	522.44	1053.8	1620.47	71.9	16.8	86.05
LID	Mean	14.76	3045.21	2258.91	1781.91	96.12	12.74	108.85
	St. Dev	1.67	667.99	1196.36	1621.61	55.24	12.85	64.6
MHI	Mean	15.24	3030.52	1458.31	221.97	110.48	13.9	124.38
	St. Dev	1.84	586.83	1015.82	160.57	95.22	17.55	111.61
12 – 14	Mean	13.44	3223.44	2166.22	1941.15	99.11	14.44	113.56
	St. Dev	0.64	716.87	1155.82	1617.74	53.52	13.26	64.53
15 – 17	Mean	15.63	2925.1	1667.67	447.73	107.93	12.57	120.5
	St. Dev	0.72	509.33	1204.63	846.45	91.16	16.67	106.71
18 – 21	Mean	18.67	2772.67	1824.5	196.5	91	9	100
	St. Dev	1.21	592.07	1149.47	126.73	89.78	9.03	97.65

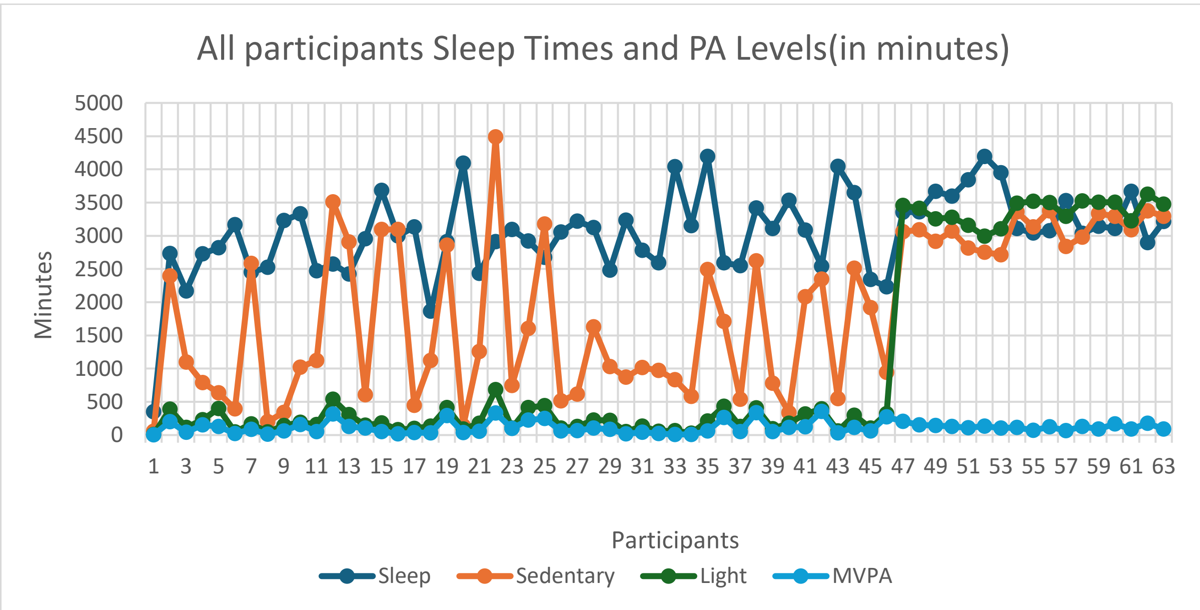

Figure 4.4: Weekly sleep times and PA levels (in minutes).

4.7.1 Sleep Patterns

For the "All Children" group, the mean weekly sleep time was 3038.44 minutes (~7.25 hours per day), with substantial variability (SD = 626.96). Notably, age differences revealed that younger CAWD (12–14 years) achieve the highest sleep durations, averaging 3223.44 minutes per week. This aligns closely with recommended sleep guidelines for younger adolescents, emphasising the importance of adequate rest during this developmental stage (Suni and Dimitriu, 2023). In contrast, older groups, particularly those aged 18–21 years, exhibit significantly lower weekly sleep times (2772.67 minutes), which may reflect lifestyle changes, academic demands, or social factors typical of late adolescence and early adulthood.

Gender analysis shows that girls consistently sleep more (3261.03 minutes) than boys (2777.48 minutes), a trend observed across subgroups. Girls attending all-girls schools (e.g., S3 and S4) reported particularly high sleep durations. This difference in sleep behaviour reported in literature (Fatima et al., 2016) may be related to biological, social, or contextual influences, such as differing routines, structured routines or contextual and cultural factors context.

4.7.2 Sedentary Time

The mean weekly sedentary time for the "All children" group is 1890.38 minutes, but variability is high (SD = 1178.82). School subgroup differences indicate that S3 and S4 (girls) reported exceptionally high sedentary times (~3088 minutes), far exceeding other groups. This may indicate less engagement in PA by staying at home (currently the norm in KSA) and/or higher screen time. S2 has the lowest sedentary time (1599.08 minutes), aligning with their higher MVPA levels. Sedentary time was slightly lower for boys (1499.62) than girls (2223.68), possibly reflecting gendered activity preferences.

4.7.3 Light Physical Activity (LPA)

The weekly LPA for the "All children" group is 1063.84 minutes on average with significant variability (SD = 1423.22). The school subgroups S3 and S4 (girls) report very high LPA (~3371.82 minutes), contributing significantly to their total PA time while S1 has minimal LPA (192 minutes), suggesting limited engagement in light-intensity activities. Girls (1782.91) engage more in LPA than boys (220.79), and LPA declines significantly with age, from 1941.15 minutes (12–14 years) to 196.5 minutes (18–21 years).

4.7.4 Moderate-to-Vigorous Physical Activity (MVPA)

For the ‘All Children’ group, the average MVPA is 116 minutes per week, slightly below the recommended levels for CAWD (120–180 minutes). S2 achieved the highest MVPA (137.83), while S1 had the lowest (93.12), and S3 and S4 (girls) showed moderate MVPA levels (~124.59), consistent with their high LPA, slightly outperforming boys (119.74 vs. 111.62). MVPA peaks for 15–17 years (120.5) and declines significantly for the 18–21 age group (100).

4.7.5 Implications and Recommendations

Sleep and PA decrease with age, while sedentary time increases. Interventions should focus on maintaining PA levels and reducing sedentary behaviour, particularly in older adolescents and young adults as recommended by Nguyen et al. (2020) and Micklesfield et al. (2021). S2 demonstrates positive PA patterns (low sedentary time, high MVPA). On the other hand, S3 and S4 exhibited concerningly high sedentary time despite high LPA. Girls tended to sleep more and engage in slightly higher LPA and MVPA than boys with higher sedentary time. This could reflect different activity preferences or societal norms. This analysis suggests increasing MVPA for all groups, particularly S1 and older adolescents (18–21 years), to meet PA guidelines.

4.8 Health Factors

4.8.1 Impact

Analysing health factors when measuring PA across population groups is crucial for understanding activity level variations and developing PA-promoting strategies to enhance PA participation and performance. These variations help identify barriers and facilitators of PA and understand the relationship between health factors and PA at various levels: (i) schools with better sports facilities or structured PA programs may promote higher engagement, (ii) boys may engage in more vigorous activities, while girls might prefer less intense, structured forms of exercise, (iii) CAWD face unique barriers, including limitations and challenges, limited opportunities for adapted sports, or negative social attitudes, and (iv) age affecting PA levels typically through physical capabilities development, PA-age decline during adolescence, and influences by changing interests. This analysis provides valuable insights into the interplay between PA and individual, social, and environmental determinants. It helps address barriers, reduce inequalities, and design inclusive, effective interventions, ultimately improving the health and well-being of diverse populations.

Table 4.12: Health factors across schools, gender, disability and age.

Group	Variable	1	2	3	4	5	6	7	8
All Children	Mean	14.984	51.206	155.36	21.015	13.56	0.4923	0.434	1.059
	St Dev	1.7551	15.906	11.004	5.4062	3.4826	0.0803	0.4074	0.0198
S1	Mean	16	59.235	162.41	22.315	13.803	0.4932	0	1.0684
	St Dev	1.3228	21.264	12.176	7.4228	4.7499	0.1065	0	0.0189
S2	Mean	14.666	51.416	161.91	19.514	12.061	0.4536	0	1.0819
	St Dev	1.4974	12.781	8.0843	4.4962	2.8404	0.074	0	0.0112
S3	Mean	15.647	42.235	149.41	18.754	12.552	0.4669	0.7907	1.0518
	St Dev	1.9981	11.333	8.3894	4.2226	2.7417	0.0402	0.0744	0.0086
S4	Mean	13.529	52	149.64	23.034	15.382	0.5438	0.8179	1.0407
	St Dev	0.8744	11.521	6.9546	3.6304	2.2397	0.0605	0.0669	0.0102
Boys	Mean	15.448	56	162.2	21.156	13.082	0.4768	0	1.074
	St Dev	1.5256	18.382	10.509	6.4342	4.1018	0.095	0	0.0173
Girls	Mean	14.588	47.117	149.52	20.894	13.967	0.5054	0.8043	1.0462
	St Dev	1.8605	12.296	7.5888	4.4445	2.853	0.0639	0.071	0.0109
LID	Mean	14.764	55.617	156.02	22.675	14.593	0.5185	0.4089	1.0545
	St Dev	1.6707	17.236	11.717	5.7652	3.7434	0.0891	0.4177	0.0205
MHI	Mean	15.241	46.034	154.58	19.068	12.349	0.4614	0.4635	1.0643
	St Dev	1.8449	12.599	10.255	4.275	2.7433	0.0559	0.4003	0.0179
12-14	Mean	13.444	48	152.44	20.526	13.49	0.4978	0.5395	1.0577
	St Dev	0.6405	12.328	8.7851	4.2852	2.828	0.0728	0.3921	0.0209
15-17	Mean	15.633	52.633	157.63	20.94	13.317	0.4792	0.3662	1.0607
	St Dev	0.7183	15.53	12.22	4.8408	3.0638	0.0713	0.3997	0.0187
18-21	Mean	18.666	58.5	157.16	23.591	15.085	0.5323	0.2981	1.0563
	St Dev	1.211	28.57	12.384	11.033	7.1545	0.1409	0.4716	0.0227
Factor Code	1. Age 2. Weight		3. Height 4. BMI		5. Ponderal Index 6. Waist Height ratio		7. Wait Hip Ratio 8. Body density		

Group	Variable	9	10	11	12	13	14	15	16
All Children	Mean	14.294	17.317	38.235	15.566	39.936	1472.9	1419.8	1311.7
	St Dev	8.4935	8.7187	11.052	2.9795	9.2002	298.12	237.41	290.88
S1	Mean	11.652	13.207	47.657	17.931	45.137	1705.7	1585	1575.4
	St Dev	8.7427	8.2976	11.938	3.576	11.639	376.09	320.43	311.94
S2	Mean	4.5269	7.2795	44.079	16.694	41.305	1567.5	1484.1	1475.9
	St Dev	5.6544	4.7256	8.4117	2.3288	7.4468	226.04	196.2	191.09
S3	Mean	17.516	20.397	30.408	13.535	34.322	1257.8	1262.5	1071.9
	St Dev	4.5346	3.8824	5.6054	1.6832	6.7596	151.68	117.59	121.23
S4	Mean	20.609	25.432	32.514	14.435	39.381	1388.5	1366.3	1172

	St Dev	5.3099	4.6595	5.5629	1.5528	6.6885	154.2	118.39	121.81
Boys	Mean	8.704	10.754	46.177	17.419	43.551	1648.5	1543.3	1534.2
	St Dev	8.3062	7.5461	10.604	3.134	10.143	325.12	276.33	269.14
Girls	Mean	19.062	22.915	31.461	13.985	36.852	1323.1	1314.4	1121.9
	St Dev	5.1092	4.9361	5.6018	1.6587	7.1019	164.56	127.56	130
LID	Mean	16.13	19.32	40.085	16.183	42.259	1547.1	1475.7	1373.7
	St Dev	8.4495	9.0778	11.965	3.243	9.7933	325.63	262.5	310.3
MHI	Mean	12.141	14.969	36.065	14.842	37.211	1385.9	1354.2	1239
	St Dev	8.167	7.7858	9.6284	2.5015	7.7553	239.4	188.03	252.47
12-14	Mean	13.313	17.916	34.394	14.636	37.836	1389.3	1357.1	1226.3
	St Dev	8.6251	9.1461	7.6798	1.8587	7.2913	193.55	162.35	195.73
15-17	Mean	14.21	16.534	40.697	16.044	41.149	1513.3	1455.3	1359.6
	St Dev	7.9875	8.2957	11.908	2.9699	9.436	304.05	247.71	311.35
18-21	Mean	19.131	18.538	43.206	17.36	43.318	1647.5	1524	1456.6
	St Dev	10.214	10.052	15.483	5.5733	14.503	535.67	405.17	457.63
Factor Code	9. Body Fat 1 10. Body Fat 2 11. Lean Body Mass			12. Lean Mass Index 13. Lean Body Weight 14. Basal Metabolic Rate			15. Basal Energy Expenditure 16. Resting Metabolic Rate		

4.8.2 Analysis

a) Age, Weight, Height, BMI, and Ponderal Index

Age and growth trends indicate that older age groups (18–21 years) exhibit higher mean weight, height, and BMI compared to younger groups, reflecting natural growth and development. The Ponderal Index decreases slightly with age, indicating proportional weight increases relative to height. Variations across schools show that S2 and S1 reported the highest mean weights, correlating with higher BMI values. S3, with the lowest height and weight, aligns with the lowest BMI, and S4 shows a higher BMI mean (23.034), likely due to higher weight relative to height. Boys demonstrated slightly higher BMI variability, but lower average BMI compared to girls. This aligns with boys having higher muscle mass (lean mass index), while girls typically carry more body fat (Sweeting, 2008; Muscogiuri et al., 2024). The disability influence is reflected in LID participants reporting higher mean BMI and ponderal index compared to MHI, suggesting differences in body composition and proportional growth.

b) Waist-Height Ratio (WHtR), Waist-Hip Ratio (WHR), and Body Density

S4 has the highest WHtR (mean = 0.5438), indicating a potentially higher risk of central obesity compared to other schools, and boys display a lower WHtR than girls, which is consistent with sex-specific fat distribution patterns. WHR was generally higher in girls (mean = 0.8043) compared to boys, reflecting differences in fat distribution. MHI participants exhibit higher

WHR variability, suggesting heterogeneity in this population. Regarding the body density, there is a minimal variability across groups, which suggests consistent measurement but is slightly lower in girls and S4, indicating higher fat percentages in these populations.

c) Body Fat Percentage, Lean Mass, and Metabolic Rates

Girls had significantly higher body fat percentages (19.062–22.915) compared to boys (8.704–10.754), and S4 has the highest body fat (20.609), while S2 reports the lowest (4.5269), likely linked to activity levels and dietary variations. Boys had notably higher lean mass and lean body weight, aligning with increased basal and resting metabolic rates (BMR and RMR).

d) Metabolic Rates (BMR/RMR)

Older age groups exhibit higher BMR and RMR, reflecting higher energy requirements during late adolescence, and LID participants report higher metabolic rates than MHI, possibly due to higher muscle mass and body size.

4.8.3 Observations and Interpretations

The health factors' trends across schools reveal that S1 and S2 show higher weight, height, and metabolic rates compared to S3 and S4, and S3 stands out for lower BMI, body fat, and metabolic rates. S1 exhibits higher BMI, weight, and BMR indicating an active, possibly well-nourished group. S3 show Lower metrics across most factors, particularly body fat and metabolic rates, suggesting lower energy requirements or physical engagement. S4 High BMI, WHtR, and body fat indicate greater health risks, possibly linked to nutritional or lifestyle differences. The gender-based insights indicate that boys had consistently higher height, lean mass, and BMR, while girls showed higher body fat percentages, waist-height ratios, and slightly higher BMI. The disability group comparison reports that LID participants showed higher BMI, waist-height ratios, body fat percentages, and metabolic rates, indicating differences in body composition and health risk factors compared to MHI. Age-related changes in weight, BMI, body fat, and metabolic rates increase steadily with age (Santos et al., 2019), particularly noticeable in the 18–21 group, and lean mass and height peak by 15–17 and stabilise thereafter. LID participants have higher weight, BMI, and lean mass suggesting a more robust body composition. Their higher metabolic rates align with increased energy expenditure for daily activities. MHI participants have Lower WHR and metabolic rates, coupled with higher variability in body density, which may indicate a more heterogeneous population.

4.9 Semi-Structured Activities

The study analysed the average SVM per second during 10 distinct semi-structured activities (S-S Act 1–10), providing insights into activity intensity across various population groups, schools, and age ranges. The 10 semi-structured activities taken from the Youth Compendium of PAs represent a spectrum of movement intensities and motor skills. These activities span sedentary to vigorous behaviours, allowing researchers to observe how participants engage across a range of physical challenges.

The analysis aims to establish refined intensity cut-points for adolescents aged 15–17 and 18–21 by comparing the Sum of Vector Magnitude per second (SVM/s) with the metabolic equivalent of tasks (METs) defined in the Youth Compendium of Physical Activities. It maps SVM/s to MET categories by associating the observed SVM/s values from the semi-structured activities with their corresponding MET values to suggest thresholds for Sedentary, Light, Moderate, and Vigorous activity. This approach addresses a key gap in the literature, as the commonly used Phillips cut points lack coverage for these age groups.

Table 4.13: Semi-structured activities across population groups.

	S-S Act 1	S-S Act 2	S-S Act 3	S-S Act 4	S-S Act 5	S-S Act 6	S-S Act 7	S-S Act 8	S-S Act 9	S-S Act 10	Mean
All children	14.82	30.98	33.75	32.16	14.63	14.31	13.56	16.59	15.68	19.69	14.82
S1	21.04	61.36	55.55	50.09	13.28	20.89	12.73	16.18	19.78	18.04	21.04
S2	22.81	48.58	67.37	65.58	24.82	8.69	8.69	25.32	14.44	32.86	22.81
S3	11.35	13.74	15.98	12.41	12.23	14.62	15.37	11.24	8.70	11.94	11.35
S4	6.69	6.70	6.75	10.86	11.06	11.77	16.01	16.00	19.49	19.48	6.69
Boys	21.80	55.88	60.62	56.73	18.22	15.67	11.00	20.09	17.49	24.39	21.80
Girls	8.98	10.17	11.29	11.62	11.63	13.18	15.69	13.65	14.18	15.77	8.98
LID	13.65	33.20	30.41	29.88	12.14	16.19	14.42	16.09	19.63	18.78	13.65
MHI	6.80	5.66	7.68	6.10	5.77	7.25	6.17	8.46	5.27	6.39	6.80
12-14	10.53	17.35	21.14	21.38	13.68	10.98	13.53	16.89	16.16	20.87	10.53
15-17	17.88	40.88	44.14	42.09	15.60	16.21	12.51	16.46	14.74	19.96	17.88
18-21	18.37	41.34	37.28	30.05	14.04	19.42	18.79	15.89	18.27	13.26	18.37
Mean	14.56	30.49	32.66	30.75	13.92	14.10	13.21	16.07	15.32	18.45	14.56
Age	Semi-Structured Activities' MET From the Youth Compendium of Physical Activities										
12	0.8	1.5	5.0	3.5	3.2	4.2	2.6	4.4	7.0	5.1	
13-15	0.8	1.4	4.8	3.5	3.1	4.0	2.4	4.2	6.7	5.0	
16-18	0.9	1.4	4.8	3.5	3.0	4.0	2.4	4.2	6.7	5.0	

S-S Act	Intensity	MET’s	SVM	S-S Act	Intensity	MET’s	SVM
1, 2	Sedent.	< 1.5	< 7	3,4,5,6,8,10	Moderate	≥ 3 and < 6	20 to 60
7	Light	≥ 1.5 and < 3	≥ 7 and < 20	9	Vigorous	>6	>60

List of semi-structured activities	
1) Lay supine 2) Seated DVD viewing 3) Playing a virtual sport (Dance) 4) Overarm throwing and catching using the dominant hand 5) Underarm throwing and catching using the dominant hand	6) Instep passing a football 7) Slow walk (35m/minute) 8) Fast walk (70 m per minute) 9) Slow rum (100m per minute) 10)Medium run (150 m per minute)

4.9.1 Observed Trends in PA Levels Across Age Groups

The 12–14-year-old group (Younger Adolescents) tend to engage more in low-to-moderate intensity activities. Their PA levels (SVM/s) are generally consistent across activities, reflecting lower variability and moderate effort. Recommending a combination of school-based activities and natural play will help to meet recommended PA guidelines (Chaput et al., 2020). The 15–17-year-old group (Middle Adolescents) showed greater variability in PA levels across activities, engaging less in certain light/moderate activities, suggesting transitional behaviours influenced by academic pressures, reduced opportunities for free play, or changing motivation. Their vigorous PA levels are somewhat reduced compared to younger or older groups, potentially due to inconsistent engagement, fatigue or lack of motivation. Finally, the 18–21-year-old group (Older Adolescents /Young Adults) exhibited higher SVM/s values in vigorous and skill-based activities (e.g., running, virtual sports), demonstrating peak physical capabilities, and enabling higher effort and intensity during activities.

4.9.2 Analysis

The study analysed SVM/s distribution by population groups by comparing the SVM/s values across the 10 semi-structured activities for all CAWD participants, particularly for those aged 15–17 and 18–21. It examined whether there are systematic differences in SVM/s intensity between the two age groups and how these differences align with the MET-based intensity categories. This step ensures age-appropriate classification of PA intensities.

The overall mean SVM/s (14.82) corresponds to light activity intensity compared to MET categories. Activities such as S-S Act 2, 3, and 4 had the highest SVM values across all groups, reflecting MVPA intensity, particularly for older participants (e.g., 15–21 years). Activities like S-S Act 6 and 7 showed consistently lower SVM, aligning with light intensity levels. School 1 shows the highest activity levels, with consistently high SVM for moderate-to-vigorous activities (S-S Act 2: 61.36, Act 3: 55.55). School 3 reflected sedentary to light intensity (mean SVM = 11.35), suggesting reduced participation or physical engagement compared to other groups. Boys consistently demonstrate higher intensity for activities like S-S Act 2 (55.88) and S-S Act 3 (60.62), indicating more vigorous engagement. They show a higher mean SVM (21.80: low moderate intensity) than girls (8.98: low light intensity). In the girls' group, peak SVM is seen in S-S Act 10 (15.77) and S-S Act 9 (14.18), aligning with light-activity levels, suggesting potential gender-based differences in physical engagement (Kretschmer et al., 2023; Biadgilign et al., 2022).

There are age-specific trends: Peaks occur for the 12–14 years group (mean SVM = 10.53, light intensity overall) in S-S Act 9 (16.16) and S-S Act 10 (20.87), corresponding to moderate intensity, particularly for running activities. Significant peaks can be seen for the 15–17 years group in S-S Act 2 (40.88) and S-S Act 3 (44.14), suggesting MVPA intensities for these activities. Steady SVM increases in this group (Mean SVM = 17.88 corresponding to high light intensity overall) reflect dynamic activities such as Act 4 (42.09) and Act 9 (14.74). Although there is a noticeable decline in SVM for later activities like Act 10 (13.26), the 18–21 years group (mean SVM = 18.37 corresponding to high light intensity overall), shows peaks in S-S Act 2 (41.34) and S-S Act 3 (37.28) indicating similar intensity trends as the 15–17 group.

4.9.3 Observations and Interpretations

Activity Variations were observed: S-S Act 2 and S-S Act 3 consistently elicited the highest activity levels across most groups, suggesting these activities involve more intense or engaging movements. There are group differences: S1 participants were the most active, while S3 participants had the lowest intensity. Boys, LID participants, and older adolescents (18–21 years) showed higher activity levels than their counterparts. The analysis shows gender and disability trends: Boys and LID participants exhibited greater intensity during all activities, highlighting potential disparities in participation or energy expenditure. Older adolescents (15–17 and 18–21 years) exhibit consistently higher SVM/s values for the selected activities compared to younger adolescents (12–14 years). Activities involving greater movement intensity, such as those requiring dynamic or whole-body engagement (e.g., Activity 2 and Activity 3), show sharper increases in SVM/s with age. These trends likely reflect physical and biomechanical development, including greater muscle mass, coordination, and energy output in older age groups.

The analysis highlights the nuanced relationship between PA, age, and activity type. It underscores the importance of recognising developmental transitions when analysing or interpreting PA data and designing interventions or measurement systems (Gropper et al., 2020). It suggests that intensity cut-points can be refined by closely aligning SVM values with MET thresholds. Significant age and gender differences highlight the need for tailored classifications to ensure accurate PA measurement and categorisation. The variability observed between activities (e.g., dynamic vs. static) and population groups (schools, gender, disability and age) further underscores the importance of contextual and demographic factors in refining PA intensity metrics. It suggests that activity intensity varies significantly across groups and activities, influenced by demographic, contextual, and behavioural factors. Further research into specific activities' nature and their suitability for different groups (mainly age and disability) could help refine specifically engagement strategies for various age groups.

4.9.4 Implications for Intensity Cut-Point Refinement

The age-related increase in SVM/s supports the need for age-specific intensity cut-points for adolescents aged 15–17 and 18–21. Activities with marked differences in SVM/s across age groups (e.g., Activities 2 and 3) can provide valuable benchmarks for calibrating new intensity thresholds. For the selected activities, preliminary thresholds might be developed by analysing the distribution of SVM/s values relative to MET-defined intensity levels (e.g., sedentary, light, moderate, vigorous). This age-specific approach helps refine intensity classification systems and enhance the accuracy of physical activity measurement for adolescents aged 15–21.

Table 4.14: Semi-structured activities across age groups.

Activity	S-S Act 1	S-S Act 2	S-S Act 3	S-S Act 4	S-S Act 5	S-S Act 6	S-S Act 7	S-S Act 8	S-S Act 9	S-S Act 10	Mean
All children	14.82	30.98	33.75	32.16	14.63	14.31	13.56	16.59	15.68	19.69	14.82
12-14	10.53	17.35	21.14	21.38	13.68	10.98	13.53	16.89	16.16	20.87	10.53
15-17	17.88	40.88	44.14	42.09	15.60	16.21	12.51	16.46	14.74	19.96	17.88
18-21	18.37	41.34	37.28	30.05	14.04	19.42	18.79	15.89	18.27	13.26	18.37

The observed pattern of SVM/s distribution across age groups shown in Table 4.13 and Table 4.14, reflects the complex interplay of developmental, physiological, and activity-specific factors illustrated by 2 main trends: SVM/s values steadily increase across the first two age groups (12–14, 15–17) for Activities 1, 2, 3, 4, 5 and 6, and decreases for Activities 7, 8, 9 and 10. There was a decrease for the 18-21 age group for Activities 3, 4, 5, 8 and 10. Some aspects of PA engagement relate to the older adolescents' peak physical capacity when they reach a developmental stage where strength, endurance, and movement efficiency are at their highest. These aspects can show greater PA engagement as they approach PAs with greater intensity due to increased autonomy, social influences, or competitive tendencies, and enhanced motor skill refinement that improves their ability to perform activities with greater efficiency or power.

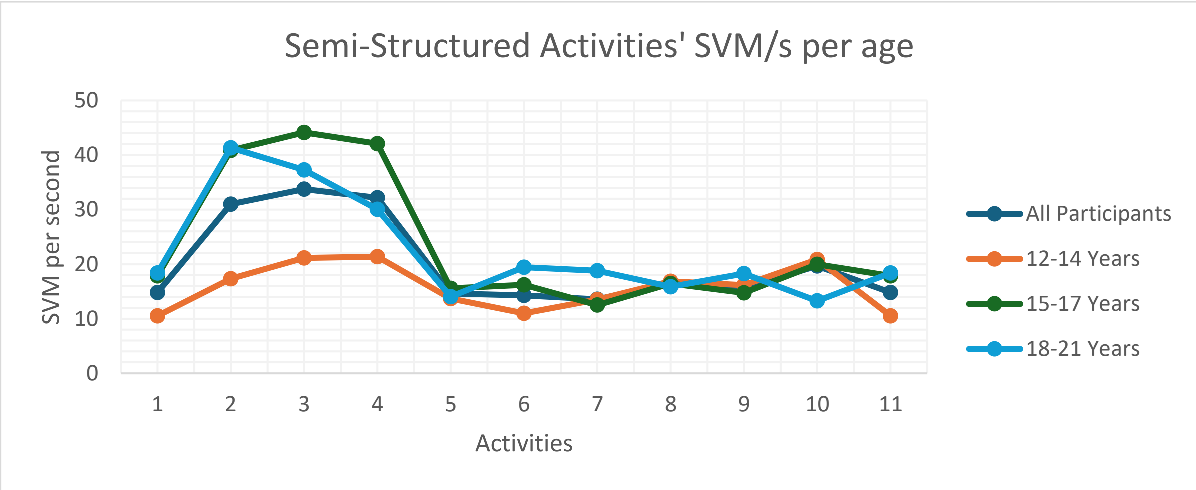

Figure 4.5: Semi-Structured Activities SVM/s per age.

Regarding the first trend, possible explanations include (i) physical maturation enabling older adolescents to produce more forceful or energetic movements due to their higher muscle mass, better motor coordination, and greater biomechanical efficiency, (ii) complexity of activities involving gross motor movements or dynamic engagement requiring higher physical capabilities of older age groups, and (iii) behavioural factors including enthusiastic and higher engagement of older adolescents due to greater confidence, motivation, or peer influences. The second trend can be explained possibly by (i) developmental transition when adolescents aged 15–17 might experience a period of reduced physical engagement or efficiency in activities that require fine motor control, endurance, or specific skills, (ii) engagement variation characterising these adolescents participating in these activities with less intensity or focus due to distractions, lower interest, or perceived difficulty including disability limitations, (iii) activity-specific dynamics affecting mid adolescents in a way that the nature of these activities might appeal more to younger or older participants, affecting the intensity of effort, and (iv) fluctuations in energy expenditure due to growth spurts and changes in movement patterns.

4.9.5 Intensity Classification Refinement

The analysis highlighted the need to refine the intensity classification and effectively compare trends by cross-referencing SVM with METs. Observed SVM values require to be aligned for each activity with the MET values provided from the Youth Compendium: For example, S-S Act 9 (Slow Run) has METs ranging from 6.7–7.0, suggesting moderate intensity for 12–14 years but aligning with vigorous intensity for older age groups (15–21) based on SVM trends.

4.9.6 Further analysis

SVM transitions across MET-defined boundaries helped to identify potential discrepancies in intensity cut-points by examining specific activities like S-S Act 3 (Dance) and S-S Act 9 (Slow Run) to evaluate age-specific engagement. Investigating whether the SVM difference between 12–14 and 15–17 years reflects genuine intensity changes or behavioural shifts was crucial to assess the need to evaluate intensity cut-point adjustments and redefine the lower and upper-intensity thresholds of the different categories. Additionally, investigating outliers and contextual factors is important the SVM/s of activities with sharp changes across groups, such as Activities 2 and 3, and comparing school-specific variations (e.g., S1 vs. S4) to understand activity execution variations including differences in movement technique, participation style, or group-specific preferences, and the impact of environmental or instructional factors affecting intensity. Finally, evaluating intensity cut-point adjustment for age groups 15–17 and 18–2 using the MET-intensity thresholds is crucial to validate these cut-points by comparing classified activities across all groups.

4.10 Conclusion

The quantitative analysis findings offer critical insights that serve as a foundation for stakeholder discussions, enabling them to identify and address specific challenges related to physical activity levels and associated health factors across various population groups. These insights are instrumental in guiding the development of tailored, evidence-based strategies to effectively tackle emerging issues and promote equitable PA engagement and health outcomes.

By focusing on the trends of MVPA variability inside and outside school, and SVM/s of the different semi-structured activities, the study can tailor PA evidence-based guidance to elaborate PA-promoting strategies and programs that align with physical developmental stages and address barriers and challenges to PA participation and performance. To validate this knowledge, further analysis using statistical tests such as correlational and regression analyses, is required to assess significant differences between inside and outside school MVPA, explore how these relate to overall PA guideline compliance, and explore relationships between PA levels and SEVs, identifying predictors of PA behaviour change and assessing in the next chapter, the impact of barriers and facilitators on the PA participation of CAWD.

Chapter Five: Quantitative Analysis - Statistical Analysis of PA Levels and SEV

5.0 Introduction

This chapter builds on the previous quantitative analysis by further exploring the associations between objectively measured PA levels, various health factors and socio-ecological variables, among CAWD. While the earlier analysis provided insights into MVPA compliance with the UK PA guidelines, PA levels, sleep times, health factors, and semi-structured activities across different population groups (schools, gender, disability, and age), this chapter takes a deeper analytical approach. Using correlation and general linear model (univariate and multivariate) analysis and statistical testing, it seeks to identify significant relationships and patterns between health outcomes, individual attributes, and socio-ecological variables with PA behaviours. Understanding these associations will offer a comprehensive perspective on the interplay of multi-level influences on PA participation, help to inform stakeholders (children and parents, health practitioners, school managers and SN and Teachers) about potential intervention points to improve PA engagement and associated health outcomes for CAWD.

This chapter begins by providing a comprehensive overview of the data, meticulously detailing the dependent and independent variables that form the foundation of the statistical analyses. These variables are systematically categorised into three distinct contextual levels: demographics or group factors, health factors, and socio-ecological variables (SEVs), which are further grouped into clusters. The second section delves into a correlational analysis, exploring the intricate relationships between PA levels, sleep duration, key health factors, and clusters of socio-ecological variables. This in-depth examination reveals trends and patterns, offering valuable insights and highlighting their implications for stakeholders across various sectors. Following this, a global correlation analysis quantifies the distribution of correlation strengths ranging from very strong to very weak across clusters of variables, presenting an overarching view of these associations.

Building on these findings, the fourth section reports the results of general linear modelling, quantifying the strength and direction of relationships between health factors, SEVs, and PA levels, as well as sleep duration. This rigorous analysis provides a nuanced understanding of the interconnectedness of these critical factors. The fifth section introduces a granular analysis of group factors, examining their associations with various aspects of MVPA across different population groups. This targeted exploration offers critical insights into how specific demographic or group characteristics influence MVPA engagement.

Finally, the chapter concludes with a comprehensive discussion of the key findings, emphasising their significant implications for the study, practice and policy development, and future research. This critical discussion lays the groundwork for stakeholders, such as PE teachers, to make informed decision-making and advance their knowledge in this field.

5.1 Data Overview

PA levels and sleep times, health factors, and socio-ecological variables are inherently interconnected and multifaceted, influencing each other in complex ways. Recent academic research underscores the intricate and multidimensional relationships between PA levels, sleep patterns, health factors, and socio-ecological variables (Pesonen et al., 2022; Benisti and Baron-Epel, 2023). These elements are deeply interconnected, each influencing the others in complex ways.

The breadth of variables related to health and socio-ecological variables can yield vast amounts of data. This complexity presents significant analytical challenges, as these variables often exhibit overlapping associations and intricate patterns. Analysing the extensive array of health and socio-ecological variables presents significant analytical challenges due to their complex and overlapping associations. To manage this complexity, clustering these variables into meaningful groups offers a structured approach to analysis (Brazil, 2022). Grouping factors allows for a clearer interpretation of relationships within and across clusters, simplifies the exploration of correlations, and facilitates the identification of key factors driving differences in PA behaviours (Mello et al., 2023). This strategy aims to disentangle the possible diverse influences to understand how they collectively shape health outcomes and physical activity participation. It focuses on clustering the number of PA, health, and socio-ecological variables into distinct clusters, enabling a systematic investigation of their interdependencies and their impact on the CAWDs' PA levels.

5.2 Variables Clustering

5.2.1 Health factors

The study of PA participation among CAWD can be enriched by examining key biological and demographic factors. These factors can be grouped into four clusters: (i) Demographics, which encompass age, gender, and socio-economic status, providing essential context for understanding PA patterns; (ii) Anthropometric Measurements, including height, weight, and other physical measurements, which offer insights into growth and development; (iii) Body Composition, which focuses on the proportion of fat, muscle, and bone mass, revealing important indicators of physical health and fitness; and (iv) Metabolic Indicators, which include factors such as blood pressure, cholesterol levels, and glucose metabolism, providing crucial information on the physiological impact of PA (Alghamdi and Alsaigh, 2023). Together, these clusters allow for a comprehensive understanding of the factors influencing PA participation and overall health in children with disabilities.

Table 5.1: Health Factors Clusters.

Cluster: Demographics	Cluster: Anthropometric measurements	Cluster: Body composition	Cluster: Metabolic indicators
Code: HF1	Code: HF2	Code: HF3	Code: HF4
Provide contextual information about the CAWD	Measure physical dimensions and proportions	Assess the distribution of body tissues, such as fat and lean mass	Relate to energy consumption and metabolic activity
– School – Age – Gender – Disability	– Weight – Height – BMI – Ponderal Index – Waist-Height Ratio (WHtR) – Waist-Hip Ratio (WHR)	– Body Density – Body Fat 1 – Body Fat 2 – Lean Body Mass – Lean Mass Index – Lean Body Weight	– Basal Metabolic Rate (BMR) – Basal Energy Expenditure (BEE) – Resting Metabolic Rate (RMR)

This classification particularly appeals to health practitioners among the stakeholders, as it aligns with their focus on individual health profiles. At this level, the correlational analysis is performed comprehensively for all key health factors, enabling a holistic understanding of their associations with PA levels.

5.2.2 PA Levels and Sleep

Understanding the factors influencing sleep and PA levels, including sedentary, light, and MVPA in different contexts, is critical for promoting healthy lifestyles among CAWD. These factors provide information on different PA levels, with Sleep indicating rest duration, Sedentary capturing low-energy activities, Moderate and Vigorous representing intensities of active movement and MVPA summarising the total time spent in health-promoting activity intensities. MVPA is then distributed in day groups (MVPA Day groups) and days (MVPA Days) inside and outside the school. By analysing sleep duration and PA levels concurrently, the analysis provides a comprehensive understanding of how individual, social, and environmental factors interact to shape PA behavioural patterns. The results aim to inform stakeholders to develop appropriate PA participation strategies to enhance overall health and well-being in this population.

Table 5.2: PA Levels Clusters.

<table>
<tr><td>PA Levels and Sleep</td><td>MVPA Day groups</td><td colspan="2">MVPA Days</td></tr>
<tr><td>PAL1</td><td>PAL2</td><td colspan="2">PAL3</td></tr>
<tr><td>– Sleep
– Sedentary
– Moderate
– Vigorous
– MVPA</td><td>– MVPA
– MVPA-OS
– MVPA-IS
– MVPA-SDOS
– MVPA-SDIS
– MVPA-ADOS
– MVPA-ADIS
– MVPA-WDOS
– MVPA-DSDOS
– MVPA-DADOS
– MVPA-DSDIS
– MVPA-DADIS
– MVPA-DSADOS
– MVPA-DWDOS</td><td>– MVPA
– MVPA-OS
– MVPA-IS
– MVPA-SD1OS
– MVPA-SD1IS
– MVPA-SD2OS
– MVPA-SD2IS
– MVPA-SD3OS
– MVPA-SD3IS</td><td>– MVPA-SD4OS
– MVPA-SD4IS
– MVPA-AD1OS
– MVPA-AD1IS
– MVPA-AD2OS
– MVPA-AD2IS
– MVPA-WD1OS
– MVPA-WD2OS</td></tr>
<tr><td></td><td colspan="3">OS & IS: Outside and Inside the school
SD & AD: School days without and with semi-structured activities
WD: Weekend days
D: Average Daily</td></tr>
</table>

For the statistical analysis presented in this chapter, only the first two clusters were included, as they provide a broader perspective on activity patterns. The third cluster, focusing on daily MVPA, was discussed in focus group discussions with stakeholders and presented in Chapter 6. These discussions aim to compare specific days, such as the beginning, middle, or end of the school week, to derive insights into PA participation trends and challenges.

5.2.3 Socio-Ecological Variables

The PA socio-ecological model underscores the complex interactions between individuals and their environments, recognising that multiple layers of influence shape PA behaviour and well-being. In the context of PA among CAWD, understanding these influences is crucial for promoting PA participation strategies. The Family cluster captures familial factors, such as parental roles and household dynamics, which are key determinants of children's PA. The Disability cluster addresses the specific challenges faced due to varying levels of impairments and PA participation limitations, influencing the capacity and opportunities for PA. The Family Support cluster highlights the importance of adult encouragement, facilitation, and participation in PA, shaping children's engagement and motivation. The PA and PE Engagement clusters explore how children's perceptions, preferences, and behaviours in day-to-day and structured PA contexts, including school-based physical education, impact their overall activity levels. Lastly, the School Support cluster emphasises the role of educational settings in providing awareness, resources, and a supportive environment for PA and physical education, directly influencing children's participation and attitudes. Together, these clusters provide a comprehensive framework for understanding and promoting PA engagement in children with disabilities.

Table 5-3: Socio-Ecological Variables Clusters.

Cluster: Family	Variables	
Code: SEV1	1 Distance to school	11 Father: Alive
Analysis purpose: explore how familial factors, such as parental characteristics, living arrangements, and sibling composition, influence the PA levels of CAWDs.	2 Parental situation	12 Father: Educational level
	3 Living with	13 Father: Working
	4 Mother: Alive	14 Father: Income Level
	5 Mother: Educational level	15 Father: Age
	6 Mother: Working	16 Father: Body shape
	7 Mother: Income level	17 Father: Physical activity
	8 Mother: Age	28 Brothers: Older
	9 Mother: Body shape	29 Brothers: Younger
	10 Mother: Physical activity level	30 Sisters: Older
		31 Sisters: Younger

Cluster: Disability	Variables	
Code: SEV2 Analysis purpose: assess how various health conditions, levels of impairment, and functional difficulties influence the PA levels and participation of CAWDs.	32 Health status 33 Impairment level: Physical 34 Impairment level: Mental 35 Impairment level: Hearing 36 Impairment level: Vision 51 Difficulty walking 100 m with aid 52 Difficulty walking 100 m without aid 53 Difficulty walking 500 m with aid 54 Difficulty walking 500 m without aid	55 Difficulty of being self-dressed 56 Difficulty of being understood at home 57 Difficulty of being understood outside 58 Difficulty of Learning 59 Difficulty of Remembering 60 Difficulty of Concentrating 61 Difficulty of Accepting Changes 62 Difficulty of Controlling Behaviours 63 Difficulty of Making Friends

Cluster: Home Support	Variables	
Code: SEV3 Analysis purpose: evaluate how parental and adult support, encouragement, participation, and facilitation influence the PA levels and participation of CAWDs.	160 Adults encourage child practice at home 161 Adults encourage child practice outside 162 Adults encourage child practice at school 163 Adults watch children practice at home 164 Adults watch children practice outside	165 Parents practice at home 166 Parents practice Outside 167 Parents transport child practice outside 168 Parents transport child practice in sports facility 169 Parents want their child to engage in PA

Cluster: PA Engagement	Variables	
Code: SEV4	170 Child can be active on weekdays	180 Children can ask Adults to practice together at home
Analysis purpose: examine the environmental, social, and motivational factors that facilitate or hinder PA participation for CAWDs, including contextual influences, personal preferences, and recommendations from key stakeholders.	171 Child can be active on weekend days	181 Children can ask Adults to practice together at school
	172 Child can be active at home	182 Children can ask Adults to practice together outside
	173 Child can be active at school	186 Children engage in PA Doctor's recommendation
	174 Child can be active outside	187 Child engage in PA School recommendation
	175 Children can be active in cold weather	188 Children engage in PA Parents' recommendation
	176 Child can be active in hot weather	189 Child engage in PA Friends recommendation
	177 Child can be active on busy days	190 Child engage in PA important exercise regularly
	178 Child prefers PA to watch TV on Weekdays	191 Child not bothered to engage in PA
	179 Child prefers PA to watch TV on Weekend days	

Cluster: PE Engagement	Variables	
Code: SEV5 Analysis purpose: understand how CAWDs experience and participate in PE lessons, focusing on their preparedness, behaviour, motivation, social interactions, and emotional responses to assess factors influencing their engagement and enjoyment of PE and organised PAs	203 Child brings PE kit to school 204 Child gets quickly changed in PE lessons 205 Child gets quickly lined up in PE lessons 206 Child gets quickly ready in PE lessons 207 Children understand instructions in PE lessons 208 Child follow instructions in PE lessons 209 Child feeling motivated during PE lessons 210 Child feeling concentrated during PE lessons 211 Child feeling confident during PE lessons 212 Child feeling neglected during PE lessons 213 Child feeling bullied during PE lessons 214 Child feeling less confident when underperforming during PE lessons	215 Child ask for assistance from PE teacher during PE lessons 216 Child ask for assistance from support staff during PE lessons 217 Child ask for assistance from classmates during PE lessons 218 Child likes participating in PE lessons 219 Child likes engaging in PA 220 Child likes participating in organised activities 221 Child likes participating in self-organised activities 222 Child likes competing 223 Child likes helping peers when needed 224 Child-like teaming-up 225 Child likes playing collectively

Cluster: School Support	Variables	
Code: SEV6	244 Child performs better at school after PE lessons	252 Child awareness extramural activities
Analysis purpose: evaluate how awareness, perceptions, and preferences regarding PE and PA curricula, and extracurricular opportunities influence the engagement and performance of CAWDs in school-based physical activities.	245 Child prefers sports at school rather than outside	253 Child appropriateness view of PE curriculum
	246 Child would like PE to become a core subject	254 Child appropriateness view of PA curriculum
	247 Child Awareness PE curriculum	255 Child appropriateness view of intra-curricular activities
	248 Child Awareness PA curriculum	256 Child appropriateness view of extra-curricular activities
	249 Child awareness intra-curricular activities	257 Child appropriateness view of intramural activities
	250 Child awareness extra-curricular activities	258 Child appropriateness view of extramural activities
	251 Child awareness intramural activities	

The analysis for socio-ecological variables (SEVs) is conducted at the cluster level, with SEVs grouped into distinct categories to facilitate interpretation. However, these clusters may be redefined by stakeholders, depending on their specific investigation needs and priorities. Stakeholders, such as health practitioners for example can compose a cluster of variables including all the child's health factors and the parents' body composition, considered alternative groupings of SEVs that align with their objectives, ensuring the analysis remains relevant and adaptable to different contexts of inquiry.

5.2.4 Variables Analysis

The statistical analysis developed in this chapter explores the relationship between dependent variables (PA levels and sleep duration) and a range of independent variables, including health factors (such as anthropometric measurements, body composition, and metabolic indicators) and socio-ecological variables (SEV). PA levels and sleep are critical indicators of overall health and well-being, especially in CAWD. Health factors including BMI and metabolic health, may influence activity levels and sleep patterns, while SEV factors, including family dynamics, disability-related challenges, and school or community support, provide important contextual influences. By examining these variables, the study aims to identify key predictors of PA and sleep, contributing to a deeper understanding of the factors that affect health outcomes among CAWD.

The analysis of the associations between health factors and socio-ecological variables (SEV) with PA levels and sleep among CAWD is based on considering the contextual groups (School, Gender, Disability, and Age), and using a multi-step analytical strategy including 4 phases: (i) the descriptive analysis summarising and describing the distribution of key variables were presented in the previous chapter (Chapter 4), (ii) the correlational analysis to investigate relationships between PA levels, sleep, health factors, and socio-ecological variables (SEVs), (iii) the general linear modelling including bivariate analysis to identify initial associations between health and SEV factors with PA levels and sleep within each contextual group, using correlations and independent and Chi-Square testing, and multi-variate analysis to examine the influence of multiple health and SEV factors on PA levels and sleep, adjusting for contextual group differences, and (iv) a group analysis of how associations differ across contextual groups, and finally, a model comparison to test the relative importance of health factors versus SEV factors using paired samples T-testing.

5.2.5 Correlational Analysis

The correlation analysis presented in this section was conducted to explore relationships between a substantial number of variables encompassing PA levels, sleep, health factors, and socio-ecological variables. Given the variables' complexity and diversity, the primary objective of this analysis is to provide stakeholders with a comprehensive matrix of correlation coefficients. These coefficients serve as an accessible and systematic summary of the associations between variables, enabling stakeholders to examine and interpret the results based on their specific areas of interest or research priorities.

This approach ensures transparency and supports data-driven decision-making tailored to diverse stakeholder perspectives. Additionally, to facilitate a more granular understanding of the strength and direction of these relationships, the analysis includes a calculation of correlation frequency across predefined correlation value groups (very strong, strong, moderate, weak and very weak). This frequency distribution provides the stakeholders with a clearer perspective on the prevalence and intensity of correlations within specific ranges, offering valuable insights into the data's overall patterns and trends. This dual-level approach enhances the interpretability of the findings, hopefully empowering stakeholders to make data-informed decisions effectively.

5.3 Health Factors vs PA Levels and Sleep

The correlation matrix in Table 5.4 and Figure 5.1 provides insights into the relationships between health factors various PA Levels and sleep. The correlation frequency between variables indicates the following results: Very Strong (n=40, 8.71%), Strong (n=41, 8.93%), Moderate (n=52, 11.33%), Weak (n=109, 23.75%) and Very Weak (n=217, 47.28%).

Table 5.4: Correlation matrix between Health Factors and PA levels and sleep.

All Children | Correlations: Context, PA levels, Sleep and Health Factors | Versus

Correlations	Age	Weight	Height	BMI	Pond Index	WHtR	WHR	B Density	B Fat	B Fat 2	LBM	LMI	LBW	BMR	BEE	RMR
School	-.439**	-0.229	-.524**	0.021	0.162	0.226	.903**	-.634**	.514**	.634**	-.613**	-.527**	-.306*	-.488**	-.427**	-.635**
	0.000	0.071	0.000	0.871	0.204	0.075	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.000	0.000	0.000
Gender	-0.246	-.281*	-.579**	-0.024	0.128	0.178	.992**	-.703**	.613**	.701**	-.669**	-.579**	-.366**	-.548**	-.484**	-.712**
	0.052	0.026	0.000	0.850	0.319	0.162	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000
Disability	0.136	-.303*	-0.066	-.335**	-.324**	-.357**	0.067	0.247	-0.236	-.251*	-0.183	-0.226	-.276*	-.272*	-.257*	-0.233
	0.286	0.016	0.608	0.007	0.010	0.004	0.600	0.051	0.063	0.047	0.152	0.075	0.029	0.031	0.042	0.067
Age Group	.903**	0.204	0.203	0.132	0.079	0.028	-0.224	0.024	0.163	-0.025	.301*	.300*	0.208	.276*	0.243	.272*
	0.000	0.109	0.111	0.302	0.539	0.830	0.078	0.853	0.202	0.844	0.017	0.017	0.101	0.028	0.055	0.031
Sleep	-.284*	-0.108	-0.153	-0.041	0.001	0.041	.386**	-0.235	0.166	0.240	-.278*	-.305*	-0.128	-0.229	-0.194	-.279*
	0.024	0.401	0.230	0.748	0.992	0.750	0.002	0.064	0.194	0.058	0.028	0.015	0.317	0.072	0.127	0.027
Sedentary	-0.100	0.053	-0.170	0.209	.272*	0.243	.311*	-.404**	.378**	.405**	-0.146	-0.054	0.010	-0.072	-0.069	-0.154
	0.435	0.678	0.183	0.101	0.031	0.055	0.013	0.001	0.002	0.001	0.253	0.676	0.940	0.573	0.590	0.229
Light	-.485**	0.032	-.318*	0.231	.322*	.386**	.567**	-.564**	.458**	.568**	-.312*	-0.222	-0.036	-0.170	-0.138	-.291*
	0.000	0.806	0.011	0.069	0.010	0.002	0.000	0.000	0.000	0.000	0.013	0.080	0.777	0.182	0.280	0.021
MVPA	0.034	-0.077	-0.142	-0.024	0.006	-0.024	0.043	-0.035	0.042	0.032	-0.086	-0.024	-0.099	-0.079	-0.099	-0.094
	0.791	0.550	0.267	0.851	0.960	0.850	0.739	0.786	0.746	0.800	0.503	0.853	0.438	0.540	0.438	0.466
MVPA-OS	0.226	-0.150	-0.108	-0.136	-0.118	-0.151	-0.057	0.098	-0.053	-0.102	-0.073	-0.029	-0.158	-0.106	-0.140	-0.091
	0.074	0.239	0.400	0.287	0.356	0.236	0.658	0.446	0.681	0.428	0.569	0.822	0.215	0.410	0.272	0.477
MVPA-IS	-.270*	0.064	-0.139	0.155	0.193	0.177	0.177	-0.222	0.168	0.223	-0.072	-0.007	0.028	-0.008	0.001	-0.061
	0.032	0.617	0.276	0.225	0.130	0.164	0.165	0.080	0.187	0.079	0.574	0.957	0.829	0.952	0.995	0.633
MVPA-SDOS	0.226	-0.150	-0.108	-0.136	-0.118	-0.151	-0.057	0.098	-0.053	-0.102	-0.073	-0.029	-0.158	-0.106	-0.140	-0.091
	0.074	0.239	0.400	0.287	0.356	0.236	0.658	0.446	0.681	0.428	0.569	0.822	0.215	0.410	0.272	0.477
MVPA-SDIS	-0.215	-0.045	-0.185	0.040	0.087	0.051	0.246	-0.204	0.153	0.203	-0.156	-0.104	-0.076	-0.121	-0.102	-0.170

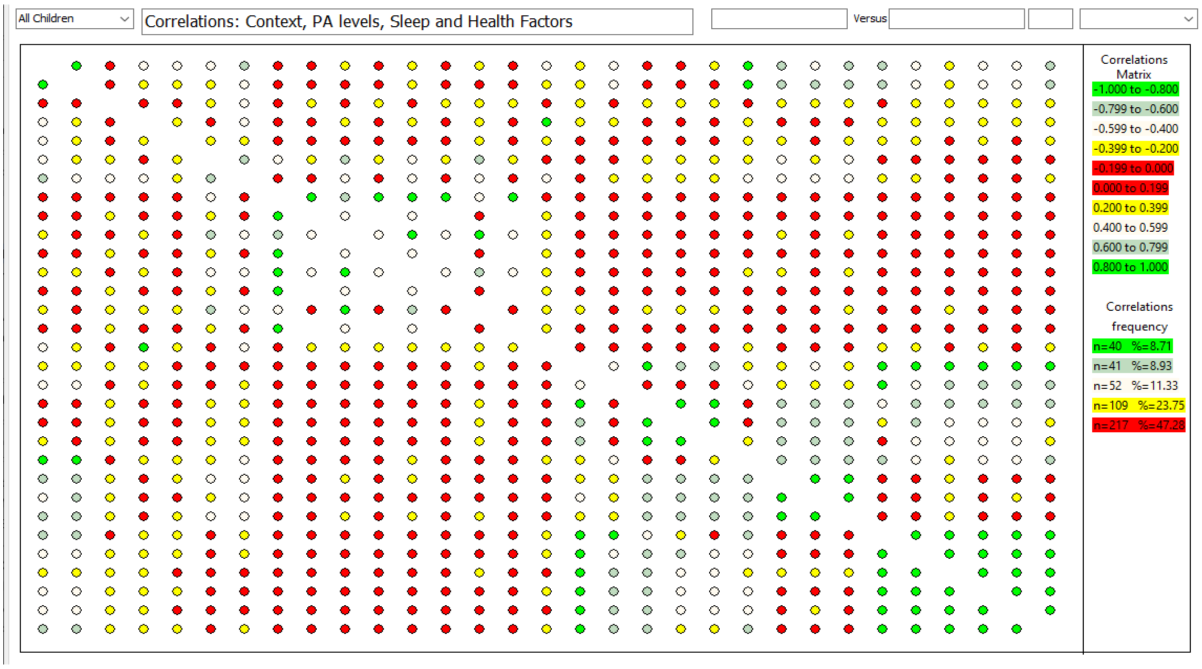

Figure 5.1: Correlation matrix between Health Factors and PA levels and sleep.

5.3.1 Interpretation

The correlation frequency analysis revealed the strength of relationships between the variables. The results indicated that the majority of correlations fall into the Very Weak category (47.28%), suggesting limited linear associations between most variable pairs. This was followed by Weak correlations (23.75%), which also reflected modest relationships. In contrast, Moderate correlations accounted for 11.33%, showing a smaller but meaningful proportion of variable pairs with moderate linear associations. Stronger correlations were less frequent, with Strong correlations at 8.93% and Very Strong correlations at 8.719%. These findings highlighted that while some variable pairs exhibit strong linear relationships, most associations were weak or very weak, underscoring the diversity and complexity of interactions within the dataset. This correlation distribution provided valuable insight into which relationships warrant closer attention for further exploration or targeted interventions.

a) Age Correlations

There was a negative moderate correlation with Light activity ($r = -0.485$, $p < 0.001$) (as age increases, light activity decreases significantly) and a low negative correlation with MVPA-IS ($r = -0.270$, $p < 0.05$), MVPA-ADIS ($r = -0.298$, $p < 0.05$), and Sleep ($r = -0.284$, $p < 0.05$). In contrast, there were no significant correlations with MVPA overall, sedentary behaviour, or other MVPA subcategories. Older CAWD tended to have less in-school MVPA, after-school MVPA, and sleep.

b) MVPA and Related Sub-Categories

MVPA showed strong positive correlations with all its subcategories, such as MVPA-OS ($r = 0.903$, $p < 0.001$) and MVPA-WDOS ($r = 0.903$, $p < 0.001$), confirming consistent relationships between the overall and specific measures of MVPA. Comparatively, MVPA had a moderate positive correlation with Sedentary behaviour ($r = 0.494$, $p < 0.001$), suggesting participants who engaged in higher MVPA levels might also exhibit higher sedentary behaviour during other periods. In contrast, MVPA showed no significant correlation with Sleep or Light activity.

c) Sleep Correlations

Sleep was positively correlated with Light activity ($r = 0.329$, $p = 0.009$), indicating that participants with higher light activity levels tended to have slightly better sleep. However, no significant relationships were observed between Sleep and MVPA or Sedentary behaviour.

d) Sedentary Behaviour Correlations

Sedentary behaviour was positively correlated with MVPA ($r = 0.494$, $p < 0.001$) and its subcategories, such as MVPA-SDIS ($r = 0.557$, $p < 0.001$), Light activity ($r = 0.675$, $p < 0.001$), suggesting that individuals with more sedentary time might also have more light activity periods. In contrast, no significant relationship was observed between Sedentary behaviour and Age or Sleep.

e) **Light Activity Correlations**

Light activity was positively correlated with Sleep ($r = 0.329$, $p = 0.009$), indicating a potential beneficial link between light activity and better sleep, and with Sedentary behaviour ($r = 0.675$, $p < 0.001$), suggesting a coexistence of both light and sedentary behaviours in participants.
In contrast, Light activity was negatively correlated with Age ($r = -0.485$, $p < 0.001$), indicating older participants engaged in less light activity.

5.3.2 Observations

Age was inversely associated with MVPA-IS, MVPA-ADOS, Sleep, and Light activity, indicating declining physical activity and sleep with age. MVPA was strongly correlated with its subcategories but not with Sleep or Light activity, while positively associated with Sedentary behaviour. Light activity was positively associated with better sleep and sedentary behaviour, but it decreased with age. Sleep was weakly but positively associated with Light activity.

These results suggest intricate interrelationships between PA levels and sleep across different age groups, emphasising the multifaceted nature of these behaviours. The observed positive correlations between MVPA, sedentary time, and light activity were unexpected and warrant further investigation. These relationships could be influenced by underlying behavioural patterns, measurement considerations, or contextual factors such as school schedules, environmental constraints, and individual differences in movement patterns.

Interestingly, sleep exhibited fewer significant correlations with PA levels than initially anticipated. This could indicate a more complex and indirect relationship, where factors such as sleep quality, circadian rhythms, or individual lifestyle habits mediate the connection between sleep and PA. It is also possible that variations in PA behaviour across different days of the week, or differences in how children with disabilities regulate their activity and rest cycles, contribute to this lack of strong associations.

Age appeared to play a significant role, particularly showing a negative relationship with light activity and certain MVPA measures. This aligns with existing literature suggesting that as children grow older, they tend to engage in less unstructured movement and spontaneous play, shifting towards more sedentary behaviours due to academic pressures, social changes, or limited opportunities for structured PA. The decline in light activity with age could also reflect shifts in daily routines, where older children might transition toward more structured exercise patterns or reduced overall movement due to external commitments.

These findings reinforce the well-documented trend of age-related declines in PA and provide insight into the nuanced interplay between different activity intensities, sedentary behaviour, and sleep. Further analysis is needed to explore potential causal mechanisms, examine subgroup-specific variations, and determine whether certain socio-ecological factors mediate these relationships. A deeper understanding of these dynamics could inform tailored interventions to support PA engagement and sleep health among children and adolescents with disabilities.

5.4 Socio-Ecological Variables

The correlation matrix in Table 5.5 and Figure 5.2 provides insights into the relationships between socio-ecological variables (SEV1: Family) and various PA Levels and sleep. The correlation frequency between variables indicated the following results: Very Strong (n=24, 4.92%), Strong (n=15, 3.07%), Moderate (n=20, 4.10%), Weak (n=125, 25.61%) and Very Weak (n=304, 62.30%).

Table 5.5: Correlation matrix between SEV and PA levels and sleep.

All Children

Correlations: Context, PA Levels and Sleep and Socio-Ecological Factors

Versus

	School	Gender	Disability	Age Group	Sleep	Sedentary	Light	MVPA	MVPA-OS	MVPA-IS	MVPA-SDOS	MVPA-SDIS	MVPA-ADOS	MVPA-ADIS	MVPA-WDO:	Distance to
School	1.000	.893**	0.000	-.484**	.445**	.474**	.606**	0.217	-0.082	.400**	-0.082	.454**	-0.082	.295*	-0.082	-.422**
		0.000	1.000	0.000	0.000	0.000	0.000	0.088	0.523	0.001	0.523	0.000	0.523	0.019	0.523	0.001
Gender	.893**	1.000	0.086	-0.233	.399**	.291*	.379**	0.103	-0.071	0.182	-0.071	.290*	-0.071	-0.018	-0.071	-.397**
	0.000		0.502	0.066	0.001	0.021	0.002	0.420	0.581	0.153	0.581	0.021	0.581	0.886	0.581	0.001
Disability	0.000	0.086	1.000	0.108	-0.076	-.348**	-.392**	-0.077	0.079	-0.105	0.079	-0.096	0.079	-.306*	0.079	0.021
	1.000	0.502		0.400	0.553	0.005	0.001	0.548	0.539	0.412	0.539	0.453	0.539	0.015	0.539	0.872
Age Group	-.484**	-0.233	0.108	1.000	-.364**	-0.183	-.371**	-0.130	0.105	-.290*	0.105	-.260*	0.105	-.344**	0.105	0.179
	0.000	0.066	0.400		0.003	0.152	0.003	0.310	0.413	0.021	0.413	0.039	0.413	0.006	0.413	0.161
Sleep	.445**	.399**	-0.076	-.364**	1.000	0.086	0.162	-0.032	-0.157	0.055	-0.157	0.016	-0.157	0.171	-0.157	-0.195
	0.000	0.001	0.553	0.003		0.504	0.203	0.805	0.218	0.670	0.218	0.900	0.218	0.181	0.218	0.125
Sedentary	.474**	.291*	-.348**	-0.183	0.086	1.000	.808**	.530**	.284*	.600**	.284*	.628**	.284*	.593**	.284*	-.289*
	0.000	0.021	0.005	0.152	0.504		0.000	0.000	0.024	0.000	0.024	0.000	0.024	0.000	0.024	0.022
Light	.606**	.379**	-.392**	-.371**	0.162	.808**	1.000	.738**	.448**	.781**	.448**	.781**	.448**	.724**	.448**	-.261*
	0.000	0.002	0.001	0.003	0.203	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.039
MVPA	0.217	0.103	-0.077	-0.130	-0.032	.530**	.738**	1.000	.854**	.844**	.854**	.839**	.854**	.639**	.854**	-0.106
	0.088	0.420	0.548	0.310	0.805	0.000	0.000		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.406
MVPA-OS	-0.082	-0.071	0.079	0.105	-0.157	.284*	.448**	.854**	1.000	.509**	1.000**	.539**	1.000**	.280*	1.000**	0.031
	0.523	0.581	0.539	0.413	0.218	0.024	0.000	0.000		0.000		0.000		0.026		0.812
MVPA-IS	.400**	0.182	-0.105	-.290*	0.055	.600**	.781**	.844**	.509**	1.000	.509**	.960**	.509**	.821**	.509**	-0.210
	0.001	0.153	0.412	0.021	0.670	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.000	0.098
MVPA-SDOS	-0.082	-0.071	0.079	0.105	-0.157	.284*	.448**	.854**	1.000**	.509**	1.000	.539**	1.000**	.280*	1.000**	0.031
	0.523	0.581	0.539	0.413	0.218	0.024	0.000	0.000		0.000		0.000		0.026		0.812
MVPA-SDIS	.454**	.290*	-0.096	-.260*	0.016	.628**	.781**	.839**	.539**	.960**	.539**	1.000	.539**	.690**	.539**	-.255*

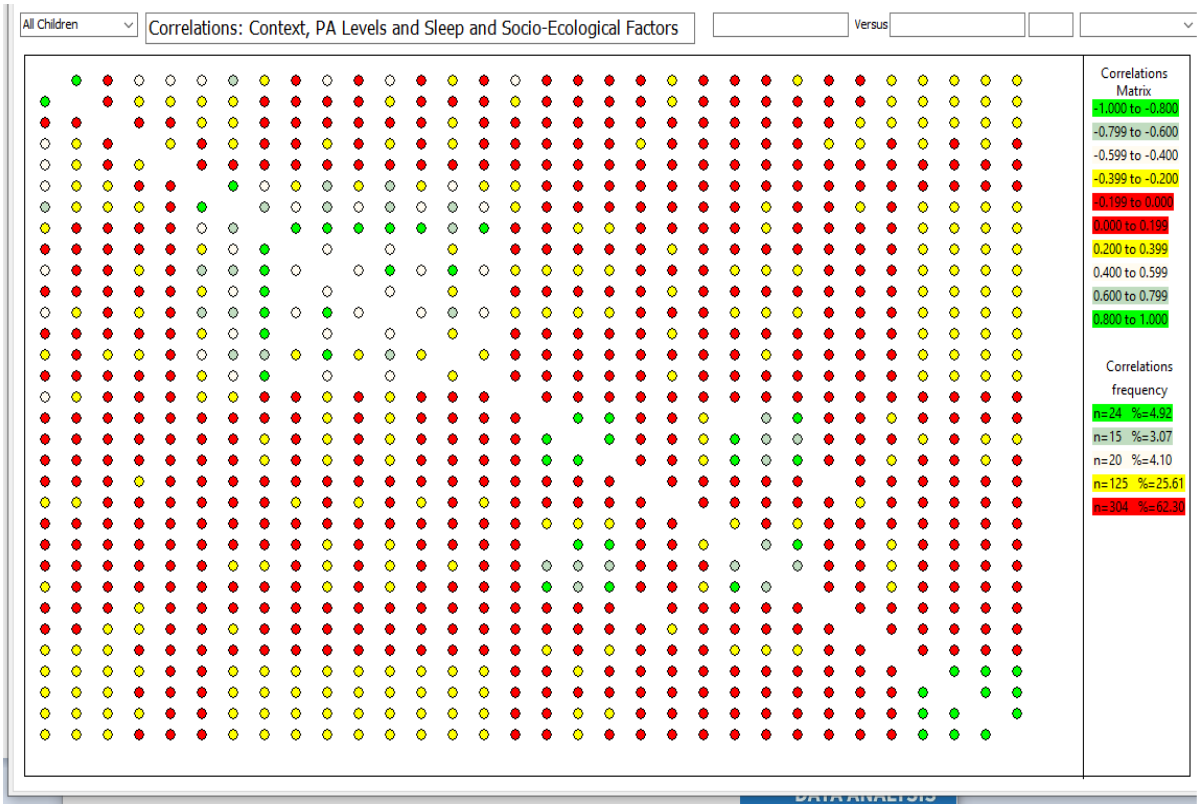

Figure 5.2: Correlation matrix between SEV and PA levels and sleep.

This study's correlational analysis involved a large number of variables grouped into clusters. While detailed interpretations focused on PA levels, the primary objective was to illustrate the interpretation process and highlight key observations. A comprehensive interpretation of the results was presented to stakeholders during focus group discussions to explore barriers, challenges, and facilitators to CAWD PA participation, considering the associations among variables of interest. Additionally, a global analysis of the frequency of correlation intervals (very strong, strong, moderate, weak, and very weak) across the different clusters of variables was performed to provide an overall trend of associations between PA levels and health factors and socio-ecological variables.

5.5 Global Correlation Analysis

5.5.1 Analysis

The global correlation analysis results highlighted in Table 5.6, revealed key insights into the strength of associations between PA levels, sleep, health factors, and socio-ecological variables (SEV).

Table 5.6: Global correlation analysis.

Correlation Coefficient	±1.000 to ±0.800		±0.799 to ±0.600		±0.599 to ±0.400		±0.399 to ±0.200		±0.199 to 0.000	
Strength	Very Strong		Strong		Moderate		Weak		Very Weak	
Number and %	n	%	n	%	n	%	N	%	n	%
PA Levels	43	9.43%	35	7.68%	84	18.42%	256	56.14%	38	8.33%
Heath Factors	40	8.71%	41	8.93%	52	11.33%	109	23.75%	217	47.28%
SEV1: Family	17	3.48%	14	2.87%	24	4.92%	115	23.57%	318	65.16%
SEV2: Disability	11	4.89%	9	4.00%	20	8.89%	38	16.89%	147	65.33%
SEV3: Family Support	33	6.09%	26	4.80%	65	11.99%	233	42.99%	185	34.13%
SEV4: PA Engagement	21	3.32%	18	2.84%	39	6.16%	117	18.48%	438	69.19%
SEV5: PE Engagement	31	3.48%	27	3.03%	59	6.61%	210	23.54%	565	63.34%
SEV6: School Support	25	4.17%	20	3.34%	44	7.35%	183	30.55%	327	54.59%
Total	221	5.15%	190	4.42%	387	9.01%	1261	29.37%	2235	52.05%

a) Health Factors (All Clusters grouped):

The analysis showed the highest proportion of strong and very strong correlations (8.71% and 8.93%, respectively), indicating that health factors have a notable influence on PA levels and sleep compared to other variable clusters. However, nearly half of the correlations (47.28%) were very weak, suggesting variability in the strength of associations within this cluster.

b) Family (SEV1):

The correlations were predominantly very weak (65.16%), with only a small percentage being strong (2.87%) or very strong (3.48%). This implies that family-related variables generally had weaker relationships with PA levels and sleep.

c) Disability (SEV2):

Similarly, the majority of correlations were very weak (65.33%). Strong and very strong correlations account for 4.00% and 4.89%, respectively, indicating some significant but limited relationships between disability-related factors and PA or sleep.

d) Family Support (SEV3):

Correlations in this cluster were more evenly distributed, with 11.99% moderate and 42.99% weak correlations. This suggests that family support had a more consistent, albeit weaker, influence on PA levels and sleep.

e) PA Engagement (SEV4):

The distribution of correlations within the PA engagement variables was notably skewed, with the majority (69.19%) classified as very weak, while only a small fraction (3.32%) exhibited very strong correlations. This indicates that although PA engagement factors are linked to PA levels and sleep, the strength of these associations is generally limited, suggesting that other influencing variables may play a more dominant role in shaping these behaviours.

f) PE Engagement (SEV5)

The correlation patterns for PE engagement followed a similar trend to PA engagement, with a majority (63.34%) falling within the very weak range. However, this cluster demonstrated a slightly higher proportion of moderate correlations (6.61%), suggesting that certain PE-related factors may have a more meaningful impact on PA behaviour and sleep. This highlights the potential influence of structured PE programs in shaping activity levels.

g) School Support (SEV6)

The school support cluster exhibited a more balanced distribution of correlation strengths, with 30.55% classified as weak and 7.35% as moderate. While the majority of associations remain on the weaker side, the presence of a notable proportion of moderate correlations suggests that school-related factors such as policies, teacher support, and facility access may play a role in shaping PA engagement and related behaviours, warranting further exploration.

5.5.2 Overall Trends and Interpretation

Across all variable clusters, most correlations were very weak (57.24%), followed by weak (26.19%). Very strong correlations were the least frequent (4.64%), emphasising that while there are key variables with strong relationships to PA and sleep, the majority were less influential. The dominance of very weak and weak correlations across clusters suggests that many of the measured variables have limited relationships with PA levels and sleep. Health factors stand out as the most consistently impactful group, with the highest proportion of strong and very strong correlations. Socio-ecological variables (SEV clusters) show more mixed results, with school support, family support, and PE engagement offering some moderately significant relationships.

The global correlation analysis reports an average of 18.58 % of very strong, strong and moderate correlation for all the variable groups indicating a general weakness in relationships (81.42% are weak or very weak) and suggesting limited or minor associations. However, there might have been meaningful associations in a subset of variable groupings due to the heterogeneity of the variable groups in their relationships, and some variables such as health factors (body composition) may play a more significant role in influencing others, while many are largely independent. The overall pattern suggests that the relationships between PA levels, sleep, health factors, and SEV variables in this sample are generally weak. There is potential for further investigation as most correlations are weak. The "Moderate" and "Strong" correlations identified for certain Health Factors and SEV variables (particularly SEV4 and SEV5) require further investigation to understand the nature and implications of these relationships.

5.5.3 Implications for Stakeholders

Stakeholders should prioritise health factors, such as body composition, and metabolic rates, for targeted interventions to improve PA levels and sleep. Within SEV clusters, school and family support appeared to have more actionable relationships that could inform program designs. The identification of very strong and strong correlations within clusters can guide efforts to focus on the most impactful variables to make change while focusing less on those with very weak correlations.

5.5.4 Group-level MVPA Association with Health Factors and SEV

Quantifying the strength and direction of the relationship between health factors and SEV variables with PA levels and sleep using linear regression provides coefficients that indicate how much a change in independent variables influences the dependent variables. Predicting PA levels and sleep based on key predictors, such as health status, family support, or school environment, can help stakeholders identify the most influential factors affecting PA and sleep behaviours.

This section explores the group-level associations of global MVPA with health factors and socio-ecological variables (SEVs) employing bivariate analysis. While MVPA is subsequently examined across various patterns—daily, inside and outside school, school days with and without semi-structured activities, and school vs. weekend days—this analysis specifically emphasises global MVPA. The detailed investigation of other MVPA patterns, such as day-specific comparisons (e.g., beginning, middle, or end of the school week), is reserved for stakeholder discussions to address tailored objectives and intervention strategies. This analytical approach provides a foundational understanding of broad trends while leaving room for stakeholder-driven refinements.

5.5.5 MVPA vs Health Factors

The analysis is reported in Table 5.7 and Table 5.8, showing the results of a multiple linear regression analysis of the dependent variable MVPA. The model includes various predictors including context variables (school, gender, disability and age group), and health factors (weight, height, BMI, and others).

Table 5.7: Model Summary of MVPA Association with Health Factors (Global).

Model Summary[b]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.375[a]	.140	-.184	96.746	.140	.432	17	45	.969

a. Predictors: (Constant), RMR, B Fat, Age, Disability, Height, School, Age Group, WHtR, LMI, Gender, Pond Index, Weight, WHR, LBM, B Density, LBW, BMI

b. Dependent Variable: MVPA

a) Global interpretation

The R-value of 0.375 indicates the strength of the linear relationship between the predictors (listed in the table) and the dependent variable MVPA, suggesting a moderate, but not strong, correlation. The coefficient of determination R^2 value of 0.140 means that only 14% of the variance in MVPA was explained by the predictors in the model, suggesting that other factors, not included in this model such as parents' body composition, may influence MVPA. The adjusted R^2 value of -0.184 accounts for the number of predictors indicating that the model may not be a good fit. In addition, the p-value of 0.969 indicated that the predictors do not significantly improve the model, suggesting that the relationship between the predictors and MVPA is not statistically significant. Overall, this model had limited predictive power, explaining only a small portion of the variance in MVPA, and indicating the need for additional variables from SEV clusters or fitness factors to better understand what influences MVPA levels.

b) Variables Group Interpretation

Independent variables were grouped in a cluster of significant variables to investigate complex interactions of groups or multi-influences. However, the resulting direction and significance of the influence on the dependent variable, considering whether the independent variable was analysed singly or as part of a group, might have been compromised by possible opposite directions and significances of individual independent variables, as illustrated in the following examples (Figures 5.3 and 5.4) that highlights different directions and significances of the variables body fat and body density on the Light intensity PA level.

Table 5.8: Model Summary of MVPA Association with Health Factors (Variables).

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	95.0% Confidence Interval for B Upper Bound
1	(Constant)	2573.159	24131.347		.107	.916	-46060.375	51206.693
	School	59.478	36.164	.777	1.645	.107	-13.405	132.362
	Gender	-274.346	424.383	-1.551	-.646	.521	-1129.633	580.941
	Disability	5.299	31.378	.030	.169	.867	-57.939	68.536
	Age Group	18.031	54.647	.131	.330	.743	-92.104	128.165
	Sleep	-.005	.024	-.036	-.215	.831	-.054	.043
	Age	5.408	50.970	.107	.106	.916	-97.315	108.132
	Weight	-33.134	53.344	-5.929	-.621	.538	-140.642	74.375
	Height	-15.317	17.411	-1.896	-.880	.384	-50.407	19.774
	BMI	119.148	199.296	7.246	.598	.553	-282.508	520.803
	Pond Index	-136.928	186.896	-5.364	-.733	.468	-513.593	239.737
	WHtR	-1453.475	1530.933	-1.314	-.949	.348	-4538.867	1631.918
	WHR	295.179	571.524	1.353	.516	.608	-856.652	1447.010
	B Density	-629.998	21956.929	-.141	-.029	.977	-44881.281	43621.285
	B Fat	3.013	49.411	.288	.061	.952	-96.568	102.594
	LBM	-21.710	45.269	-2.699	-.480	.634	-112.943	69.524
	LMI	18.925	90.746	.634	.209	.836	-163.962	201.813
	LBW	41.409	69.360	4.286	.597	.554	-98.377	181.194
	RMR	.941	1.218	3.078	.772	.444	-1.514	3.395

a. Dependent Variable: MVPA

- School (B= 59.478, p =.107): Positive relationship between the school variable and MVPA, but the result is not statistically significant ($p > .05$).
- Gender (B= -274.346, p = .521): A negative coefficient indicates that being of a specific gender might reduce MVPA. However, this result is also not statistically significant.
- Disability (B = 5.299, p = .867): Minimal positive effect, not significant.
- Sleep (B= -0.005, p =.831): Very weak negative relationship, no statistical significance.
- BMI (B = 119.148, p = .553): A positive relationship with MVPA, but not statistically significant.
- WHR (B = 295.179, p = .516): Positive coefficient, but no statistical significance.
- Weight, Height, WHtR, and other anthropometric measurements: None of these variables showed significant p-values, indicating that they do not independently explain a significant amount of variance in MVPA.
- RMR (B = 0.941, p = .444): Small coefficient and not statistically significant.

The analysis highlights the following significant CAWD MVPA predictors:

- **School:** Attending school was associated with a positive increase in MVPA.
- **WHR:** Waist-to-hip ratio had a negative association with MVPA, suggesting that higher WHR was associated with lower MVPA levels.
- **LBM:** Lean body mass showed a positive association with MVPA.
- **RMR:** Resting metabolic rate showed a positive association with MVPA.

However, non-significant predictors include most of the other predictors, such as gender, age, weight, height, BMI, and body fat percentage, which were not statistically significant in predicting MVPA in this model. Overall, none of the independent variables in the model showed a statistically significant relationship with MVPA at the .05 level. The model's predictive power appears weak ($R^2 = .141$), which suggests the variables included do not adequately explain the variations in MVPA, requiring a systemic analysis of the combinations of the different variables including additional SEV from other clusters.

c) Individual variable association interpretation

Assessing the association between health factors, SEVs, and PA levels is essential for understanding both their collective impact and individual contributions to the CAWDs' PA behaviours. A comprehensive, multi-level approach enables researchers and stakeholders to discern the broader systemic patterns that shape PA engagement while also identifying key predictors at an individual level. This group-level analysis presented above underscores the combined explanatory power of various health and SEV-related factors, offering a holistic perspective on how these variables interact and collectively influence PA levels. This approach helps identify overarching trends and shared characteristics within subgroups, facilitating the development of targeted interventions and policies. Conversely, the individual-level analysis, outlined below, isolates the specific impact of each predictor, providing a more nuanced understanding of the relative importance of different variables. This detailed examination enables stakeholders such as educators, healthcare providers, and policymakers to refine strategies that address unique barriers and facilitators of PA participation for children and adolescents with disabilities.

By integrating both analytical approaches, researchers can bridge the gap between broad policy recommendations and individualized intervention strategies. This dual perspective enhances the ability to tailor programs that effectively promote PA engagement while accounting for the diverse needs of different populations.

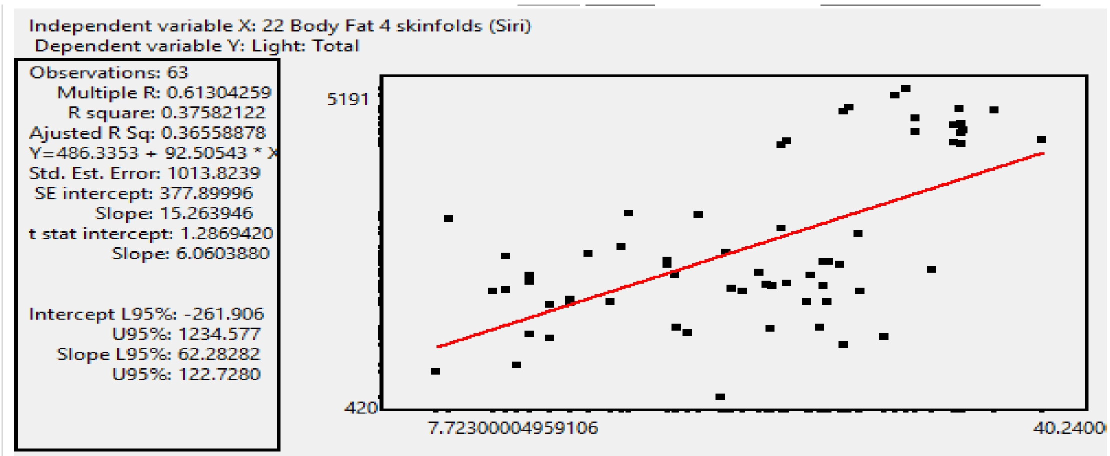

Figure 5.3: Single linear regression Light PA level vs Body Fat.

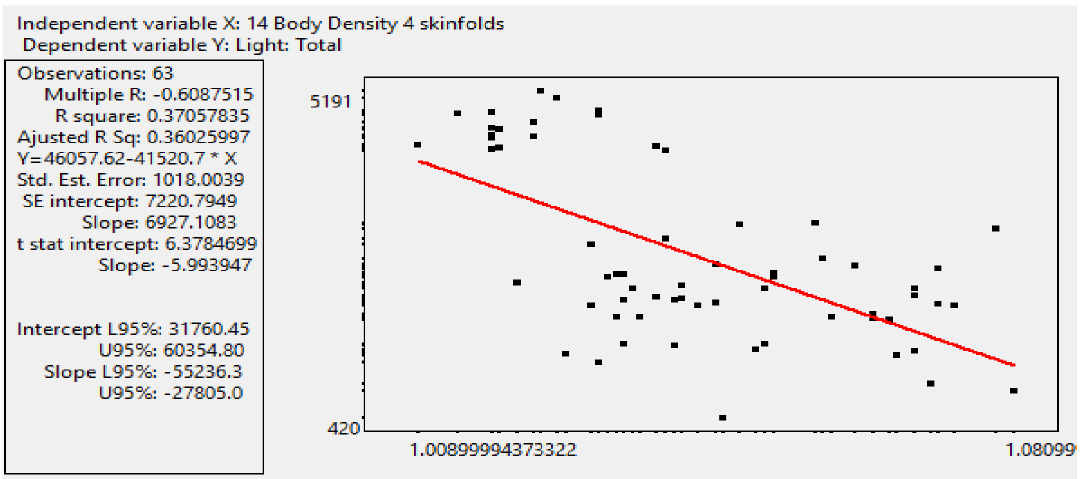

Figure 5.4: Single linear regression Light PA level vs Body Density.

These results suggest that approximately 38% and 37% of the variation in "Light" PA level can be explained by the variation in body fat (R-squared=0.3758) and body density (R-squared=0.3706).

d) **MVPA Inside and Outside School Associations with Health Factors and SEVs**

The model identifies several significant predictors; however, the overall fit remains relatively weak, as indicated by a low R-square value of .140 and a negative Adjusted R-square of -0.183. These values suggest that while some variables contribute to explaining variations in global MVPA levels, a substantial proportion of the variance remains unexplained. Figure 5.5 illustrates the residual results for the global MVPA variables (MVPA, MVPA-OS, and MVPA-IS) within the regression analysis framework.

This predictive model employed standardized residuals to quantify the difference between observed and predicted values, ensuring that residuals were assessed for normality. Examining these residuals is critical in regression analysis, as normally distributed residuals indicate a well-fitting model, while deviations from normality may suggest violations of key regression assumptions.

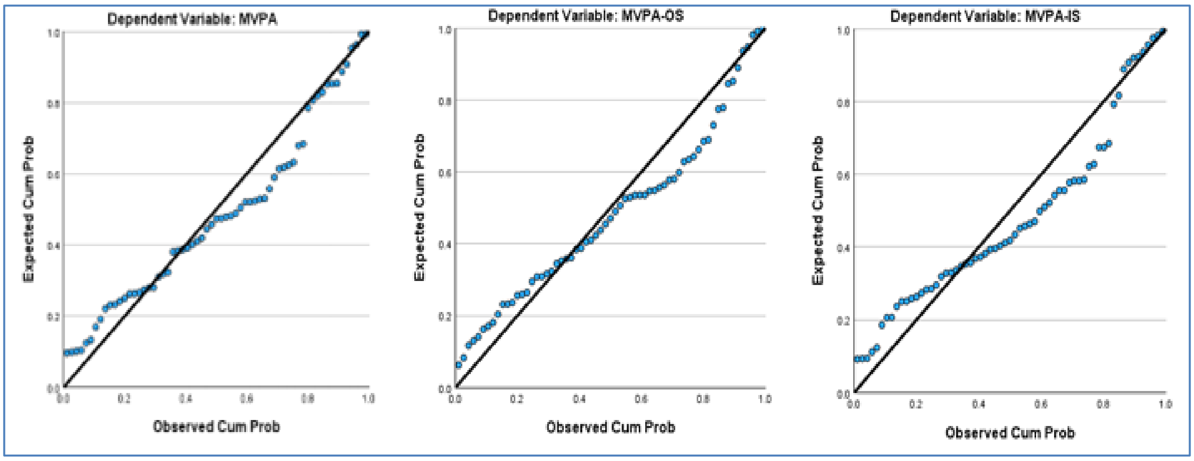

Figure 5.5: Normal probability of residual for the global MVPA variables.

Upon analysing the probability plots, it becomes evident that the data points deviate from the expected diagonal line, particularly at the tails of the distribution. This deviation suggests that the residuals are not perfectly normally distributed. Specifically, the presence of heavier tails in the distribution indicates a higher frequency of extreme residual values than what would typically be expected in a normal distribution. Such deviations may result from underlying factors not accounted for in the model, data heterogeneity, or the presence of influential outliers.

The non-normality of residuals may have implications for the model's predictive reliability, as it can impact the validity of statistical inferences derived from the regression analysis. In cases where normality assumptions are violated, alternative approaches, such as transformation of variables, robust regression techniques, or non-parametric methods, may be necessary to enhance model performance. Additionally, incorporating interaction effects or additional covariates that capture unexplained variance could potentially improve the model's overall explanatory power.

5.5.6 MVPA vs SEV

Table 5.9 presents the results and summary of the linear regression analysis of MVPA with the SE variables.

Table 5.9: MVPA vs SEVs.

SEV1: Family

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.473[a]	.223	-.094	92.985	.223	.704	18	44	.789

a. Predictors: (Constant), Sisters: Younger, Father: Working, Father: Body Shape, Distance to school, Mother: Physical activity level, Father: Age, Father: Physical activity, Mother: Body shape, Age Group, Disability, Gender, Mother: Income level, Brothers: Older, Sisters: Older, Brothers: Younger, Father: Income Level, Mother: Working, School

b. Dependent Variable: MVPA

SEV2: Disability

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.365[a]	.133	-.075	92.168	.133	.639	12	50	.798

a. Predictors: (Constant), Dif Making Friends, Disability, Health status, School, Dif Controlling Behaviours, Dif Concentrating, Dif Accepting Changes, Dif Remembering, Age Group, Imp level: Hearing, Imp level: Mental, Gender

SEV3: Family Support

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.666[a]	.443	.114	83.656	.443	1.348	23	39	.201

a. Predictors: (Constant), CNBoth Eng PA, Active WeekD, Disability, PPA to TV WeekD, Active Home, Active School, Age Group, AAPT School, AAPT Outside, Active Busy D, CEPA Par Rec, CEPA Doc Rec, Gender, Active Outside, CEPA Exer Reg, Active Hot W, PPA T0 TV WEndD, CEPA Sch Rec, AAPT Home, Active WEndD, CEPA Fr Rec, Active Cold W, School

SEV4: PA Engagement

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.666[a]	.443	.114	83.656	.443	1.348	23	39	.201

a. Predictors: (Constant), CNBoth Eng PA, Active WeekD, Disability, PPA to TV WeekD, Active Home, Active School, Age Group, AAPT School, AAPT Outside, Active Busy D, CEPA Par Rec, CEPA Doc Rec, Gender, Active Outside, CEPA Exer Reg, Active Hot W, PPA T0 TV WEndD, CEPA Sch Rec, AAPT Home, Active WEndD, CEPA Fr Rec, Active Cold W, School

SEV5: PE Engagement

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.669[a]	.447	.021	87.978	.447	1.048	27	35	.443

a. Predictors: (Constant), Play Collectively, Quickly Changed, Team-Up, Disability, Quicly Lined-up, Concentrated, Confident, Engage PE, Motivated, Get Ready, Particiapate S-OA, Compete, Participate PA, Feel Neglected, PE Kit, Age Group, Feel Bullied, Assist SSS, Help Peers, Particiapate OA, Underst, Instr,, Assist Mates, Assist PET, Underperforming, Follow Instr, Gender, School

SEV6: School Support

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.568[a]	.322	.023	87.866	.322	1.077	19	43	.405

a. Predictors: (Constant), Appr EA, Age Group, Aware EA, Aware ICA i, Aware PA Curric, Appr ECA, Aware IA, CP PE School, PE Core Subject, CPBS PE, Aware PE Curric, Appr PE curric., Aware ECA, Gender, Disability, Appr PA curric, Appr IA, Appr ICA, School

Cluster	R	R Square	Adjusted R Square	MVPA Variance explained
SEV1: Family	.473[a]	0.223	-0.094	22.35%
SEV2: Disability	.365[a]	0.133	-0.075	13.31%
SEV3: Family Support	.517[a]	0.268	0.073	26.76%
SEV4: PA Engagement	.666[a]	0.443	0.114	44.29%
SEV5: PE Engagement	.669[a]	0.447	0.021	44.71%
SEV6: School Support	.568[a]	0.322	0.023	32.24%

These results indicate that clusters related to PA Engagement (SEV4) and PE Engagement (SEV5) were the most effective in predicting MVPA. Family Support (SEV3) also showed moderate predictive power. However, the models based on Family, Disability, and School Support appeared to have limited predictive ability, suggesting more investigation to detect statistically significant associations. This investigation includes examining additional variables from the school support data or additional factors to include in the SEVs review in the context of the longitudinal study design. While this study focused on assessing the association of MVPA with Health Factors and SEVs, other MVPA patterns and physical activity levels, including sedentary and light activity, will be explored in stakeholder focus group discussions (FGDs). These FGDs, presented in the next chapter, will specifically investigate barriers, challenges, and facilitators to PA participation among CAWD, providing a comprehensive qualitative perspective to complement the quantitative findings.

5.6 Group Factors Association Analysis

This section includes a group comparison (schools, gender, disability and age) to analyse differences between groups regarding (i) MVPA regarding meeting guidelines, (ii) MVPA inside and outside the school, (iii) MVPA across different days groups (school days without semi-structured activities, school days with semi-structured activities and weekend days), and (iv) sleep times and PA levels (Sedentary, light and MVPA).

5.7 MVPA Regarding Meeting Guidelines

This analysis compares groups based on whether participants meet the recommended MVPA guidelines (e.g., 120 to 180 minutes/week) as recommended by the WHO (2022).

Table 5.10: Meeting PA Guidelines Index frequency table per population group.

Population Group		Meeting PA Guidelines Index 0 (<60)	1 (<120)	2 (<180)	3 (<240)	4 (>239)	Meeting PA Guideline	Total
Schools	S1	8	3	4	1	1	6	17
	S2	3	5	0	1	3	4	12
	S3	8	4	1	0	4	5	17
	S4	0	8	8	1	0	9	17
Gender	B	11	8	4	2	4	10	29
	G	8	12	9	1	4	14	34
Disability	LID	8	11	12	2	1	15	34
	MHI	11	9	1	1	7	9	29
Age	12-14	5	11	8	2	1	11	27
	15-17	11	7	5	1	6	12	30
	18-21	3	2	0	0	1	1	6
Total		19	20	13	3	8	24	63
%		30.16	31.75	20.63	4.76	12.70	38.10	100.00

5.7.1 Meeting PA Guidelines

This analysis compares the proportions of participants meeting PA guideline categories (<60, <120, <180, < 240 and >239 minutes of MVPA) across groups (schools, gender, disability type, and age). The Chi-Square Test with the likelihood ratio was used with the null hypothesis which states that the proportion meeting guidelines was the same across groups. In addition, the Fisher-Freeman-Halton Exact Test was used when the Chi-Square assumptions was unmet. This helps avoid Type I errors (false positives). It is more appropriate when 20% or more of cells have expected counts below 5 (Alolayan and Alsubhi, 2024).

Table 5.11: Statistical association of population groups versus meeting PA Guidelines Index.

Group	Test conducted	DoF	Value	Significance p-value Asympt.	Exact	Expected count less than 5		Minimum expected count
Schools	Pearson Chi-Square	12	28.599	0.005		14	70%	0.57
	Likelihood Ratio	12	37.365	<.001	<.001	Use Fisher-Freeman-Halton Exact Test due to high expected count of less than 5.		
	Fisher-Freedman	12	29.674	<.001	<.001	Highly statically significant association		
Gender	Pearson Chi-Square	4	3.153[a]	0.533	0.566	4	40%	1.38
	Likelihood Ratio	4	3.197	0.525	0.578	No statistically significant association		
	Fisher-Freedman	4	3.229		0.550	p-value of .550 is *not* statistically significant ($p = .550 > .05$)		

Disability	Pearson Chi-Square	4	14.509[a]	0.006	0.003	4	40%	1.38
	Likelihood Ratio	4	16.651	0.002	0.004	p-value of .003 indicates a statistically significant association ($p < .05$).		
	Fisher-Freedman	4	15.007		0.003	statistically significant association		
Age	Pearson Chi-Square	8	10.170[a]	0.253	0.249	9	60%	29
	Likelihood Ratio	8	12.065	0.148	0.214	No statistically significant association		
	Fisher-Freedman	8	10.093		0.193	p-value of .193 was *not* statistically significant ($p > .05$).		

This analysis reports that schools and disability have a highly statistically significant with the variable "meeting PA guideline index" (p-value of < 0.001 and 0.003 is less than the conventional alpha level of .05). whereas gender and age do not (p-value of 0.550 and 0.193) is greater than .05). Therefore, the null hypothesis (which states no association between the variables) is rejected for schools and disability and accepted for gender and age.

5.7.2 MVPA tests between subject effects

The MVPA "Tests of Between-Subjects Effects" was crucial for understanding how different factors influence MVPA levels by identifying significant differences including main and interaction effects and elaborating on how much of the variability in MVPA is explained by each factor and their interactions. This understanding is essential for discerning the intricate interplay of various factors influencing individual MVPA levels.

Table 5.12: MVPA tests of between-subjects' effects.

Tests of Between-Subjects Effects					
Dependent Variable: MVPA					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	59422.693[a]	9	6602.521	.812	.607
Intercept	458419.040	1	458419.040	56.389	<.001
Schools, Gender and Disability (b)	.000	0	.	.	.
Age	9787.511	2	4893.755	.602	.551
Schools*Gender and all other interaction terms (c)	.000	0	.	.	.
Error	430867.307	53	8129.572		
Total	1338018.000	63			
Corrected Total	490290.000	62			

a. R Squared = .121 (Adjusted R Squared = -.028)
b. Schools, Gender and Disability returned a .000 value
c. Schools*Gender and all other interaction terms returned a .000 value

In the "Corrected Model" listed in Table 5.12, the model's overall significance was tested (F = .812, Sig. = .607) to determine whether any of the factors or interactions significantly affect MVPA. The model was not statistically significant (p > .05), suggesting that the model factors did not predict significantly MVPA. The intercept is the grand mean of MVPA (the mean across all groups) when all other variables are zero, reports F = 56.389 and Sig. = <.001 suggesting a high statistical significance (p < .001). Age represents the main effect of the independent variables (F = .602, Sig. = .551). However, the variable main effect was not statistically significant (p > .05), suggesting that when considered alone, its corresponding MVPA's effect was not significant. All "Interaction Terms" (including schools * gender, schools * disability, etc.): had values of .000 for the Sum of Squares, Mean Square, and F, and therefore no p-values were calculated, and these interaction terms were not included in the model.

Regarding R Squared and Adjusted R Squared (.121 and -.028), the first represents the proportion of variance in the dependent variable (MVPA) explained by the model. R-squared is .121, suggesting the model explains only 12.1% of the variance in MVPA. The negative adjusted R-squared is a sign of overfitting (including too many predictors for the amount of data) and further supports the conclusion of a poor model fit.

This analysis reports non-significant results on all the tested effects (the main effect of age and the overall model) that were not statistically significant. This suggests that the independent variables do not have a strong or statistically detectable effect on MVPA in the sample.

5.7.3 MVPA Inside and Outside the School

Understanding the patterns of MVPA among CAWD across different contexts is crucial for promoting inclusive and effective PA and developing appropriate strategies to enhance participation (Livingston et al., 2025). This analysis evaluates MVPA within and outside school settings, focusing on variations during school days, with and without semi-structured activities, as well as weekend days. It provides insights into understanding the complexities of how structured environments and free time influence PA behaviours across diverse population groups including those differentiated by gender, type of disability, and school environment.

These complexities are addressed using a multivariate statistical approach to compare MVPA across the different MVPA categories, as illustrated in Table 5.13.

Table 5.13: Multivariate test results of context variables vs MVPA (all patterns).

Multivariate Tests [a]						
Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.708	23.815[b]	5.000	49.000	<.001
	Wilks' Lambda	.292	23.815[b]	5.000	49.000	<.001
	Hotelling's Trace	2.430	23.815[b]	5.000	49.000	<.001
	Roy's Largest Root	2.430	23.815[b]	5.000	49.000	<.001
Schools, Gender, Disability (d)	Pillai's Trace	.000	.[b]	.000	.000	.
	Wilks' Lambda	1.000	.[b]	.000	51.000	.
	Hotelling's Trace	.000	.[b]	.000	2.000	.
	Roy's Largest Root	.000	.000[b]	5.000	48.000	1.000
Age	Pillai's Trace	.166	.903	10.000	100.000	.534
	Wilks' Lambda	.838	.907[b]	10.000	98.000	.530
	Hotelling's Trace	.189	.910	10.000	96.000	.528
	Roy's Largest Root	.165	1.645[c]	5.000	50.000	.165
Schools * Gender and all interaction terms (e)	Pillai's Trace	.000	.[b]	.000	.000	.
	Wilks' Lambda	1.000	.[b]	.000	51.000	.
	Hotelling's Trace	.000	.[b]	.000	2.000	.
	Roy's Largest Root	.000	.000[b]	5.000	48.000	1.000
a. Design: Intercept + Schools + Gender + Disability + Age + Schools * Gender + Schools * Disability + Schools * Age + Gender * Disability + Gender * Age + Disability * Age + Schools * Gender * Disability + Schools * Gender * Age + Schools * Disability * Age + Gender * Disability * Age + Schools * Gender * Disability * Age						
b. Exact statistic c. The statistic is an upper bound on F that yields a lower bound on the significance level d. Schools, gender and disability returned the same values e. All interaction terms returned the same values for the different tests						

Tests of Between-Subjects Effects						
Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	MVPA	59422.693[a]	9	6602.521	.812	.607
	MVPA-OS	46988.878[b]	9	5220.986	1.382	.220
	MVPA-IS	34512.385[c]	9	3834.709	2.768	.010
	MVPA-SDOS	9515.248[d]	9	1057.250	1.382	.220
	MVPA-SDIS	12129.315[e]	9	1347.702	1.776	.095
	MVPA-ADOS	5756.138[f]	9	639.571	1.382	.220
	MVPA-ADIS	8372.028[g]	9	930.225	5.367	<.001
	MVPA-WDOS	1879.555[f]	9	208.839	1.382	.220
Intercept	MVPA	458419.040	1	458419.040	56.389	<.001
	MVPA-OS	161856.634	1	161856.634	42.831	<.001
	MVPA-IS	76796.867	1	76796.867	55.431	<.001
	MVPA-SDOS	32775.968	1	32775.968	42.831	<.001
	MVPA-SDIS	26968.731	1	26968.731	35.543	<.001
	MVPA-ADOS	19827.438	1	19827.438	42.831	<.001
	MVPA-ADIS	12748.393	1	12748.393	73.553	<.001
	MVPA-WDOS	6474.265	1	6474.265	42.831	<.001
Schools, Gender, Disability	All variables	.000	0	.	.	.
Age	MVPA	9787.511	2	4893.755	.602	.551
	MVPA-OS	5495.477	2	2747.738	.727	.488
	MVPA-IS	978.743	2	489.371	.353	.704
	MVPA-SDOS	1112.834	2	556.417	.727	.488
	MVPA-SDIS	682.227	2	341.114	.450	.640
	MVPA-ADOS	673.196	2	336.598	.727	.488
	MVPA-ADIS	180.600	2	90.300	.521	.597
	MVPA-WDOS	219.819	2	109.910	.727	.488
Schools * Gender and all other interaction terms	All variables	.000	0	.	.	.
Error	MVPA	430867.307	53	8129.572		
	MVPA-OS	200282.836	53	3778.921		
	MVPA-IS	73429.329	53	1385.459		
	MVPA-SDOS	40557.274	53	765.232		
	MVPA-SDIS	40214.962	53	758.773		
	MVPA-ADOS	24534.647	53	462.918		
	MVPA-ADIS	9186.135	53	173.323		
	MVPA-WDOS	8011.313	53	151.157		
Total	MVPA	1338018.000	63			
	MVPA-OS	501113.000	63			

	MVPA-IS	283639.000	63			
	MVPA-SDOS	101475.382	63			
	MVPA-SDIS	120979.661	63			
	MVPA-ADOS	61386.343	63			
	MVPA-ADIS	42272.129	63			
	MVPA-WDOS	20044.520	63			
Corrected Total	MVPA	490290.000	62			
	MVPA-OS	247271.714	62			
	MVPA-IS	107941.714	62			
	MVPA-SDOS	50072.522	62			
	MVPA-SDIS	52344.278	62			
	MVPA-ADOS	30290.785	62			
	MVPA-ADIS	17558.162	62			
	MVPA-WDOS	9890.869	62			
MVPA		a. R Squared = .121 (Adjusted R Squared = -.028)				
MVPA-OS		b. MVPA-OS: R Squared = .190 (Adjusted R Squared = .052)				
MVPA-IS		c. R Squared = .320 (Adjusted R Squared = .204)				
MVPA-SDOS		d. R Squared = .190 (Adjusted R Squared = .052)				
MVPA-SDIS		e. R Squared = .232 (Adjusted R Squared = .101)				
MVPA-ADOS		f. R Squared = .190 (Adjusted R Squared = .052)				
MVPA-ADIS		g. R Squared = .477 (Adjusted R Squared = .388)				
MVPA-WDOS		f. R Squared = .190 (Adjusted R Squared = .052)				

5.7.4 Overall Model Significance

The Corrected Model row for each dependent variable indicates the overall significance of the model. MVPA-IS: ($F = 2.768$, $p = 0.010$) and the activity days MVPA inside the school (MVPA-ADIS: $F = 5.367$, $p < 0.001$) show statistically significant results, suggesting that predictors, such as age or interaction terms, significantly influence MVPA inside the school setting, and in activity days outside the school. Other MVPA variables (MVPA, MVPA-OS, MVPA-SDOS, MVPA-SDIS, MVPA-ADOS, MVPA-WDOS) did not show statistically significant results ($p > 0.05$), indicating that the model does not explain these outcomes well.

The independent variables and predictors included in the model were not sufficient to capture the variations or relationships in the MVPA variables that were not statistically significant (e.g., MVPA, MVPA-OS, MVPA-SDOS, MVPA-SDIS, MVPA-ADOS, MVPA-WDOS). This implies that factors outside of the model, or potentially unmeasured variables, may be influencing these outcomes. The model might be missing key predictors, interactions, or covariates that are necessary to fully explain the variability in these particular PA variables. It could also point to the possibility of measurement issues, misspecification of the model, or the inherent complexity of the data, where other unaccounted-for factors (e.g., environmental, social, psychological) play a role in determining PA outcomes. Consequently, the model's low explanatory power for these specific outcomes suggests that it may require refinement, additional variables, or more sophisticated modelling approaches to improve the fit and prediction of these PA behaviours.

The Intercept is significant ($p < 0.001$) for all dependent variables, which was expected and represents the grand mean when all predictors are zero. Regarding the independent variables, Age did not have a significant effect on any of the MVPA variables (all p-values > 0.05) and Schools, Gender and Disability and their interactions showed no results (df = 0), suggesting they should not be included in the final model or had no variability. The model fit based on the R Squared values indicating the proportion of variance explained by the model shows that MVPA-ADIS had the highest R Squared (0.477), with the model explaining 47.7% of its variance. MVPA-IS had the second-highest R Squared (0.320) and other variables had lower R Squared values, indicating poorer model fit. The Adjusted R Squared values are lower than the R Squared values, which is normal, and account for the number of predictors in the model: MVPA-ADIS has the highest Adjusted R Squared (0.388) and MVPA had negative Adjusted R Squared values, suggesting poor model fit for predicting global MVPA.

The error terms indicate the unexplained variance in the model, considering for example, the error mean square for MVPA-ADOS is relatively small (MS=173.323), reflecting less unexplained variability. In contrast, MVPA has a larger error (MS=8129.572). The multivariate analysis shows that the model explains effectively the variance in MVPA-ADOS and MVPA-IS. However, it performs poorly for other MVPA variables. Age does not appear to be a significant predictor for any of the MVPA outcomes. The lack of results for Schools, Gender, and disability suggests these variables may need further investigation and recording.

5.7.5 Implications

The results from the contexts of MVPA Inside School and Semi-Structured Activities show significant effects, which highlights the importance of focusing on targeted school-based PA programs. These findings suggest that school environments may provide a more structured and controlled context for promoting physical activity, where factors such as teacher support, school resources, and programmatic interventions can play a pivotal role. For CAWD, these settings may offer a unique opportunity to implement specific PA strategies that take into account the physical and cognitive limitations of these individuals. The significance of these contexts suggests that more tailored PA initiatives within schools could help uncover specific predictors of engagement in different MVPA categories, such as intensity and frequency, that are relevant for this population. These results provide actionable insights that can inform how PA is structured within schools, the kinds of support and accommodations needed, and how schools can serve as a critical setting for promoting active lifestyles among CAWD.

On the other hand, the non-significant results observed in the global and Outside School MVPA variables raise important questions about the generalisability of the identified predictors across different contexts. These findings suggest that the predictors chosen in the study may not fully capture the key drivers of MVPA in these broader contexts, outside the structured school environment. For instance, factors such as family support, community resources, or environmental barriers (e.g., accessibility to safe spaces for physical activity) may be influencing PA levels outside the school. It is also possible that the nature of MVPA outside school may be more influenced by intrinsic factors, such as individual motivation or peer interactions, which were not adequately addressed in the current model. Therefore, these results indicate the need for further exploration into the specific barriers and enablers that impact PA engagement outside school, particularly for CAWD, who may face unique challenges in accessing recreational opportunities.

The observed differences between inside-school and outside-school contexts highlight a critical area for intervention: schools may be better equipped to support PA for CAWD, yet more work is needed to understand and address the environmental and social factors influencing their PA levels outside of school hours. This also suggests that policies targeting PA promotion for CAWD should consider both structured in-school programs and broader community-based strategies that provide inclusive opportunities for PA across different settings. Furthermore, these findings may inform future research into the multi-layered factors influencing PA behaviour, emphasising the need for a more nuanced approach to PA promotion that accounts for the complex interplay between personal, social, and environmental factors across different life contexts.

5.8 Sleep and PA levels

Table 5.14 presents the Tests of Between-Subjects Effects for a multivariate analysis with four dependent variables (Sleep, Sedentary, Light, and MVPA) in different contexts (Schools, Gender, Disability and Age).

Table 5.14: Multivariate test results of context variables PA Levels and Sleep.

Tests of Between-Subjects Effects						
Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Sleep	7511499.831[a]	9	834611.092	2.624	.014
	Sedentary	39637289.084[b]	9	4404143.232	5.018	<.001
	Light	124217523.531[c]	9	13801947.059	535.216	<.001
	MVPA	59422.693[d]	9	6602.521	.812	.607
Intercept	Sleep	294299155.470	1	294299155.470	925.192	<.001
	Sedentary	121863944.476	1	121863944.476	138.840	<.001
	Light	31162634.089	1	31162634.089	1208.435	<.001
	MVPA	458419.040	1	458419.040	56.389	<.001
Schools, Gender and Disability	All variables	.000	0	.	.	.
Age	Sleep	9915.795	2	4957.897	.016	.985
	Sedentary	4668405.067	2	2334202.533	2.659	.079
	Light	111822.816	2	55911.408	2.168	.124
	MVPA	9787.511	2	4893.755	.602	.551
Schools * Gender and all other interaction terms	All variables	.000	0	.	.	.
Error	Sleep	16859049.725	53	318095.278		
	Sedentary	46519613.773	53	877728.562		
	Light	1366742.882	53	25787.602		
	MVPA	430867.307	53	8129.572		
Total	Sleep	605995662.000	63			
	Sedentary	311289932.000	63			
	Light	196885036.000	63			
	MVPA	1338018.000	63			
Corrected Total	Sleep	24370549.556	62			
	Sedentary	86156902.857	62			
	Light	125584266.413	62			
	MVPA	490290.000	62			
Sleep		a. R Squared = .308 (Adjusted R Squared = .191)				
Sedentary		b. R Squared = .460 (Adjusted R Squared = .368)				
Light		c. R Squared = .989 (Adjusted R Squared = .987)				
MVPA		d. R Squared = .121 (Adjusted R Squared = -.028)				

Significance indicates that the corrected model is statistically significant for Sleep ($F= 2.624$, $p = .014$), Sedentary ($F= 5.018$, $p < .001$), and Light activity ($F= 535.216$). The intercept is highly significant ($p < .001$) for all dependent variables, indicating that the overall means are significantly different from zero. The independent variables have no significant effect on any dependent variable (all $p > .05$). However, Age was closest to significance for Sedentary behaviour ($p = .079$). All interaction terms return a .000 value ($df = 0$), indicating they show no variability. The model fit (R Squared is most effective in explaining Light activity ($R^2 =.989$, Adjusted $R^2 = .987$), followed by Sedentary behaviour ($R^2 = .460$, Adjusted $R^2 = .368$) and Sleep ($R^2 = .308$, Adjusted $R^2 = .191$). However, it performed poorly in explaining MVPA ($R^2 = .121$ (Adjusted $R^2 = -.028$).

Age did not have a significant effect on any of the dependent variables, which suggests that age may not be as influential in shaping PA patterns for CAWD as initially anticipated. However, this finding may also reflect the complexity of how age interacts with other factors, such as school environment or disability type. The lack of significant results for variables like Schools, Gender, Disability, and their interactions implies that these factors may require further exploration or more refined measurement to capture their potential influence on PA. It is possible that the way these variables were measured or the specific context in which they were examined may not fully reflect their impact. Future studies could benefit from considering additional contextual factors or using more granular measures to better understand the nuanced relationships between these variables and PA outcomes for CAWD. The high R^2 for Light activity (98.9%) is unusually high and may warrant further examination to ensure no data or analysis issues. Overall, while the model shows a good fit for some variables, the lack of significant predictors (except the intercept) suggests that important factors influencing these behaviours may not be captured in the current model.

5.9 MVPA: School Days Without and With Semi-Structured Activities

MVPA during School Days Without and With Semi-Structured Activities were compared to assess their impact on PA, using Paired t-Test. Two pairs were considered: average Global MVPA outside (MVPA-DSDOS vs MVPA-DADOS) and inside the school (MVPA-DSDIS vs MVPA-DADIS). The first variable in each pair relates to the daily average MVPA during school days without semi-structured activities and the later to the daily average MVPA during school days with semi-structured activities. The analysis indicates a statistically significant difference between the 2 variables in each pair. The impact for PA disability and schools is developed after the presentation of the analysis results.

5.9.1 Results Analysis

a) **Pair 1: MVPA-DSDOS vs. MVPA-DADOS** (School days without SSA vs School Days with SSA)

Table 5.15: MVPA of School Days without SSA vs School Days with SSA.

MVPA-DSDOS vs MVPA-DADOS		Average Difference	Mean difference		t-Value	2-Sided p-Value
			Lower	Upper		
All Children		-1.48	-3.85	0.89	-1.25	0.22
School	S1	3.74	-1.04	8.52	1.66	0.12
	S2	-0.70	-5.22	3.83	-0.34	0.74
	S3	1.73	-2.93	6.39	0.79	0.44
	S4	-10.46	-12.35	-8.57	-11.74	0.00
Gender	Boys	1.90	-1.37	5.18	1.19	0.24
	Girls	-4.37	-7.58	-1.16	-2.77	0.01
Disability	LID	-3.36	-6.86	0.13	-1.96	0.06
	MHI	0.73	-2.42	3.87	0.47	0.64
Age group	12-14	-6.15	-9.72	-2.58	-3.55	0.00
	15-17	0.85	-2.14	3.84	0.58	0.56
	18-21	5.79	-6.84	18.41	0.72	0.29

There were significantly lower differences in MVPA levels between DSDOS and DADOS for S4, girls, and the 12–14 age group. CAWD with LID shows slightly significant differences with lower MVPA for DSDOS. The overall trend shows no significant difference across all children, boys, or other clusters like MHI or older age groups.

b) **Pair 2: MVPA-DADOS vs. MVPA-DADIS** (School days with SSA outside vs inside school)

Table 5.16: MVPA of School days with SSA outside vs inside school.

MVPA-DADOS vs MVPA-DADIS		Average Difference	Mean difference		t-Value	2-Sided p-Value
			Lower	Upper		
All Children		1.21	-2.07	4.48	0.74	0.46
School	S1	3.98	-2.04	10.00	1.40	0.18
	S2	0.92	-7.52	5.68	-0.31	0.76
	S3	10.92	3.96	17.87	3.33	0.00
	S4	-9.77	-12.13	-7.41	-12.13	0.00
Gender	Boys	1.95	-2.33	6.24	0.93	0.36
	Girls	0.57	-4.48	5.62	0.23	0.82
Disability	LID	-2.90	-6.80	1.01	-1.51	0.14
	MHI	6.02	0.88	11.15	2.40	0.02

Age group	12-14	-5.35	-9.32	-1.38	-2.78	0.01
	15-17	5.87	1.23	10.50	2.59	0.01
	18-21	5.49	-14.23	25.21	0.72	0.51

Significant differences in MVPA for DADOS were observed in the following groups: Higher (S3, MHI and 15-17 years) and Lower (S4 and 12-14 years). The differences in MVPA levels between DADOS and DADIS for all other groups were not statistically significant.

5.9.2 Impact for PA Disability and School

MVPA during School Days Without and With Semi-Structured Activities were compared to assess their impact on PA, using a Paired t-Test. Two pairs were considered: average Global MVPA outside (MVPA-DSDOS vs MVPA-DADOS) and inside the school (MVPA-DSDIS vs MVPA-DADIS). The first variable in each pair relates to the daily average MVPA during school days without semi-structured activities, and the latter to the daily average MVPA during school days with semi-structured activities. The analysis indicates a statistically significant difference between the two variables in each pair, suggesting that semi-structured activities within the school day contribute positively to PA levels.

This finding has important implications for PA, disability, and schools. The increase in MVPA during school days with semi-structured activities highlights the potential of structured physical activities to enhance overall PA participation, especially for CAWD. Schools, as primary environments for CAWD, can play a critical role in fostering regular and varied physical activity opportunities. By incorporating more semi-structured activities, schools can support PA participation, particularly for students who may face barriers to unstructured play due to their disabilities. This finding also emphasizes the need for schools to prioritize and provide adequate resources and support for structured PA programs that can engage all students, including those with disabilities, and contribute to their overall health and well-being.

5.9.3 MVPA: School and Weekend Days

MVPA during school and weekend days were compared to evaluate differences in PA patterns. The analysis indicates a statistically significant difference between the 2 variables: MVPA-DSAOS - MVPA-DWDOS.

Table 5.17: MVPA of School days vs Weekend days.

MVPA-DSAOS vs MVPA-DWDOS		Average Difference	Mean difference		t-Value	2-Sided p-Value
			Lower	Upper		
All Children		6.35	4.76	7.94	7.98	0.00
School	S1	6.26	2.99	9.54	4.05	0.00
	S2	7.47	3.16	11.78	3.81	0.00
	S3	7.9	3.60	12.20	3.89	0.00
	S4	4.09	3.15	5.03	9.23	0.00
Gender	Boys	6.76	1.20	4.31	5.64	0.00
	Girls	5.99	3.81	8.18	5.58	0.00
Disability	LID	5.18	-6.80	1.01	6.36	0.00
	MHI	7.72	4.82	10.62	5.45	0.00
Age Group	12-14	4.93	3.33	6.52	6.36	0.00
	15-17	7.51	4.77	10.24	5.62	0.00
	18-21	7.17	-2.24	16.57	1.96	0.11

Significant differences in MVPA levels were observed for most groups, indicating consistently higher MVPA during DSAOS compared to DWDOS. The only exception is for the 18–21 **years** age group, where the results did not show a significant difference ($p>0.05$). The effect appears consistent across schools, genders, and disability types, with DSAOS consistently associated with higher MVPA levels**.**

The paired t-tests comparing MVPA levels across the different conditions reveal several key insights:

a) **MVPA-DSDOS vs MVPA-DADOS**

There were no significant differences in MVPA levels for the overall group or most subgroups, except for S4, girls, and the 12–14 years age group, where MVPA was significantly lower during DADOS compared to DSDOS. Differences were more pronounced in specific contexts, suggesting variability in MVPA levels based on school, gender, and age.

b) **MVPA-DADOS vs MVPA-DADIS**

The overall group did not show significant differences in MVPA levels for these MVPA patterns. However, significant differences were observed for S3, S4, and children with MHI, with S3 and MHI having higher MVPA during DADIS, while S4 had lower MVPA. Among age groups, children aged 12–14 had significantly lower MVPA during DADIS, while adolescents aged 15–17 exhibited higher MVPA. These results suggest context-specific variations, possibly influenced by school, disability type, and age-related factors.

The results highlight the existence of context-specific variations in MVPA, indicating that the factors affecting physical activity are not uniform across the entire sample. This suggests that different contexts, such as school environments, disability types, and age, play a critical role in shaping physical activity behaviours, and these factors must be considered when developing interventions or strategies for promoting PA among children and adolescents, especially those with disabilities.

- **School Influence**: The observed differences between S3 and S4 indicate that the type of school (or the specific school setting) may have an impact on PA levels. S3 showed higher MVPA during DADIS, while S4 exhibited lower MVPA. This suggests that some schools may have more conducive environments for PA (e.g., better facilities, more structured PA programs, or supportive staff), while others may face barriers that limit opportunities for students to engage in PA. These differences warrant further exploration to determine the specific school-related factors that are either promoting or hindering MVPA.
- **Disability Type Impact**: Children with MHI showed higher MVPA during DADIS, compared to other groups. This suggests that disability type (in this case, MHI) might have a unique influence on how children engage in physical activities, particularly in structured school settings. It's possible that children with MHI may have different needs, preferences, or support structures that lead to increased participation in PA during certain activities.
- **Age-Related Effects**: The age differences observed in MVPA levels—children aged 12–14 showing lower MVPA, while adolescents aged 15–17 had higher levels—reflect the potential impact of developmental changes on PA participation. Younger children may have different activity patterns, possibly influenced by physical development, cognitive factors, or the types of PA opportunities available to them, whereas older adolescents may engage in more structured or independent forms of PA. This underscores the importance of tailoring PA interventions to age-specific needs and interests.

c) **MVPA-DSAOS vs MVPA-DWDOS**

Significant differences were observed across all groups except the 18–21 years age group. MVPA levels were consistently higher during DSAOS compared to DWDOS, indicating the influence of semi-structured activities on increasing MVPA. This trend was consistent across schools, genders, and disability types, demonstrating the potential of semi-structured activities to promote physical activity participation.

Overall, the results highlight variability in MVPA levels based on contextual factors such as school, gender, age, and disability type. While semi-structured activities (DSAOS) consistently enhanced MVPA levels compared to unstructured weekend days (DWDOS), differences between other conditions (DSDOS vs. DADOS, DADOS vs. DADIS) were more nuanced, revealing subtle, context-specific patterns that varied across subgroups. These nuanced differences suggest that the factors influencing MVPA in these different contexts are not uniform but instead are shaped by a combination of individual characteristics, activity types, and environmental conditions that may vary from one subgroup to another. For instance, children with different disabilities or those in different age groups may respond to the same activity types in distinct ways, underscoring the complexity of PA engagement in these populations. These findings emphasise the importance of tailored school and community programmes that consider these unique barriers and facilitators, addressing the individualised needs of children and adolescents with disabilities to enhance their MVPA participation.

5.10 Findings Overview and Implications

The study employed three measures to explore relationships among PA levels, sleep, health factors, and socio-ecological variables (SEVs): (i) PA Levels and Sleep times objectively measured using accelerometers, ensuring high accuracy, (ii) Health Factors derived from precise anthropometric measurements, providing reliable data, and (iii) SEVs: data gathered from parent-reported questionnaires, which may introduce recall or desirability biases.

5.10.1 Correlation Trends

Although a substantial proportion of correlations were globally very weak (52.05%) or weak (29.37%), moderate correlations accounted for 9.01%, while strong and very strong correlations represented 4.42% and 5.15%, respectively. The predominance of weak associations indicates complex and multifactorial influences on PA levels.

The correlation analysis revealed for PA Levels and Health Factors substantial proportions of very strong, strong, and moderate correlations: PA Levels fall within these higher correlation categories (35.53%), indicating significant relationships with associated variables, and Health Factors correlations are similarly robust (28.97%), emphasising their interconnectedness with PA levels and sleep. SEV Clusters, despite their potential importance, the average proportion of higher correlations across six SEV clusters is notably lower, at 15.37% with 4 clusters under 15% (Family, PA and PE engagement and school support). This may reflect the inherent variability and subjectivity in parent-reported data.

5.10.2 MVPA Association Trends

The CAWD PA predictors include demographic (age, gender), anthropometric (height, weight, BMI), other factors like disability, school, and body composition measures (e.g., RMR, B Fat) and several SEVs. The statistical analysis reveals that none of these predictors seem to have a significant impact on MVPA based on the model's overall lack of significance.

The high p-value suggests that the predictors collectively do not significantly explain MVPA variance, suggesting a review of the predictors included, and additional socio-ecological or contextual variables may need to be incorporated to capture the complex dynamics influencing MVPA.

5.10.3 MVPA Meeting PA Guidelines

The analysis revealed that schools and disability have a highly statistically significant association with the variable 'meeting PA guideline index,' whereas gender and age did not show a significant effect. This finding is somewhat contradictory, as there was a clear link between schools and gender in the study's design: boys attend schools S1 and S2, while girls attend schools S3 and S4. The lack of significance for gender may be attributed to overlapping effects between schools and gender, where the school variable captures most of the variability that could be attributed to gender. This interdependence suggests that the school environment, potentially influenced by gender-specific programming or resources, plays a crucial role in PA participation, and the gender effect may be indirectly reflected through the school variable. Further exploration is needed to disentangle the individual contributions of schools and gender and better understand their interaction.

5.10.4 MVPA Daily Patterns

Statistically lower and higher significant differences were observed for some MVPA patterns. These differences were not similar for all population groups of Pair 1: MVPA-DSDOS vs. MVPA-DADOS (School days without SSA vs School Days with SSA) and Pair 2 MVPA-DADOS vs. MVPA-DADIS (School days with SSA outside vs inside school) of the paired samples T-test analysis whereas they were uniform for Pair 3: MVPA-DSAOS - MVPA-DWDOS (School days and Weekend days). These results highlight a consistent trend across all groups, emphasising the broader influence of structured school routines on promoting higher MVPA levels compared to the less structured weekend environment. These results underscore the importance of tailoring PA interventions to specific contexts and population subgroups to maximise their effectiveness.

5.10.5 Key Observations

Observations about the variables' correlation and PA levels association with health factors and SEVs can be made at three levels: accuracy, biases in SEV data and stakeholder relevance. The objective and precise nature of PA and health data likely accounts for their stronger correlations compared to SEVs. The lower correlation levels for SEVs could stem from the limitations of parent-reported questionnaires, including recall and desirability biases. They underline the need for stakeholders to carefully interpret the SEV data in their context while considering its limitations. These insights will help refine the SEV clusters during focus group discussions to align with stakeholders' objectives and improve relevance for addressing barriers, challenges, and facilitators to PA participation. This nuanced analysis highlights the strengths of the objectively measured data while recognising the variability in self-reported measures, paving the way for focused discussions and actionable recommendations.

5.10.6 Implications

The analysis findings highlight critical areas for exploration in stakeholder focus groups suggesting the integration of quantitative insights into stakeholder discussions to refine the analysis needs and better understand when and why structured activities were effective and identify barriers to participation in less structured contexts, which will help Stakeholders redefine socio-ecological variables clusters to better address specific barriers or facilitators of PA based on local contexts and stakeholder priorities.

5.11 Conclusion

The integral interpretation of the findings will be expanded during stakeholder discussions (Chapter 6) to complement the qualitative insights and contribute to a holistic understanding of PA participation and in the "Discussion and Conclusion" chapter (Chapter 7). Focus groups will explore barriers, challenges, and facilitators to PA participation in the light of these quantitative and qualitative results, ensuring the development of actionable and context sensitive analysis and recommendations for developing appropriate PA-promoting strategies among CAWD.

Chapter Six: Qualitative Analysis

6.0 Introduction

This chapter presents the qualitative analysis, which builds upon the findings of the quantitative analysis presented in the previous chapters, by incorporating the perspectives of key stakeholders including PE and SN parents, health practitioners, teachers and school managers. Using focus group discussions (FGDs), stakeholders including PE and SN teachers and school managers, health practitioners, parents, and policymakers critically evaluated and interpreted the statistical results characterising PA levels, as well as their correlations and associations with health factors and socio-ecological variables (SEVs). These discussions focussing on the variables' clusters of their specific interest (family and support, PA engagement, and school support), provide valuable context and depth to the quantitative insights, offering a more nuanced understanding of the challenges, barriers, and facilitators to PA participation among CAWD.

The chapter begins by introducing the qualitative analysis context followed by the chapter's overview. The second section presents the approach used to link PA participation barriers among CAWD to evidence-based strategies to enhance promoting PA among the various groups of this population, and the strategy used to address the influence factors interplay. The third section starts with the presentation of the stakeholders with the quantitative findings from Chapters 4 and 5. Then, it details the stakeholders' analysis of PA factors of influence and their implications and impact on CAWD PA of the SEV clusters (Disability, Family, School resources, Family and school support and child PA engagement. The fourth section summarises the stakeholders' recommendations to elaborate inclusive enhanced PA-promoting strategies. This chapter concludes by emphasising the importance of multi-level interaction between barriers and facilitators for developing effective strategies to promote effective and enhanced inclusive PA participation among CAWD.

6.1 Linking Barriers and Facilitators to Evidence-Based Strategies

It is essential to comprehensively understand how PA levels are influenced by various factors across the PA socio-ecological model when linking barriers and facilitators to evidence-based PA-promoting strategies to enhance CAWD PA engagement. This requires stakeholders using their perceptions and field experience to interpret quantitative insights to uncover associations between PA levels and the individual, social, environmental, and policy-level variables that shape PA behaviour (Bronfenbrenner, 1977; McLeroy et al., 1988). Such analysis enables the identification of targeted mechanisms for collaboration and input to address barriers and leverage facilitators, to help to foster effective and sustainable PA promotion strategies. PE and PA engagement among CAWD is shaped by a delicate balance between the limitations imposed by individual and contextual barriers and the PA participation opportunities provided by family and school support systems. Disability-specific characteristics, such as cognitive, or sensory impairments that characterise CAWD with light intellectual disability or mild hearing impairment, coupled with family dynamics, such as socioeconomic status or caregiver availability, can restrict the abilities of CAWD to engage in PA fully. These issues often manifest as significant challenges, including lower confidence, reduced opportunities for participation, or difficulties accessing inclusive PA programs or sports facilities in the community (Bloemen et al., 2014; Yu et al., 2022; Shields & Synnot, 2024).

6.1.1 The Approach

The qualitative analysis bridges between data-driven findings and actionable strategies, capturing the lived experiences and practical considerations of stakeholders from both a global perspective (Martin Ginis et al., 2021) and specific contexts such as schools with cultural norms in KSA (Twardowski, 2022). This approach ensures that recommendations for promoting PA participation among CAWD are evidence-based, inclusive, and context-sensitive (McGarty et al., 2024), and involve qualitative research to benefit from including stakeholders in sports and exercise in this population (Smith et al., 2022). The diagram illustrated in Figure 6.1, represents a structured approach that integrates cross-sectional quantitative insights with qualitative evaluations by stakeholders to develop evidence-based strategies for promoting PA and PE engagement among CAWDs and review the study requirements for a longitudinal design to support naturalistic generalisability or transferability in qualitative research (Smith, 2018). This diagram's approach is justified by its emphasis on investigating barriers, challenges and facilitators to CAWD PA participation (Shields et al., 2024) and integrating quantitative evidence with stakeholder-driven qualitative insights to design sustainable, inclusive, and impactful PA-promoting strategies. It reflects a collaborative and adaptive methodology to address the complex interplay of factors influencing CAWD's PA participation.

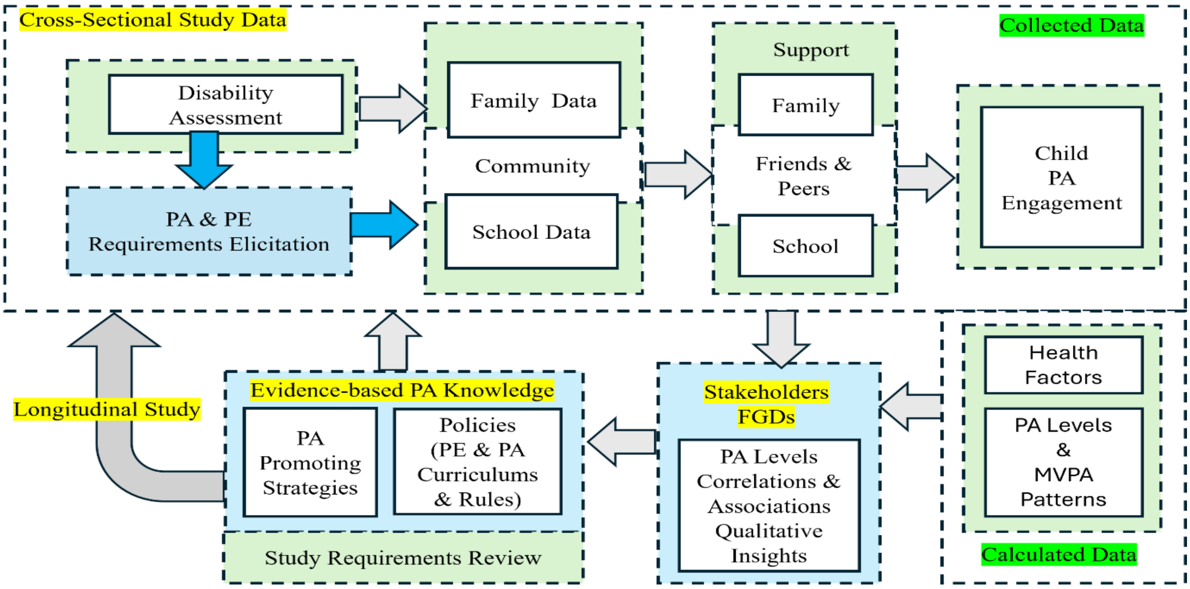

Figure 6.1: The qualitative analysis approach of PA-promoting strategies among CAWD.

The rationale for this approach lies in its systematic design, which ensures that data from various socio-ecological levels and patterns (disability, family, school, and community) are comprehensively analysed to address barriers and enhance facilitators of PA participation in the CAWD population groups (Sit et al., 2024). The key aspects of this approach are listed below.

a) **Data-Driven Foundations:** The cross-sectional study provides a robust foundation through objective PA measurements and detailed socio-ecological data, including disability assessments, family demographics, socio-economic conditions, and school resources. These insights reveal associations and disparities in PA participation across different population groups, offering a clear starting point for targeted intervention.

b) **Stakeholder Involvement:** The qualitative phase leverages stakeholders' expertise to interpret the quantitative findings. Stakeholders bring practical perspectives, enabling the identification of context-specific barriers, challenges, and facilitators. Their involvement help ensure that strategies are not only theoretically sound but also practically viable.

c) **Holistic Focus:** The framework highlights the interconnected nature of factors influencing PA engagement. It addresses the individual (disability-specific limitations), social (family and peer support), and environmental (school and community resources) dimensions, ensuring a holistic approach to promoting PA participation.

d) **Strategic Planning:** By focusing on eliciting PA and PE requirements and stakeholder-driven strategy development, the approach bridges the gap between data insights and actionable solutions. This ensures that strategies are evidence-based and tailored to the unique needs of CAWD.

e) **Scalability and Future Planning:** The inclusion of a study requirements reviews and the transition to a longitudinal study demonstrate foresight. Expanding the study to more schools and other disability types will strengthen the generalisability of findings and provide a more comprehensive understanding of PA participation among diverse CAWD groups.

f) **Outcome-Oriented Design:** The ultimate goal is enhanced PA and PE engagement through strategies that address both immediate barriers and long-term facilitators. The integration of longitudinal components will allow for tracking progress and refining interventions over time.

6.1.2 The Influence Factors Interplay Strategy

By examining the complex interplay of individual, social, and environmental factors influencing PA behaviour explained by established associations between PA levels and health and SE factors, stakeholders explore the implications of the data for real-world applications (Bloemen et al., 2024). Particular attention is paid to interpreting patterns and trends in the correlations and associations, such as the role of family support, school environments, and structured activities, while also addressing broader contextual factors like disability-specific needs and demographic differences. The proposed strategy to address the influence factors interplay for enhanced PA participation among CAWD is based on a hierarchy of sequential influences that can be structured as follows:

i) Identify the Hierarchical Layers of Influence

a) Disability Assessment

The first layer of the strategy focuses on assessing the CAWD's unique limitations and abilities, their sensory, cognitive, or behavioural challenges, personal, social and environmental barriers and strengths (recognised abilities and interests) that may affect or motivate PA engagement. These form the foundation upon which families, schools, and communities can build targeted strategies to address barriers and challenges to active and inclusive PA participation and create a foundation for inclusive and active PA participation, reducing mismatches between CAWD's needs and the support provided by their environment.

b) Family and School Influence

Two levels of influence resulting from the family and school organisations form the second layer where families provide foundational support, including emotional encouragement, and logistical assistance to reinforce PA behaviours at home, and schools play a critical role by offering accessible, adapted PE and extracurricular PA programs. Both influences depend on resource availability, parents' awareness, school policy framework and programs to support inclusion in sports and activities. The families' and schools' responses and influence are shaped by their understanding of and capacity to support CAWD's specific needs.

c) CAWD PE and PA Engagement

The third layer is the CAWD's response to family and school influence. CAWD's participation in PA is directly shaped by the quality and alignment of family and school support with the child's unique limitations and abilities. The child's attitudes, motivations, and behaviours develop within this environment through several phases that reflect progression in skills, motivation, and participation over time. These phases emphasise the gradual evolution of active engagement across different CAWD groups and include awareness and familiarisation, foundational skill development, structured engagement, autonomy and motivation, and continual PA engagement. They provide a comprehensive framework for PA-promoting strategies where structured improvements in child PA participation stem from continuous adjustments in family and school strategies developed to address the barriers and challenges at the various PA engagement phases.

ii) Influence Interplay

The influence of interplay is crucial to identify improvements or decline in child participation stemming from continuous adjustments in family and school strategies or PA behavioural changes. A framework structuring the different layers can be developed to visualise the dynamic interactions among the key influences.

a) Input Layer

This layer includes the family and school actions aimed at responding to the CAWD's specific limitations. Family provides tailored encouragement and resources based on the child's needs and schools and the community offer inclusive and adaptable PA/PE opportunities.

b) Interaction Layer

The CAWD's PA participation reflects the interplay of family and school influences and positive reinforcement from family and structured support from schools and the community work synergistically.

c) Output Layer

Enhanced PA behaviour emerges over time, increasing the CAWD's confidence and ability to actively engage in PA and develop PA competence enabling them to self-manage their PA participation and benefit from inclusive and stimulating PA environments.

iii) Strategy

Linking PA participation barriers and facilitators among CAWD and across different population groups (schools, gender, disability and age) requires a strategy that integrates the hierarchical and sequential influences of families, schools and community using collaboration and adaptive strategies to ensure that the interplay of factors is directed toward fostering sustainable PA behaviours (Shields et al., 2012; Shields et al., 2021). This strategy is based on defining longitudinal goals to measure active and progressive PA participation, focusing on gradual improvements in PA behaviour changes, competence, skills, and confidence over time. It helps foster a staggered process of PA behaviour change, evolving from the dependence on family and school for support and resources (initial phase) to gradually developing self-confidence and independence in PA participation (intermediate phase) and reaching sustained and self-motivated engagement in PA (advanced phase).

6.2 Stakeholders FGD: Socio-Ecological Influences on PA Participation in CAWD

This section of the FGD aims to engage stakeholders in a collaborative discussion to analyse socio-ecological factors influencing PA participation among CAWD. The discussion will examine findings from the quantitative analysis, interpret qualitative insights, and identify actionable implications to inform interventions.

Stakeholders are critical enablers of systemic PA behaviour change, providing sustainable support for PA among CAWD through assessing the CAWD needs and limitations, strengthening family engagement, enhancing PE and PA school policies and resources, and regularly assessing the child's PA behaviour change and adjust family and school strategies as needed. A quantitative analysis of PA levels reveals insights into how these stakeholders influence participation through direct actions such as encouragement, observation, and facilitation, as well as through broader factors like family demographics, school policies, and environmental accessibility. This section explores these interconnections, offering a data-driven perspective on the role of socio-ecological variables and health determinants in shaping PA behaviours.

6.2.1 Presentation of Findings Per Cluster Domain of Socio-Ecological Factors

Stakeholders were presented with the key findings related to socio-ecological factors, categorised into the following domains: disability, family characteristics, school resources and organisation, family support, CAWD school support and CAWD PA engagement. The findings highlight patterns, barriers, and facilitators within each domain to provide a structured framework for the discussion. In the second step, stakeholders collectively analysed the results presented, reflecting on how socio-ecological factors interact to shape CAWD's PA participation, discussing the importance of the barriers and associated facilitators on PA participation, and making key observations on the extent to which specific factors (e.g., family income, parent education level) influence PA engagement. To deepen their understanding of the PA participation barriers and facilitators, stakeholders reviewed qualitative insights, with selected quotations to support interpreting the findings, and summarised the main themes from the discussion in a findings summary before reflecting on the broader implications of the findings for practice and policy. Finally, the FGD concludes with recommendations.

6.2.2 Quantitative Findings

Stakeholders were presented with a comprehensive overview of the quantitative analysis findings from Chapters 4 and 5. These chapters focused on analysing the data collected regarding PA levels, health status, disability-related factors, and socio-ecological influences on CAWD. The presentation aimed to provide stakeholders with evidence-based insights into the patterns of PA engagement, barriers, and facilitators, as well as the relationship between disability-related factors and PA participation. Key findings from the analysis were shared in a clear and accessible format to support informed decision-making and to guide the development of targeted interventions and strategies for promoting PA among CAWD.

The stakeholders were encouraged to ask questions and engage with the data to enhance their understanding of the implications for practice. This more collaborative approach ensures that the findings are not only disseminated effectively but also translated into actionable strategies that can address the unique needs of CAWD in various contexts.

6.2.3 Assessing and Interpreting Disability

Interpreting the disability assessment of CAWD is crucial to understanding how cognitive and sensory limitations uniquely shape their capacity for PE and PA engagement as defined in various PA guidelines (Smith et al., 2022), and how the relative knowledge can be produced and used (Smith, 2021; Smith & Sparkes, 2021; Smith et al., 2015). Cognitive impairments, such as those associated with light intellectual disability, may hinder the understanding or execution of complex activities, while sensory limitations, like mild hearing impairments, can affect communication and coordination. Table 6.1 illustrates the disability key indicators of the study population.

Table 6.1: Disability key indicators.

SEV1: Disability	(%) Resp. 1	(%) Resp. 2	(%) Resp. 3	(%) Resp. 4	(%) Resp. 5	(%) Resp. 6
Status	0.00	0.00	25.40	47.62	26.98	0.00
Mental Impairment	0.00	0.00	0.00	33.33	20.63	46.03
Hearing Impairment	0.00	0.00	0.00	25.40	20.63	53.97
Vision Impairment	0.00	0.00	0.00	0.00	100.00	0.00
Seeing without Aid	0.00	0.00	0.00	0.00	100.00	0.00
Seeing with Aid	0.00	0.00	0.00	0.00	100.00	0.00
Hearing without Aid	0.00	0.00	0.00	0.00	100.00	0.00
Hearing with Aid	0.00	0.00	0.00	0.00	100.00	0.00
Self-Dressed Difficulty	0.00	0.00	0.00	0.00	100.00	0.00
Being Understood at Home	0.00	0.00	0.00	0.00	100.00	0.00
Being Understood Outside	0.00	0.00	0.00	0.00	100.00	0.00
Learning Difficulty	0.00	0.00	25.40	44.44	30.16	0.00
Remembering Difficulty	0.00	0.00	30.16	39.68	30.16	0.00
Concentrating Difficulty	0.00	0.00	23.81	39.68	36.51	0.00

i) Analysis

The study reveals that the health status of CAWD is categorised as moderate (25.40%), good (47.62%), and very good (26.99%). Among mental and hearing impairments, the distribution is as follows: light (33.33% and 25.40%, respectively), very light (20.63%), and no impairment (46.04% and 53.97%, respectively). The difficulty in learning, remembering, and concentrating is reported as some difficulty (25.40%, 30.16%, and 23.81%, respectively), little difficulty (44.44%, 39.67%, and 39.67%, respectively), and no difficulty (30.16%, 30.16%, and 36.51%, respectively). All other key indicators in the above table show 100% reporting no difficulty.

a) Minimal Disability-Related Limitations on PA Abilities

The study reports that the majority of CAWD have good to very good health (74.61%) and experience no or very light mental and hearing impairments (66.67% and 79.37%, respectively). Cognitive functions such as learning, remembering, and concentrating are largely unaffected, with more than 70% of CAWD reporting little to no difficulty, implying that cognitive challenges related to these functions are minimal and are not a major barrier to engagement in PA or PE activities. This suggests that minimal limitations in cognitive or sensory abilities are not expected to restrict their PA participation heavily.

All other disability-related indicators show 100% "No Difficulty," further underscoring the absence of substantial barriers tied to physical or cognitive impairments.

b) Lack of Association Between PA Levels and Disability Key Indicators

A correlation analysis and inferential statistical tests (e.g., Pearson correlation, Spearman's rank correlation, and ANOVA) were conducted to examine the relationship between PA levels (MVPA patterns and PA guideline adherence) and disability-related key indicators. The results revealed no statistically significant associations ($p > 0.05$), suggesting that the type and degree of disability did not have a substantial influence on PA participation within this study population.

These findings indicate that limitations in PA abilities due to disability were not a major factor affecting PA engagement among CAWD. Further interpretation of disability key indicators suggests that the majority of CAWD in this study reported good or very good health status, with only a small proportion classified in the "moderate" category. This relatively positive health profile may explain the lack of significant health-related barriers to PA participation, as children with better overall health might not experience substantial restrictions in engaging in PA.

Overall, the disability-related limitations on PA abilities are minimal, given the light-to-no impairments reported in mental, hearing, and cognitive domains, and the generally good health status of the participants. This highlights that other factors, such as family and school support, availability of inclusive PA programs and accessible sports facilities, and social-environmental barriers, are likely to be more critical determinants of CAWD PA participation. The findings underscore the importance of addressing these contextual and socio-ecological factors to promote inclusive and equitable PA opportunities.

ii) Qualitative Insights

The study findings reveal that impairment-related limitations on PA abilities among CAWD are minimal. Insights from the stakeholders' FGD demonstrated that CAWD possess strong confidence and a genuine desire to engage in sports and PAs, despite their mild disabilities and associated cognitive or sensory challenges. Rather than physical or sensory barriers, factors such as social inclusion, access to suitable facilities, and peer support emerged as more significant influences on their PA participation.

PE teachers reported that CAWD often show high levels of engagement, comparable to their peers without disabilities, reinforcing the idea that interest and opportunity play a more critical role in PA participation than the nature or severity of their disabilities.

- *"The children with mild disabilities often show a high level of engagement, comparable to those without disabilities."*
- *"We haven't observed a significant difference in activity levels between students with light intellectual and mild hearing disabilities."*
- *"Physical activity engagement seems to depend more on interest and opportunities than the type of disability."*

Health practitioners and SN teachers echoed this perspective, emphasising that physical capabilities remain largely unaffected across the groups studied (boys and girls, LID and MHI, and age groups). They highlighted the broad health benefits of PA and advocated for active encouragement from schools and families to foster continuous participation, reduce barriers, and enhance well-being.

- *"The children and adolescents feel healthy and can join most individual or group sports without problems."*
- *"We often advise families and schools to focus on promoting PA as a means to improve overall well-being, irrespective of the type or degree of disability."*

Parents also underscored the importance of inclusive programs and supportive environments in enabling their children to remain active. They echoed these sentiments, emphasising the significance of accessible programs and the encouragement of PA to reduce the perceived impact of disabilities. They noted that the availability of structured opportunities, rather than the child's condition, was the key determinant of participation.

- *"I encourage my child to stay active because their disability doesn't limit them in doing sports or playing outdoors."*

- *"What matters is the availability of programs that include my child, not their health condition."*

CAWD demonstrated in FGDs a strong determination to participate in PAs, with many expressing that their disabilities do not hinder their engagement. They reported their experiences and highlighted the importance of peer support and suitable facilities. These insights underscore their resilience and the critical role of social and environmental factors in enabling active participation.

- *"Even though I have mild hearing issues, it doesn't stop me from participating in PE activities."*
- *"Learning new things takes time, but it hasn't stopped me from playing or being active."*
- *"I like playing football. My disability doesn't make it harder for me to play after school every day."*
- *"Sometimes the facilities are not designed for people like me, so it feels hard to join in."*
- *"I don't think my condition affects how active I am it is more about having friends to play with."*

iii) Findings Summary

Overall, these findings emphasise the resilience and adaptability of CAWD in overcoming challenges to PA engagement. They underscore the importance of creating supportive, inclusive opportunities that empower CAWD to participate actively and regularly in PAs, enhancing their physical, social, and emotional well-being. By addressing environmental and social barriers and fostering a culture of encouragement, schools, families, and communities can empower CAWD to develop PA habits and culture, improve their PA competence, achieve greater PA levels and enhance their active living. These findings are supported by the perspectives shared during focus group discussions, where stakeholders including CAWD, parents, PE teachers, health practitioners, and special needs (SN) teachers consistently emphasised the minimal impact of disabilities on physical activity participation and the importance of social and environmental factors.

iv) Implications and Impact on PA

The analysis findings point to a population where the physical or cognitive impairments commonly associated with disabilities are not severe enough to limit PA engagement or differentiate levels of PA participation, characterising a uniform opportunity for PA across the various CAWD population groups. The minimal disability-related limitations on PA abilities observed in the study align closely with the lack of a significant association between PA levels and disability key indicators. Therefore, it is essential to consider external factors as primary determinants of CAWD PA participation. These factors include the other SEV clusters (environmental barriers, family or school support, and access to PA programs) which might play a more dominant role in influencing PA levels than the disability indicators themselves.

The lack of association between disability and PA levels reinforces the importance of addressing socio-ecological factors, such as inclusive school policies, family encouragement, and community infrastructure, rather than focusing solely on the type or degree of disability. It shifts the narrative from "disability as a limitation" to understanding how enabling environments can ensure more equitable PA opportunities for all CAWD, regardless of their impairments. By emphasising the alignment between these findings, the study highlights the critical role of context and support systems in promoting PA participation over individual disability characteristics.

6.2.4 Assessing and Interpreting Family Characteristics

Understanding the family demographics and socioeconomic situation of CAWD highlighted in Figure 6.2, is essential for addressing the challenges and barriers that limit their PA participation. Factors such as low income, caregiver availability, and parental education levels can significantly influence access to PA opportunities, transportation, and resources for inclusive activities. These limitations may reduce the likelihood of active participation in structured or unstructured PA both within and outside school. Recognising these dynamics highlights the importance of targeted family and school support to create equitable opportunities, foster an inclusive environment, and empower families to overcome socioeconomic challenges. This approach ensures that CAWD can benefit from enriched PE and PA engagement tailored to their unique contexts.

Table 6.2: Family key indicators.

SEV 2: Family Characteristics	(%) Resp 0	(%) Resp 1	(%) Resp 2	(%) Resp 3	(%) Resp 4	(%) Resp 5
Distance to school	0.00	17.46	30.16	22.22	20.63	9.52
Parental situation	0.00	0.00	0.00	100.00	0.00	0.00
Living with	0.00	0.00	0.00	0.00	0.00	100.00
Mother: Alive	0.00	100.00	0.00	0.00	0.00	0.00
Mother: Educational level	20.63	17.46	20.63	33.33	7.94	0.00
Mother: Working	38.10	0.00	0.00	61.90	0.00	0.00
Mother: Income level	38.10	53.97	7.94	0.00	0.00	0.00
Mother: Age	0.00	26.98	49.21	23.81	0.00	0.00
Mother: Body shape	30.16	44.44	25.40	0.00	0.00	0.00
Mother: Physical activity level	20.63	19.05	25.40	12.70	17.46	4.76
Father: Alive	0.00	100.00	0.00	0.00	0.00	0.00
Father: Educational level	0.00	20.63	17.46	20.63	33.33	7.94
Father: Working	20.63	0.00	0.00	79.37	0.00	0.00
Father: Income Level	20.63	38.10	33.33	7.94	0.00	0.00

i) Analysis

The collected data revealed that all the CAWD live with their parents, and 93.65% of them have no siblings, whether older or younger. The educational level of mothers, with primary or no education, was relatively lower than that of fathers (38.09% and 20.63%, respectively, with 20.63% of mothers having no education). In contrast, the proportion of mothers with higher education was much smaller compared to fathers (7.94% and 41.27%, respectively).

The proportion of mothers not working and without income was high (38.10%) compared to fathers (20.63%). Among those with low incomes, the proportions were 53.97% for mothers and 38.10% for fathers. Similarly, in full-time employment, the proportions were 61.90% for mothers and 79.37% for fathers. Despite being employed full-time, mothers were more likely to have low incomes (53.97% compared to 38.10% for fathers) and less likely to have medium incomes (7.94% compared to 33.33% for fathers).

Mothers in the study were younger than fathers. Among mothers, 76.19% are under 45 years old, compared to 26.28% of fathers. Additionally, 23.81% of mothers and 49.21% of fathers are under 60 years old. No obese parents were identified in the study population. However, the proportion of parents who are overweight was 25.40% for mothers and 28.57% for fathers. Parents with little or no physical activity represent 39.68% of mothers and 34.92% of fathers.

The mean body mass index (BMI) of girls in schools S3 and S4 is 20.89 ± 4.44, compared to boys in schools S1 and S2, whose BMI is 21.12 ± 6.43.

ii) Qualitative Insights

The parents reflected how the lack of siblings required them to focus more on the child. However, they highlighted the financial, transportation and housing challenges. They indicated making sacrifices often to meet their child's needs, especially given the lower income levels reported or the distance from sports facilities, insisting that the family dynamics are strongly affected.

- *"As a single child, my son gets all our attention and support, but it's still hard balancing his needs with our limited income and the location of our home."*
- *"Sharing the house with my parents, it's inconvenient for myself and my child to practice at home."*

Some others indicated that their work or age prevents them from supporting their children in PAs, and those with lower educational levels declared not being confident to provide them effective PA support.

- *"I know I should be more active, but after work, I'm often too tired to do much. My job leaves me a short time to support my child's PA."*
- *"Even though I'm not well educated and working long hours, I do my best to support my child in PA as much as I can. It's stressful, but I make sure my child doesn't feel it."*

They also illustrated how their limited PA can indirectly affect the CAWDs' activity levels and discussed their relative dedication to playing a key role in their children's development and education. A majority of them indicated stress, fatigue, and lack of confidence as barriers to supporting their children's PA, impacting negatively their child's PA perception and engagement.

- *"I know I should be more active myself, but between work and household responsibilities, I'm often too tired. I worry that this might affect how much my child gets involved in physical activities."*
- *"It's hard to balance everything. I try to support my child as much as I can, but sometimes I feel I'm not confident or active enough to encourage them properly."*

The religious customs did not appear to be a PA participation barrier.

- *"Even though our religious customs are strict, my daughter joins me in exercising inside and outside the home."*

iii) Findings Summary

The data and qualitative insights reveal a multifaceted picture of factors influencing CAWD's PA participation including family and socio-economic dynamics, parental barriers and facilitators, health and activity indicators and the role of external supports The absence of siblings and the parents' lower educational attainment, particularly among mothers, combined with economic constraints, shaped the extent of parental support for PA. Mothers often faced greater challenges, balancing full-time work with lower income levels, impacting their capacity to provide active PA support. Parents identified stress, fatigue, and logistical issues as key barriers to supporting their children’s PA. However, they also demonstrated resilience and adaptability, often finding ways to prioritise their child’s PA needs despite personal and socio-economic challenges. Religious customs were not perceived as a significant barrier and cultural adaptability facilitated PA participation.

Despite logistical and socio-economic challenges, parents’ health indicators, such as BMI and PA levels, suggested minimal barriers related to obesity or physical inactivity. However, their limited engagement in PA may indirectly influence CAWD's activity habits. Parents emphasised the importance of accessible sports facilities and structured PA programs in overcoming barriers and enabling their children to participate in PA. These findings suggest that addressing contextual and environmental barriers is critical to enhancing PA participation among CAWD.

iv) Implications and Impact on PA

The family characteristics outlined in the data have several potential implications for the PA participation of CAWD. Below is an analysis of how these factors may influence PA behaviours.

a) Parental Education Levels

Mothers had relatively lower educational levels compared to fathers, with a significant proportion having no formal education. Lower education levels may limit parents' understanding of the benefits of PA and their ability to effectively prioritise and support their child's PA involvement and engagement (Ruedl et al., 2021). Fathers, with higher rates of higher education, may have more access to resources or knowledge to facilitate PA but may be less involved in caregiving due to employment responsibilities. Lower maternal education could reduce engagement in structured or organised PA activities at home or in the community

(Jiménez-Pavón et al., 2020). Programs targeting maternal education on the importance of PA might improve outcomes.

b) Employment and Income

Mothers were predominantly unemployed or had low income, suggesting limited financial resources to support PA for sports equipment and paying for sports programs and events (King et al., 2003; Witt & Dangi, 2018). Despite higher employment and income levels, fathers may be less involved in daily caregiving and PA encouragement due to time constraints. Families with low financial resources may prioritise basic needs over extracurricular activities, limiting PA opportunities for CAWD and restricting access to adaptive sports programs, transportation, or specialised equipment needed for CAWD to participate in PA (King et al., 2003). Full-time working fathers might contribute financially but leave caregiving and PA facilitation primarily to mothers, who may lack the resources or knowledge to engage children in PA (Witt & Dangi, 2018).

c) Parental Age

Mothers were generally younger than fathers, which might indicate greater energy and physical capacity to engage with their children in PA. Younger mothers may also be more open to adopting new PA strategies or participating in community-based PA programs. Older fathers might contribute less directly to PA participation, as age could limit their physical involvement or ability to support active play. The age difference between parents might result in imbalances in how PA is modelled and supported at home, with younger mothers potentially playing a larger role (Su et al., 2022).

d) Parental BMI and PA Levels

No obese parents were identified, but a notable proportion of parents were overweight and had low PA levels. Parents' behaviours often influence their children’s activity levels through role modelling (Schoeppe et al., 2017). Parents with little or no PA may fail to encourage or participate in PA with their children, creating an environment that normalises inactivity. A lack of parental participation in PA could lead to fewer opportunities for children to be active. This is particularly critical for CAWD often requiring more structured and supported opportunities to engage in PA. Parents who are overweight or inactive might also struggle to promote a healthy lifestyle, indirectly affecting their children’s PA habits.

e) Lack of Siblings

Most CAWD had no siblings. They thus miss peer modelling or spontaneous play at home. Siblings often serve as companions for unstructured PA, such as running, cycling, or playing sports (Kracht and Sisson, 2018). Without siblings, the responsibility for engaging children in PA often falls entirely on parents or external programs. CAWD might rely more heavily on structured environments, such as school PE or community sports, to meet PA needs. The absence of siblings could lead to social isolation, discouraging group participation or team-based PA.

f) Gender-Specific Observations

The BMI data suggest that boys and girls had similar weight statuses, but considering gender differences within families might influence PA. Mothers might play a more significant role in shaping girls' PA behaviours, while fathers may influence boys' participation and girls may be at a higher risk of inactivity if maternal education, resources, or activity levels are low. Fathers might model PA behaviours for boys, but this influence could be limited if fathers are inactive or primarily engaged in work (Sherar et al., 2016; Solomon-Moore et al., 2018).

6.2.5 Assessing and Interpreting School Resources and Organisation

All four schools provided identical responses as illustrated in Figure 6.2, indicating consistency in the adequacy of PA facilities, the provision of resources for special needs children, and the organisation of awareness events, highlighting uniformity in their approaches to supporting PA.

The schools had similar physical environments and were governed by a common educational authority (GDET) that enforced uniform standards for PA facilities, resources, and programs, providing the same training or guidelines for assessing and implementing PA support and allocates a similar budget for PA-related infrastructure and programs. Although aligned resources and policies across the schools, their average MVPA levels vary, suggesting that students in S4 engage in higher levels of MVPA on average compared to those in S1, indicating variability in activity engagement between schools. The standard deviations reveal differences in the variability of MVPA levels among students within each school.

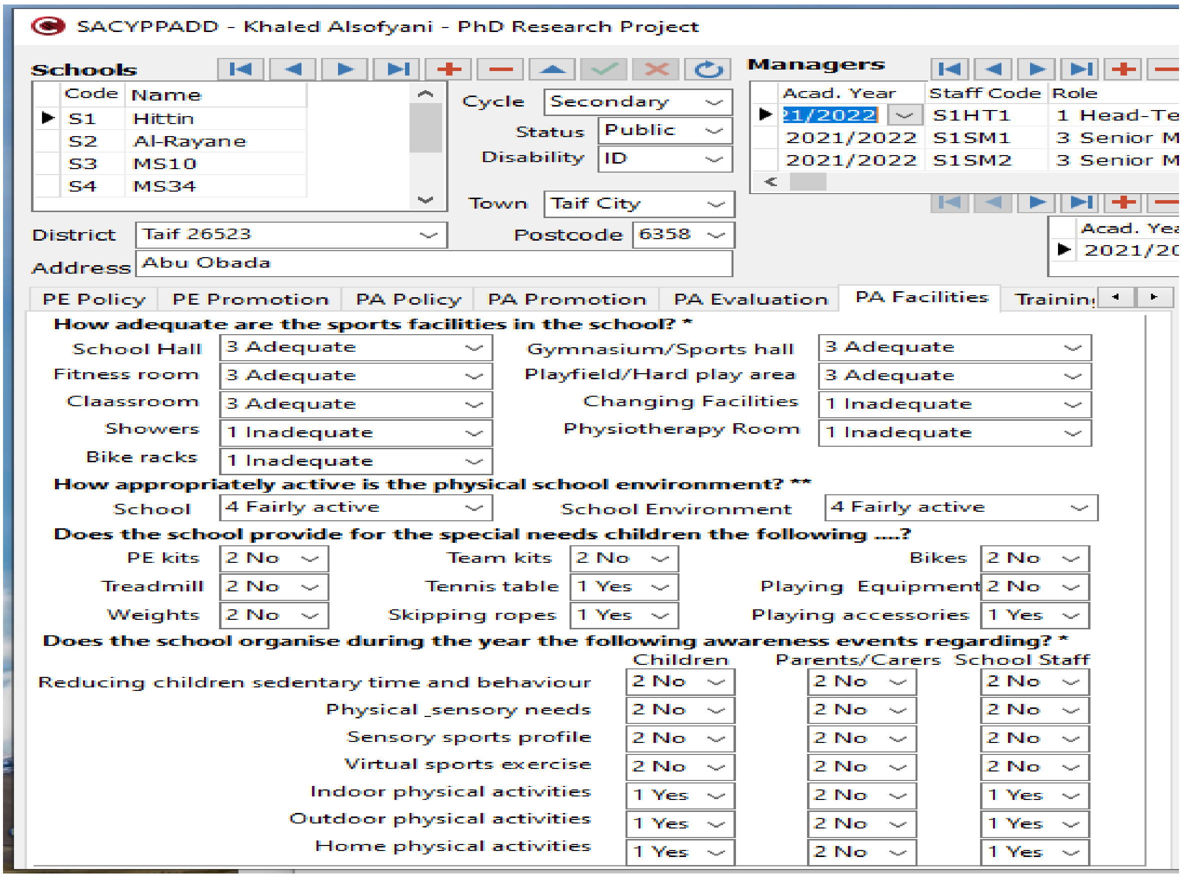

Figure 6.2: School facilities and provision.

i) Analysis

a) Adequacy of Sports Facilities

The adequacy and inadequacy of school sports facilities forming the physical school environment were evaluated across multiple categories by stakeholders in FGDs. School Hall, Gymnasium/Sports Hall, Fitness Room, Playfield/Hard Play Area, and Classrooms were all rated as Adequate, and these spaces provide essential environments for conducting PAs and inclusive sports. Changing Facilities, Showers, Physiotherapy Room, and Bike Racks were rated in FGDs as Inadequate, and the lack of adequate changing facilities and showers can discourage active participation, especially among older students. Inadequate bike racks may reduce the likelihood of cycling to school, an important form of PA. The physical school environment was rated as Fairly Active, indicating moderate integration of PA-promoting elements into the school setting.

b) Provision for Special Needs Children

The availability of PA-related resources for SN children was assessed, with significant gaps identified about insufficient resources. PE Kits, Team Kits, Treadmills, Bikes, Tennis Tables, and Weights were marked as "No" across the board, highlighting a lack of essential equipment for inclusive PA, whereas Skipping Ropes, Playing Equipment, and Playing Accessories were marked as "Yes," indicating some basic equipment is provided. The lack of awareness programs limited the opportunities to educate and motivate stakeholders about the importance of PA. Expanding such programs can foster a more supportive environment for PA participation.

c) Awareness Events Organized by Schools

Schools were assessed on their organisation of awareness events to promote PA for children, parents/carers, and school staff. The analysis of qualitative insights in FGDs reveals limited awareness of events, indicating that most events, including those addressing reducing sedentary behaviour, Physical/sensory needs, indoor/outdoor activities, and home PAs, were rated negatively for all groups (children, parents, and staff). However, virtual sports activities were marked positively, suggesting some innovative approaches to engage stakeholders.

ii) Qualitative insights

CAWD expressed their disappointment in the school's lack of resources and poor sports management. They felt self-conscious or discouraged from participating in PA as proper changing rooms and shower facilities are unavailable, impacting their willingness to engage in after-school sports or high-intensity activities that require freshening up afterwards.

- *“We want to be active, but the lack of proper and adequate facilities makes us feel like we’re not being taken seriously.”*
- *“We need more equipment like treadmills for indoor activities, especially during bad weather. It’s not always safe or comfortable to go outside.”*
- *“It’s embarrassing to go back to class sweaty because there are no showers. It makes me want to skip gym classes altogether.”*

Parents echoed these sentiments, emphasising how a lack of proper facilities and poor management impacts their children’s enthusiasm for PA.

- *“My son loves sports, but I need to be confident he’s in a safe environment where staff understand his needs and can act quickly if there’s an issue.”*

- *“My daughter doesn’t want to go to after-school sports in the sports community facilities anymore because she says it’s awkward not having a proper place to change. it feels like there is no privacy.”*

Teachers and staff also acknowledged the lack of resources and highlighted creative ways they’ve adapted to encourage activity despite limitations including supervision and safety concerns. They insisted on the importance of additional training to ensure the safety and inclusion of all CAWD and shared their desire for more training and resources to organise impactful events and parental awareness.

- *“We try to keep all the children safe, but it can be challenging when we don’t have enough staff trained in adaptive sports or disability-specific needs.”*
- *“We want to do more, but with limited funding and time, it’s challenging to plan events that reach everyone.”*
- *“Workshops for parents and children could make a huge difference in encouraging active lifestyles at home and in school.”*
- *“We sometimes let the children use the hallways or unused classrooms to move around during breaks. It’s not ideal, but it helps them stay active.”*

School managers reported that CAWD also suffered from the lack of funding, impacting the purchase of specialised equipment like treadmills and exercise bikes restricting their indoor activities. The children enjoyed the teachers’ tolerance to use occasionally the classroom to play.

- “*We have limited funds that prevent us from buying indoor equipment to meet the CAWDs’. It’s hard for them to join sport activities in cold weather.”*
- *“Sometimes, the teachers allow the children to stretch, dance or do a quick activity between lessons. It’s fun and helps us focus.”*

iii) Finding Summary

The analysis of sports facilities, provision for SN children, and awareness events reveals several key challenges and opportunities for enhancing PA among CAWD including the adequation of sports facilities, the provision for CAWD, and awareness events organised by the school and the community. While essential spaces such as school halls, gymnasiums, and playfields were rated as adequate, there is a significant lack of facilities like changing rooms, showers, and bike racks, which can deter participation in PA, particularly for girls and older students. The lack of adequate facilities can discourage engagement in after-school sports and high-intensity activities, particularly during adverse weather conditions, ultimately resulting in a school environment that is "Fairly Active".

Stakeholders, including CAWD, parents, and teachers, expressed disappointment over the inadequate facilities and the negative impact on students' enthusiasm for PA. CAWD feel self-conscious and discouraged due to the absence of proper changing facilities and showers, which affect their willingness to engage in after-school sports. Parents and teachers echoed these sentiments, highlighting the barriers posed by inadequate resources and the challenges in ensuring the safety and inclusion of CAWD during PA activities. The lack of specialised equipment and insufficient staff training were seen as major hurdles in creating a truly inclusive environment. Despite these challenges, teachers have adapted by using available spaces appropriately, such as hallways or unused classrooms, to encourage movement and stay active.

Overall, while there are some efforts to facilitate PA for CAWD, significant gaps in resources, training, and child and parental awareness remain. Addressing these gaps through better-adapted facilities, more inclusive resources, and increased training for staff is essential to enhance significant participation in PA in this population leading to better physical and mental health outcomes for CAWD. Additionally, organising more targeted awareness events for parents and expanding their involvement could support long-term sports changes in the school environment, encouraging a culture of active living across all school groups.

iv) Implications and Impact on PA

School resources and organisational practices are crucial in shaping CAWD PE and PA experiences. Adequate resources, such as trained staff, adaptive equipment, and inclusive facilities, are essential for creating an environment that supports diverse abilities. However, limited resources or lack of proper organisation are barriers that restrict CAWD's active participation in PE and PA programs. Organisational factors, including scheduling, class size, and the integration of inclusive teaching methods, also influenced engagement. Addressing these challenges emphasises the need for schools to adopt evidence-based strategies and resource allocation to foster an inclusive culture. By optimising school resources and enhancing organisational practices, schools can provide PE and PA opportunities for CAWD, promoting equity and meaningful participation across various settings.

The absence of adequate support facilities (e.g., showers and physiotherapy rooms) limits opportunities for post-activity recovery and inclusive PA support. Additionally, improving bike storage could encourage active commuting. A fairly active environment suggests room for improvement, such as introducing active break zones, PA-promoting signage, or outdoor activity areas. The lack of critical equipment (e.g., treadmills, weights, and bikes) limited opportunities for tailored PA programs for children with disabilities. Addressing these gaps can promote greater inclusivity and accessibility. Furthermore, enhancing these facilities could contribute to a more supportive and motivating environment, fostering increased participation in physical activity. Providing specialised equipment and support spaces would not only make PA more accessible for children with disabilities but also improve their overall health and well-being. This could include offering adaptive equipment and personalised activity plans, ensuring that all children, regardless of their abilities, have equal opportunities to engage in physical activities and experience the benefits of an active lifestyle.

The quantitative analysis revealed the higher mean MVPA levels in S4, paired with a lower standard deviation, might indicate more structured or evenly distributed PA opportunities. The greater variability in S2 and S3 suggests potential disparities in accessing or participating in MVPA, which could be influenced by factors that include individual differences, school policies, or available resources. The relatively low mean in S1 may reflect fewer PA opportunities, less encouragement, or other environmental or socio-ecological barriers.

6.2.6 Assessing Family Support

The analysis of data about the CAWD PA home support shows the various ways in which adults, particularly parents, influence and facilitate PA behaviours. Support can take many forms, including direct encouragement for children to engage in PA at home, outside, or inside school. Additionally, adults may actively participate by watching children practice at home or in outdoor settings, as well as modelling PA through their activities at home or outside. Transportation support is also a key factor, with parents facilitating access to outdoor spaces and sports facilities. This multifaceted approach highlights the critical role of family involvement in shaping PA opportunities for CAWD as highlighted in Table 6.3.

Table 6.3: Home support key indicators.

SEV 3: Home Support	(%) Resp 1	(%) Resp 2	(%) Resp 3	(%) Resp 4	(%) Resp 5
Adults encourage children to practice at home	15.87	28.57	15.87	31.75	7.94
Adults encourage children to practice outside	14.29	41.27	15.87	20.63	7.94
Adults encourage children to practice at school	6.35	36.51	22.22	25.40	9.52
Adults watch children practice at home	7.94	28.57	23.81	28.57	11.11
Adults watch children practice outside	12.70	38.10	20.63	22.22	6.35
Parents practice with the child at home	15.87	25.40	23.81	28.57	6.35
Parents practice with the child Outside	20.63	22.22	28.57	19.05	9.52
Parents transport child practice outside	14.29	25.40	26.98	23.81	9.52
Parents transport child practice in sports facility	17.46	33.33	23.81	15.87	9.52

i) Analysis

A significant proportion of adults often encouraged children to practice at home (31.75%) whereas fewer adults always provided this encouragement (7.94%), and about 44.44% rarely or never offered support. Most adults encouraged outdoor practice rarely (41.27%), with only 28.57% often or always offering support. Encouragement at school showed moderate support, of adults encouraging children often and always 25.40% and 9.52% respectively.

A significant proportion (42.86%) never or rarely provided school-based encouragement, suggesting that outdoor encouragement is less frequent compared to home-based encouragement. Parents observed their child’s practice at home often (28.57%) and always (11.11%) whereas a significant minority never or rarely observed (36.51%). Watching practice outside is less common, rarely with 38.10% and only 6.35% always participating. Barriers such as limited time or outdoor accessibility might explain lower involvement.

Parental practice at home is relatively balanced, participating often (28.57%) and always (6.35%) whereas a combined 41.27% never or rarely engage. The outdoor practice showed lower engagement, with only 28.57% practising sometimes and 19.05% often. About 42.85% rarely or never engaged in this activity. Transportation outside showed moderate engagement, providing support sometimes (26.98%) and often (23.81%) whereas 39.69% never or rarely provided transportation. Transportation to sports facilities was less frequent, with supporting this activity rarely 33.33% and often, only 15.87%. A combined 50.79% rarely or never transported their child to facilities.

ii) Qualitative insights

The analysis highlights varying levels of parental involvement in facilitating home-based activities. While some parents actively encouraged their children to engage in PA at home, others face challenges that limited their ability to provide consistent support.

- *"We encourage our child to exercise at home as much as we can, but sometimes it's hard to keep up with their needs."*
- *"My daughter is always enthusiastic about indoor activities like skipping or stretching, and we try to cheer her on, even if we're busy."*

Outdoor PA encouragement appeared less frequent, reflecting potential barriers such as safety concerns or limited access to outdoor spaces. While some parents actively promoted outdoor activities, others face challenges that hinder their ability to do so consistently.

- *"It's not safe to let my child play outside alone, so we're hesitant to encourage him unless we can supervise."*
- *"We'd love to motivate outdoor play, but with limited parks nearby, it's not always feasible."*

Observation of PA at home shows varying levels of parental involvement. While some parents often or always watch their children practice, others face challenges, such as work schedules or other responsibilities that limited their availability.

- *"Watching my child practice at home is easier—we can step in to correct or encourage when needed."*
- *"Sometimes, we're too occupied with other tasks, so we don't always have the time to watch our son's activities."*

Watching children practice outdoors was less frequent, often due to accessibility and time constraints. While some parents strived to watch, when possible, many faced barriers to consistent involvement.

- *"It's tough to always be there when our daughter is playing outside, but we try when we can."*
- *"I wish we had more time to accompany my child to outdoor activities—it would help us bond and keep him motivated."*

Parental participation in PA showed a mixed pattern. At home, engagement is moderate, with some parents actively involving themselves, while outdoor participation was comparatively lower, often impacted by work schedules and other commitments.

- *"Joining in my son's PA activities at home is fun and keeps us both active—it's our little family routine."*
- *"Outdoor participation is harder, especially with work schedules, but we know it's important for our child's development."*

Transportation support for PA highlights varying levels of involvement. Some parents actively provided transport to parks or sports facilities, while others struggled due to logistical challenges or busy schedules.

- *"We try to take our daughter to parks or sports facilities whenever we can, but it's not always easy with our busy schedules."*
- *"Without reliable transportation options, it is difficult to ensure my child has consistent access to activities."*

iii) Findings Summary

The analysis of parental involvement in supporting PA for CAWD reveals significant variation in the types and levels of support provided. Parents were more involved in encouraging PA at home than outdoors or at school. Many parents cheered their children during home activities, but outdoor encouragement was inconsistent due to safety concerns and limited access to spaces. Observing PA at home was more common than outdoor practice where time constraints and logistical challenges limited participation.

While parents were willing to be involved, work and household responsibilities often acted as barriers. PA home participation was stronger, with families integrating PA into daily routines, but outdoor participation was hindered by competing commitments. Transportation support was moderate, with some parents facilitating access to parks and facilities, though many struggled due to financial constraints or logistical issues.

Parental involvement was crucial for CAWD's PA participation, with gaps in outdoor and school-related support. Addressing these gaps through better access to safe outdoor spaces, reliable transportation, and support for time and resource constraints could improve PA opportunities. The findings highlight the need for targeted interventions to promote inclusive and consistent PA for CAWD.

iv) Implications and Impact on PA

While some home support is present, a notable proportion of adults may lack the consistency needed to foster a home environment conducive to active PA participation. Barriers such as safety concerns, lack of access to outdoor spaces, or time constraints may limit family outdoor encouragement (CDC, 2024). Opportunities for collaboration between parents and schools to promote PA may be underutilised. Although outdoor practice might be limited by logistical challenges or perceived barriers to inclusion, active parents' observation of their children exercising could help reinforce PA behaviours at home. However, inconsistent parental involvement may hinder sustained engagement. Making outdoor activities more accessible or structured could enhance and increase adult observation, and strengthening parent-child interactions through structured PA programs could encourage more consistent practice. Although access to affordable and proximate sports facilities may be limited, requiring community or school interventions, providing resources or subsidies for transportation may enhance opportunities for outdoor PA participation.

6.2.7 Assessing the Child's School Support

The assessment of the CAWD school support factors highlighted in Table 6.4, focuses on evaluating how well schools promote PA and PE as part of their inclusive practices. This involves examining the perceived benefits of PE on academic performance, children's preferences for school sports, and the awareness and appropriateness of PE and PA curricula, along with intra- and extra-curricular activities. By analysing these factors, the study aims to identify strengths and areas for improvement in school support systems to enhance the overall physical activity participation and well-being of CAWD. Table 6.4 highlights the study findings.

Table 6.4: Child school support factors.

SEV4: Child School Support		(%) Resp 0	(%) Resp 1	(%) Resp 2	(%) Resp 3	(%) Resp 4	(%) Resp 5
The child performs better at school after PE lessons		0.00	9.52	14.29	41.27	20.63	14.29
The child prefers sports at school rather than outside		0.00	9.52	31.75	17.46	26.98	14.29
The child would like PE to become a core subject		0.00	15.87	22.22	25.40	28.57	7.94
The child is aware of	PE curriculum	1.59	14.29	26.98	25.40	20.63	11.11
	PA curriculum	1.59	23.81	20.63	22.22	22.22	9.52
	Intra-curricular activities	1.59	17.46	19.05	17.46	25.40	19.05
	Extra-curricular activities	1.59	9.52	33.33	22.22	17.46	15.87
	Intramural activities	1.59	14.29	26.98	22.22	26.98	7.94
	Extramural activities	1.59	14.29	23.81	22.22	25.40	12.70
The child found appropriate	PE curriculum	1.59	19.05	19.05	22.22	26.98	11.11
	PA curriculum	1.59	17.46	17.46	23.81	22.22	17.46
	Intra-curricular activities	1.59	4.76	22.22	26.98	30.16	14.29
	Extra-curricular activities	1.59	9.52	28.57	34.92	19.05	6.35
	Intramural activities	1.59	17.46	20.63	31.75	15.87	12.70
	Extramural activities	1.59	11.11	20.63	25.40	31.75	9.52

i) Analysis

a) Performance and Preference in PE and Sports and PE becoming a Core Subject

Assessing whether CAWD performs better at school after PE lessons, the analysis reveals that most responses are clustered around Slightly (14.29%), Moderately (41.27%), and Very (20.63%), indicating that a significant proportion perceives improvements in their school performance following PE lessons. However, a smaller percentage (9.52%) found PE lessons not beneficial, while 14.29% rated it as essential. A high percentage (28.57%) expressed a very interest in PE becoming a core subject, with 25.40% indicating moderate interest, and a notable portion (15.87%) does not support this idea.

Regarding whether CAWD prefer sports at school rather than outside, the analysis reveals that opinions are mixed, with 31.75% finding this slightly true and 26.98% choosing very true, and while some (14.29%) strongly prefer sports at school (Essential), the rest exhibit moderate or low preference levels.

b) Awareness of PE and PA Curricula

The results highlight that the PE curriculum awareness is slightly higher than the PA curriculum, with 25.40% moderately aware and 20.63% very aware. For the PA curriculum, 23.81% are unaware, and only 22.22% are very aware, suggesting a need for better communication of the PA curriculum. The intra-curricular activities awareness was higher (very aware (25.40%) and essential (19.05%) compared to extra-curricular activities: very aware (17.46%) and essential (15.87%). Similarly, awareness of intramural and extramural activities was moderate, with around 22–27% of responses rated as "Very aware."

c) Appropriateness of PE and PA Support

The PE curriculum was perceived as more appropriate than the PA curriculum, with 26.98% rating it as very appropriate and 11.11% as essential. A slightly lower proportion rated the PA curriculum as very appropriate (22.22%) and essential (17.46%). Intra-curricular activities received higher ratings of appropriateness, with very appropriate (30.16%) and essential (14.29%). Extra-curricular activities were seen as moderately appropriate with 34.92% and intramural activities had moderate appropriateness ratings (moderate: 31.75% and very: 15.87%), but fewer found them essential. Extramural activities scored higher (very appropriate: 31.75% and essential: 9.52% "Essential”).

Overall, a majority of CAWD perceived PE lessons as beneficial for academic performance, but only a small percentage considered them essential. A noticeable proportion preferred school-based sports over external sports, but the preferences are varied, showing no overwhelming majority. Awareness of the PE curriculum and intra-curricular activities was relatively higher than in other areas, but gaps remained in communicating the PA curriculum and extra-curricular activities. The appropriateness ratings showed room for growth, especially in the PA curriculum, extra-curricular activities, and intramural activities.

ii) Qualitative Insights

The analysis of school support factors reveals several key insights into how physical PE, PA and school settings contribute to inclusive practices. The perspectives of participants offer valuable context. Many participants believed PE positively impacted on academic performance, with moderate to significant improvements, frequently reported.

- *"After PE lessons, CAWD seem more focused and perform better in class—it helps them channel their energy."*

Although opinions vary, there was considerable interest in making PE a core subject, while some remained sceptical. Preferences for school-based sports over external options were mixed, with notable support for school environments.

- *"It would be great if PE was treated as a core subject to enjoy an extended sports curriculum and attend more sports lessons during the week. CAWD feel more confident playing sports at school, where it's structured and familiar."*
- *"PE is important, but it shouldn't overshadow other subjects."*
- *"Not everyone enjoys PE, so making it mandatory might not work for all students."*

Parental awareness of the PE curriculum was slightly higher than that of the PA curriculum, with many calling for better communication with the school. Intra-curricular activities showed relatively better awareness than extra-curricular, intramural, and extramural opportunities.

- "*We didn't even know about some of the activities available—it would help if the school shared more information."*
- *"The intra-curricular options are well-advertised, but the others seem like an afterthought."*

Awareness and perceptions of appropriateness for curricula and activities vary, indicating opportunities for schools to enhance communication and inclusivity. The PE curriculum is generally viewed as appropriate, though ratings suggest room for improvement. Intra-curricular activities received the highest ratings for appropriateness, while extra-curricular and intramural activities were considered less suitable.

- *"The PE program is solid, but it could use more variety and make inclusive and easily accessible to keep more students engaged."*
- *"We need more extra-curricular options that cater to their interests and abilities."*

iii) Findings Summary

A majority of respondents viewed PE lessons as beneficial to children's academic performance, with many reporting moderates to significant improvements, suggesting that PE promotes both physical health and academic focus. Opinions on sports preferences were mixed, with a slight preference for school-based sports, indicating that the structured school environment fosters greater engagement and confidence. Many respondents supported making PE a core subject, but some remained neutral, highlighting a need for further discussion on its integration into the broader curriculum.

Awareness of the PE curriculum was relatively high, but awareness of the PA curriculum and extra-curricular activities was lower, suggesting a need for better communication of available opportunities. The PE curriculum was seen as appropriate, though there were calls for greater variety and inclusivity, with intra-curricular activities receiving higher ratings than extra-curricular ones. Some respondents believed extra-curricular and intramural activities could better cater to the unique needs of CAWD.

The findings underscore the importance of schools in fostering inclusive and effective PA and PE programs, emphasising the need for targeted strategies to enhance participation and well-being for CAWD.

iv) Implications and Impact on PA

The minority finding PE lessons not beneficial or essential suggests variability in how PE is delivered or its relevance to individual needs, indicating a need for more tailored and inclusive PE programs. The mixed responses regarding preferences for school-based sports highlight the need for schools to enhance their PA offerings, ensuring they are engaging and inclusive. A significant portion of CAWD shows strong or moderate preferences for school sports, strengthening school sports programs as a central hub for PA. The high interest in making PE a core subject, expressed by many CAWD, reflects its perceived value in their daily lives. However, resistance from a smaller group suggests the need to advocate for the benefits of PE to a broader audience, including students and stakeholders.

The relatively low awareness of the PA curriculum compared to the PE curriculum suggests that CAWD may not effectively understand the objectives and benefits of PA programs, limiting their potential to engage fully in PA opportunities. Awareness levels for intra-curricular activities are higher than for extra-curricular activities, highlighting a need for schools to promote and facilitate participation in after-school sports and PA programs, which could provide additional avenues for engagement. The higher appropriateness ratings for the PE curriculum compared to the PA curriculum indicate that schools may need to refine their PA programs to ensure they meet the needs and expectations of CAWD more effectively. While intra-curricular activities received the highest appropriateness ratings, moderate ratings for intra- and extramural activities suggest improvement in making these offerings more inclusive, accessible, and engaging for CAWD.

These findings suggest that while PE is generally well-regarded for its impact on performance and appropriateness, efforts to improve awareness, communication, and inclusivity of PA and extracurricular programs are critical. Overall, they support past work as indicated in Chapter 4, Chapter 6 and this chapter (Bush and García Bengoechea, 2015; Fernández-Martínez et al., 2020; van Sluijs et al., 2021). Addressing these gaps could enhance CAWD's engagement in PA, improve their overall well-being, and foster a supportive environment that values their unique needs and preferences. Schools should prioritise creating a more inclusive and comprehensive PA culture, integrating feedback from CAWD and their families.

6.2.8 Assessing the Child's PA Engagement

The assessment of PA engagement factors, highlighted in Table 6.5, is essential to evaluate the factors influencing their PA participation and provide a comprehensive understanding of the challenges and opportunities for fostering active lifestyles among CAWD. The findings from this assessment will inform strategies to enhance PA engagement, ensuring equitable and inclusive opportunities for all children.

Table 6.5: Analysis of PE Engagement Factors.

SEV5: PA engagement factors The child	(%) Resp 0	(%) Resp 1	(%) Resp 2	(%) Resp 3	(%) Resp 4	(%) Resp 5
can be active on weekdays	1.59	7.94	31.75	25.40	25.40	7.94
can be active on weekend days	1.59	19.05	25.40	20.63	20.63	12.70
can be active at home	1.59	11.11	28.57	19.05	30.16	9.52
can be active at school	1.59	11.11	26.98	33.33	22.22	4.76
can be active outside	1.59	11.11	25.40	23.81	26.98	11.11
can be active in cold weather	1.59	4.76	25.40	36.51	22.22	9.52
child can be active in hot weather	1.59	7.94	23.81	28.57	25.40	12.70
can be active on busy days	1.59	17.46	22.22	34.92	14.29	9.52
prefers PA to watch TV in Weekdays	1.59	14.29	28.57	26.98	15.87	12.70
prefers PA to watch TV in Weekend days	1.59	9.52	22.22	33.33	20.63	12.70
ask adults to practice together at home	1.59	26.98	47.62	23.81	0.00	0.00
ask adults to practice together at school	1.59	15.87	36.51	36.51	9.52	0.00
ask adults to practice together outside	1.59	28.57	39.68	30.16	0.00	0.00
engage in PA Doctors' recommendation	1.59	15.87	28.57	22.22	14.29	17.46
engage in PA School recommendation	1.59	9.52	28.57	15.87	23.81	20.63
engage in PA Parents' recommendation	1.59	17.46	23.81	20.63	25.40	11.11
engage in PA Friends recommendation	1.59	15.87	22.22	14.29	28.57	17.46
engage in PA important exercise regularly	1.59	11.11	39.68	19.05	14.29	14.29
not bothered to engage in PA	1.59	23.81	20.63	20.63	25.40	7.94

i) Analysis

a) Weekday vs. Weekend Activity

Most children are moderately active on weekdays, with 31.75% disagreeing and 25.40% either neutral or agreeing. Only 7.94% strongly agreed, indicating a need for improvement in sustaining higher levels of activity during weekdays. Activity levels declined slightly on weekends. While 25.40% disagreed with being active, a similar proportion were neutral (20.63%) or agree (20.63%). However, 19.05% strongly disagreed, highlighting significant inactivity for some children during weekends.

b) Activity Locations and Weather

A significant proportion of children (30.16%) agreed in focus groups that they exercise at home, highlighting the home environment as an important setting for PA. However, 11.11% strongly disagreed, indicating disparities in home-based support or opportunities for PA. Schools also played a prominent role in promoting PA, with 22.22% of children agreeing and 33.33% remaining neutral. Yet, the low percentage of children strongly agreeing (4.76%) suggests an untapped potential for schools to enhance PA engagement further. Regarding outdoor PA, 26.98% of children agreed, and 11.11% strongly agreed, suggesting outdoor activities are moderately important. However, barriers persisted for some, as reflected by 11.11% strongly disagreeing. In cold weather, 22.22% of children agreed that PA was moderately sustained, with 36.51% remaining neutral. Conversely, PA engagement was slightly higher in hot weather, as 25.40% agree and 12.70% strongly agree. These trends reflect seasonal variations in activity levels.

c) PA Preferences and Social Influence

A preference for physical activity PA over watching TV on weekdays indicates some alignment toward active lifestyles, with 15.87% of children agreeing and 26.98% being neutral. This preference for PA increased slightly on weekends, with 20.63% agreeing and 33.33% were neutral, suggesting that weekends could provide more opportunities for PA if utilised effectively. Responses regarding asking adults to engage in PA at home, school, or outdoors was primarily skewed toward lower ratings, with most strongly disagreeing or disagreeing. Notably, no participants strongly agreed, indicating low interest or limited opportunities for such interactions.

e) Barriers to PA Engagement

Most children relied on:

- Siblings (47.62%) for practice at home, followed by parents (23.81%), while 26.98% did not ask adults for help, suggesting siblings are the primary support, with fewer children seeking assistance from parents or adults overall.
- Peers (36.51%) or friends (36.51%) for practice at school. Teachers were a less frequent source of support (9.52%), and 15.87% reported no help, suggesting peers and friends are the primary support network at school.

- Friends (39.68%) or siblings (30.16%) for practising outside, while 28.57% reported receiving no help. indicating friends are the primary support for outdoor practice.

Doctors' PA recommendations were the least influential, with the majority of responses being neutral. School recommendations for more PA had a more balanced distribution, while parent and friends' recommendations were generally more positive, with parents showing a higher proportion of agreement and friends having the strongest influence, especially for those who strongly agreed. Children strongly disagreed that they were not concerned to engage in PA represent 23.81% while a substantial 25.40% agreed the presence of disengaged children underscores the importance of addressing barriers, such as motivation or access. The majority of participants were neutral (39.68%) or agreed (19.05%) that regular exercise is important for child PA, with a smaller proportion strongly agreeing or disagreeing.

ii) Qualitative Insights

Parents in focus groups reported that children exhibited moderate activity levels on weekdays, but the data suggests that it was a challenge to maintain consistent activity throughout the week. Weekend activity also presented challenges, with some children showing low engagement, emphasising the need for strategies to boost PA engagement throughout the entire week.

- *"We try to get them to move after school, but they're often tired from homework and other things."*
- *"Weekends are tough sometimes they'd rather stay indoors and watch TV than go out to play."*

The home environment played a significant role in fostering PA, with some children engaging in in-home activities. However, parents highlighted barriers like lack of space or equipment in the home, suggesting that schools can contribute to PA, even though improvements are needed. They also pointed out that weather impacts engagement, whether it's cold or hot as it's the case in KSA.

- "*We have space in the living room, so my child plays indoors if the weather is bad. It keeps him active."*
- *"I'd love to see my daughter active at home more, but it's hard when we don't have much space for anything but basic exercises."*
- *"When it's too cold, my child doesn't want to go outside, but when it's warmer, he is happy to run around outside."*

Many children preferred PA over watching TV, particularly on weekends. They seemed to like it more when it's a family thing. However, some still expressed a strong preference for sedentary activities. Encouraging PA at home, school, or outdoors through adult and peers' involvement seemed to have limited success according to parents and children.

- *"On the weekends, we try to go for walks or bike rides instead of sitting around all day."*
- *"They're not always excited to get active, especially when they can just sit and watch their favourite shows."*
- *"We ask them to join us outside, but they don't always want to. They're more interested in doing their own thing."*

Siblings and friends served as key sources of support for PA engagement, and according to the children, the strong influence of parents, friends, and doctors' recommendations for PA seems less impactful.

- *"My brother helps me practice basketball at home. He's always up for it, and we make a game out of it."*
- *"I usually go outside with my friends after school. We just play whatever comes to mind."*
- *"Our doctor tells us to stay active, but it doesn't change much. It's easier when friends are around to get us moving."*
- *When my parents say we should go for a walk or play outside, I usually agree. But it's my friends who push me to stay active."*

A significant portion of children reported not being concerned about PA, highlighting the need for motivation, and despite some children's resistance, regular exercise was still seen as important.

- *"Sometimes I don't feel like doing anything, especially when it's cold outside. I'd rather stay warm."*
- *"I know they should exercise every day. I encourage them, but it's hard when they don't want to."*

These qualitative insights underline the barriers to engagement, including motivation and environmental factors. They provide a deeper understanding of the factors influencing PA engagement for CAWD, emphasising the roles of family, friends, and environmental factors, as well as the barriers that need to be addressed to improve participation.

iii) Findings Summary

Parents reported that children maintain moderate activity levels during weekdays, but face challenges in sustaining consistent PA throughout the week, with even more difficulty on weekends. Children often prefer sedentary activities like watching TV, indicating a need for strategies to increase PA across all days. The home environment is essential in fostering activity, although barriers such as limited space and equipment hinder engagement. Weather conditions, particularly in KSA, also impact participation, with children more likely to engage in PA when it's warmer.

While many children preferred PA over TV, especially when done as a family, there was still a tendency toward sedentary behaviours, and adult and peer involvement in encouraging PA often proves ineffective. Siblings and friends served as stronger sources of support for PA than adults, with some children expressing indifference to recommendations from parents, doctors, or teachers. Motivation remained a significant barrier, as many children reported a lack of interest in PA, especially in unfavourable weather conditions. Despite these challenges, parents emphasised the importance of regular exercise, highlighting the need for targeted strategies to overcome motivational and environmental barriers to enhance PA engagement for CAWD.

iv) Implications and Impact on PA

- The results indicate that most children are moderately active during weekdays, but there was a noticeable decline in activity levels on weekends, with a significant portion of children being inactive. This suggests that strategies to sustain weekday activity may not translate effectively into the weekend, and the decline in activity over the weekend could be a crucial area to address in promoting consistent PA among CAWD across different population groups.
- Home was identified as a primary location for physical activity, but there were disparities in the level of support or opportunity for PA within this setting. Schools play a significant role in PA engagement, yet the potential for greater impact is not fully realised. Outdoor PA is moderately important but can be hindered by weather, with activity levels fluctuating based on temperature, indicating that environmental factors may limit outdoor engagement during colder months.
- Children preferred PA over TV during weekdays, and this choice was more pronounced on weekends, suggesting that there is an opportunity to encourage more PA if structured activities are provided. However, the low interest in involving adults in PA at home, outside

and inside school, reflects a lack of social engagement or guidance from adults, which could impact PA motivation and opportunities.

- Siblings, friends, and peers played an important role in supporting PA, indicating that social networks, particularly among children, are central to engagement. However, the lack of adult involvement and support (particularly from parents or teachers) highlights a barrier that could hinder greater PA participation. Additionally, the response patterns regarding the lack of motivation and access emphasise the need to address intrinsic and extrinsic barriers to engagement, such as personal interest and environmental constraints.

6.3 Stakeholders Recommendations

6.3.1 Disability

Although the study reveals minimal disability-related limitations on PA abilities, key factors such as family and school support, inclusive PA programs, and accessible sports facilities are crucial for encouraging active participation. It is recommended that schools and families work together to create supportive environments that motivate and facilitate PA engagement. Peer support programs could be implemented in schools to foster inclusive and engaging PA activities for CAWD while community-based initiatives should focus on creating accessible and inclusive spaces for PA. Given the lack of significant PAQ participation barriers related to health or cognitive impairments, emphasis should be placed on ensuring the inclusivity of PA curricula.

While cognitive and sensory impairments were minimal in this the sample, it remains important to ensure the availability of specialised resources when needed. Additionally, PE teachers and school staff should receive training in inclusive teaching strategies and adaptive sports. Further recommendations to enhance PA participation among CAWD are outlined below, categorised by the levels of influence they relate to.

6.3.2 Family

The challenges posed by these family characteristics can be mitigated and the following strategies gained from stakeholders during focus groups could be considered, including school-parent communication, community outdoor programs, educational workshops, parent-child PA programs, family active support and observation, transportation subsidies and CAWD PA skill-building workshops.

- Increase awareness of the importance of consistent PA encouragement and participation, particularly in outdoor and school settings through parent education and family-based activity programs to educate both parents about the importance of PA and practical strategies for engaging children in activity, especially at home, and encourage them to participate in PA alongside their children at home and outside.

- Address parental inactivity through workshops or fitness programs to improve their own PA levels, creating a positive impact on their children's PA habits, and introduce programs that involve them actively practising PA with their children to foster engagement and role modelling through structured parent-child activities.
- Provide support for unemployed or low-income parents to help provide free access to PA resources and organise community support groups.
- Provide subsidies or community transportation options to sports facilities and improve accessibility to safe outdoor spaces.to facilitate access to resources.
- Strengthen collaboration between schools, community and families to encourage and monitor school-based PA participation through collaborative school-parent initiatives, and accessible community programs to provide low-cost or subsidised adaptive sports programs for CAWD to reduce financial barriers and facilitate peer-group activities to provide social interaction and PA opportunities for CAWD without siblings.

These recommendations from stakeholders aim to address the specific gaps in PA support for CAWD while recognising the diverse needs and barriers families face.

6.3.3 School Resources and Organisation

The analysis highlights the strengths and areas for improvement in PA facilities and programs in the schools listed below. Addressing these gaps can significantly enhance PA opportunities, particularly for children with disabilities. As stakeholders recommended:

- Enhance the facilities by upgrading changing rooms, showers, and physiotherapy rooms to ensure inclusivity and encourage PA participation, and by installing bike racks to support active commuting.
- Enhance the school sports resources for SN Children by investing in adaptive PA equipment, such as treadmills, bikes, and weights, tailored to CAWD and ensuring the availability of PE and team kits for inclusivity in team-based activities.
- Foster a supportive school environment by training educators and staff on inclusive practices to effectively and efficiently support CAWD in PA activities and encourage

peer-assisted activities to foster inclusivity, motivation, and social connections during PE and PA sessions.

- Promote Awareness Programs by organising awareness events targeting sedentary behaviour reduction, physical/sensory needs, and indoor/outdoor activities for children, parents, and staff, and fostering home-based PA by educating parents about strategies to support their children's activity levels.
- Activate the School Environment by developing initiatives to make the school environment more active, such as structured recess activities, outdoor PA zones, or regular movement breaks.

6.3.4 Child-School Support

Schools can create an inclusive and supportive environment that maximises CAWD's participation in PA, enhances their physical and mental well-being, and fosters active living. As stakeholders recommended:

- Enhance the inclusivity and quality of PE programs to tailor PE lessons to individual needs by developing customised PE programs to address the varying abilities and interests of CAWD, ensuring everyone can benefit from participation.
- Advocate for PE as a core subject to highlight the cognitive, physical, and social benefits of PE to stakeholders, including students, parents, and policymakers, to gain broader support for its inclusion as a core subject in schools.
- Improve awareness and communication by promoting the PA curriculum with CAWD and their families using accessible formats, targeted campaigns and effective communication methods such as tailored digital campaigns, accessible materials, community workshops and information sessions, partnership with community and sports groups and interactive web portals and apps to increase the visibility of extracurricular programs and encourage participation in extracurricular and after-school activities, emphasising their benefits and availability.
- Increase collaboration with families to strengthen home-school connections by engaging and encouraging parents as PA partners, offering them workshops and resources to help them support and encourage PA at home and in the community, and involve them to collaboratively develop shared strategies for supporting CAWD's PA participation across home, school, and community settings.

- Monitor and evaluate progress through regular objectively measured assessments of the appropriateness, awareness, and impact of PE and PA programs through surveys and PA-participation data-driven focus groups involving CAWD, parents, and teachers, to support evidence-based adjustments to PA offerings, ensuring they remain relevant and effective.
- Advocate for policy support by promoting funding and policies that prioritise inclusive and adaptive PA programs for CAWD and integrate PA into broader health initiatives, aligning school-based PA initiatives with local or national health campaigns to emphasise their importance in improving overall well-being.

6.3.5 Child PA Engagement

- Address barriers related to motivation and access by developing strategies to motivate disengaged children, particularly focusing on overcoming personal and socio-environmental barriers such as lack of interest or suitable spaces for activity, providing more flexible and varied PA options that cater to different interests and addressing issues like access to outdoor activities, spaces or equipment.
- Foster environments where children can motivate and encourage each other, at home and school, capitalising on the influence of peers, siblings, and friends through group-based physical activities. to sustain higher levels of engagement.
- Promote weekday and weekend PA equally by initiating programs that bridge the gap between weekday and weekend activity levels, focussing on creating fun, accessible, and engaging activities that children can participate in during the weekend to reduce inactivity.
- Focus on weather-adapted activities to address the varying weather conditions and provide alternative PA options during colder months, such as indoor sports or dance classes, while promoting outdoor activities during warmer weather to balance seasonal variations in PA engagement.
- Increase adult involvement by engaging parents and teachers in supporting adapted PA, offering incentives or programs that encourage adult-child interaction during PAs, and encouraging parent-child and teachers-children challenges in activities that could enhance adult involvement.

- Enhance home and school-based PA support by investing in providing more structured PA opportunities within schools and at home, ensuring that children have access to a variety of settings where they can engage in PAs, including home exercise programs, school-based PA, and extracurricular PA activities.

6.4 Conclusion

In conclusion, understanding the interaction between barriers and facilitators is crucial for developing effective strategies to promote enhanced and inclusive PA participation among CAWD. The approach used in this qualitative analysis emphasises the importance of evidence-based, stakeholder-driven, and context-sensitive strategies for promoting PA among CAWD. They also support the need for longitudinal studies and comprehensive approaches that address the PA participation influence factors at the multiple socio-ecological levels, as outlined in the methodology used in this research (Chapter 3). By identifying these factors measured, analysed and interpreted in Chapters 4, 5 and 6, stakeholders can help design tailored interventions that address the unique needs of different population groups, including schools, gender, disability, and age groups. Family and school support systems play a vital role in overcoming barriers to PA by providing encouragement, role modelling, and accessible programs. These support networks can transform challenges into opportunities for active and inclusive PA participation among various CAWD groups, ultimately fostering equitable and sustainable PA engagement. Through inclusive practices and targeted interventions, stakeholders can empower CAWD to engage more fully in PAs in school settings, the broader community and home environments.

Chapter Seven: Discussion and Conclusion

7.0 Introduction

This study addressed a significant knowledge gap in the context of Saudi Arabia, where limited research exists on understanding and promoting PA participation among CAWD. Despite global advancements, few studies have explored how socio-ecological and systemic factors affect PA levels among CAWD in Saudi settings. This research responds to that gap and aims to generate contextually relevant evidence to support meeting national and international PA guidelines.

Specifically, the study aimed to identify key barriers and facilitators influencing PA participation through a mixed-methods design. The first phase of the study explored perceived influences on PA using validated socio-ecological variables (SEVs), guided by the ISCOLE protocol. The second phase used accelerometer-based assessments to evaluate PA levels against the UK's recommended 120–180 minutes of MVPA per week, supplemented by structured PA sessions that supported the definition of intensity cut-points for CAWD over 14 years.

In the third phase, statistical analyses examined the association between SEVs and objectively measured PA levels to understand the complex interplay of factors influencing behaviour across individual, interpersonal, school, and environmental levels. This multi-level analysis supported stakeholder engagement in defining the practical and inclusive policy components necessary for sustainable PA participation among CAWD.

The research aligns with Saudi Arabia's Vision 2030 initiative to promote widespread, inclusive participation in physical activity, contributing to national goals for health, well-being, and disability inclusion. The chapter begins by restating the study objectives, followed by key quantitative and qualitative findings and their integration. Interpretations and implications are then discussed, leading into a reflection on the study's strengths, contributions, and limitations. The chapter concludes with recommendations for future research and final remarks.

7.1 Key Quantitative Findings

It is important to note that while this study provides valuable insights into the CAWD PA levels, particularly those with LID and MHI, existing literature does not offer direct comparisons of PA levels across various population groups among these specific disability categories. Consequently, drawing comparisons with published studies specifically focused on the PA levels of CAWD with LID and MHI is not produced in this discussion of the study findings, as such research remains underrepresented. However, this study contributed to the literature by focusing on participants with LID, comparing their PA levels to those of typically developing peers. This approach is crucial in identifying potential disparities and informing the development of inclusive interventions to improve CAWD PA engagement. Further research exploring the unique PA patterns of CAWD with LID and MHI in isolation or in comparison with other disability groups is needed to provide more nuanced insights and to enhance the generalisability of the findings.

7.1.1 Weekly MVPA Compliance

Variations in the compliance rate of weekly MVPA reflect the influence of different classification methods and assumptions on guideline adherence, emphasising the importance of refining age-specific PA intensity thresholds to ensure an accurate assessment of PA levels. The study revealed that fewer than half of the population meets the recommended PA guidelines of 120–180 minutes per week, aligning with research indicating that most adolescents do not meet daily MVPA guidelines, as indicated by Woods et al. (2021) that 87% of adolescents did not achieve the recommended levels, with variations across age, gender socioeconomic status and disabilities.

The study revealed variability in MVPA compliance among the groups, with notable differences between boys and girls, as well as across age ranges and disability categories. Girls showed slightly higher compliance rates than boys, while those with a light intellectual disability (LID) had higher compliance compared to those with a mild hearing impairment (MHI). Age-wise, younger participants (12–14 years) demonstrated slightly better compliance than older groups (15–17 years and 18–21 years). Across schools, compliance rates varied, with certain schools achieving higher levels of MVPA than others, reflecting differences in the socio-ecological environment and PA opportunities provided. These results align with the study by Ma et al. (2024) highlighting that CAWD often exhibit lower levels of PA compared to their non-disabled peers, with significant disparities influenced by factors such as disability type, gender, age, and environmental contexts. Overall, these findings highlight the heterogeneity of MVPA compliance within the population and the influence of factors such as gender, age, and disability type, as well as the school environment.

7.1.2 Daily MVPA compliance

The study assessed the daily MVPA among CAWD, revealing distinct patterns in session length. Most days participants scored less than 20 minutes of MVPA, accounting for over half of the total days. Days scoring 20 minutes or longer were less frequent, with a progressively lower percentage as the day score increased. Only a small proportion of days exceeded 30 or 40 MVPA minutes, indicating that extended days of PA were relatively uncommon within the sample. These findings align with findings that many children and adolescents with disabilities accumulated less than 20 minutes of MVPA, and do not meet the recommended 60 minutes of MVPA daily (Xu et al., 2020; Yang, 2022). They highlight the prevalence of shorter PA days among CAWD, emphasising the need for targeted interventions to increase the daily duration of PA engagement while considering individual capabilities and contextual factors.

7.2 MVPA Patterns

7.2.1 Moderate PA (MPA) and Vigorous PA (VPA)

The study identified notable differences in moderate and vigorous PA levels across the various groups. Overall trends indicate that MPA levels were significantly higher than vigorous PA across all groups, indicating that participants generally engaged more in moderate-intensity activities. MHI recorded the highest levels of both moderate and vigorous PA compared to those with LID. However, the difference between moderate and vigorous PA was more pronounced in the MHI group. Girls demonstrated slightly higher MPA and VPA levels than boys, though the difference between MPA and VPA was consistent across genders. The 12–14 age group engaged in more MPA compared to older groups, while their VPA levels remained relatively stable. The oldest group (18–21 years) recorded the lowest levels of both MPA and VPA, with a particularly low engagement in vigorous activity. Participants from S2 showed the highest levels of MPA and VPA among all schools and those from S4 exhibited the lowest VPA levels but had moderate PA comparable to other groups, highlighting the disparity between activity intensities within this group. These findings align with the study's results by Wouters et al. (2019) and the systematic review by Vanderloo et al. (2022) indicating that children with disabilities tend to engage more in moderate physical activity (MPA) than in vigorous physical activity (VPA). Overall, VPA consistently exceeded vigorous PA across all groups, with noticeable variations influenced by age, gender, and type of disability.

7.2.2 MVPA Outside and Inside the School

The study compared weekly MVPA levels among CAWD inside and outside school settings, revealing notable differences. Across the sample, a greater proportion of MVPA occurred outside school, accounting for more than half of the total MVPA. However, the distribution of MVPA varied significantly among subgroups. CAWD with LID and girls had a more balanced MVPA distribution between inside and outside school, while those with MHI and boys engaged more frequently in MVPA outside school. Younger CAWD (12–14 years) demonstrated higher proportions of inside-school MVPA compared to older age groups (15–17 and 18–21 years), where outside-school MVPA dominated. A study by Jevdjevic et al. (2025) revealed that children accumulated minimal MVPA during school, aligning with the observation that a significant portion of MVPA for CAWD occurs outside of school settings (Tassitano et al., 2020). These findings underscore the critical role of out-of-school environments in facilitating MVPA for CAWD, highlighting the importance of targeted interventions that extend beyond school settings to promote PA participation effectively.

7.2.3 MVPA Weekdays and Weekends

The study examined differences in MVPA engagement across various contexts, including school days with and without semi-structured activities, and weekend days, revealing distinct participation patterns. Across all participants, MVPA levels were generally higher during school days with semi-structured activities, particularly during inside-school periods, compared to schooldays without semi-structured activities or weekends. Subgroup analysis highlighted variability in these trends: children with MHI consistently recorded higher MVPA levels across all settings compared to those with LID. Age groups also showed differences, with younger participants (12–14 years) engaging more inside the school during semi-structured activities, while older age groups (15–17 and 18–21 years) showed more balanced or outside-school-dominant MVPA patterns. A study by Tassitano et al., (2020) indicated that children were more MVPA-engaged after school. These findings emphasise the useful role of structured activities in promoting MVPA during school and the potential for enhancing PA participation outside school hours, particularly on weekends.

7.2.4 Sleep and PA Levels

The study analysed PA levels and sleep duration among CAWD, revealing notable variations across different groups. On average, participants achieved sufficient sleep duration, with younger children (ages 12–14) recording the highest sleep averages compared to older groups. Sleep duration also tended to be slightly higher among girls than boys. PA levels varied across sedentary, light, moderate, and vigorous intensities. MVPA was relatively consistent, though boys had slightly lower MVPA levels than girls, which is contrary to Hao and Razman, (2023) findings that boys engaged in significantly more MVPA during PE classes compared to girls. Children in this study with MHI showed higher MVPA engagement compared to those with LID. Additionally, sedentary behaviour was more prominent among LID participants, while MHI participants demonstrated higher light and moderate activity levels. Similarly, age-wise, Hao and Razman, (2023) reported the same findings that the youngest group (12–14 years) engaged more in light and moderate activities, whereas the oldest group (18–21 years) recorded the lowest MVPA and highest sedentary durations. These findings highlight the interplay between age, gender, and disability type in shaping PA patterns and underscore the importance of tailoring interventions to specific group needs.

7.2.5 Semi-Structured Activities

The study analysed high-engagement activities including SSA 3, 4, 9, and 10, showing high MET and MVPA values, and confirming their role as vigorous and engaging activities across age groups. Low-engagement activities including SSA 1, 2, and 7 had lower MVPA and MET values, suggesting they required less effort and were less engaging for participants. The analysis across age groups revealed that the younger CAWD demonstrated lower MVPA levels compared to older CAWD, likely reflecting physical development. However, a noticeable decline in MVPA was observed for SSA3 and SSA4 for the 2 older groups, indicating shifting preferences or reduced motivation for these activities while consistency in low-intensity activities (SSA 1 and SSA2) was observed across all age groups, indicating limited engagement and energy expenditure. Combining validated MET values and MVPA data underscores the importance of age-specific and activity-focused interventions to support PA engagement and intensity in CAWD.

The results indicate that all age groups consistently outperform in SSA 1 and 2 when compared to their corresponding MET values from the Youth Compendium of Physical Activities (YCPA), suggesting these activities likely involve lower physical effort or are familiar and easy to execute, making them accessible for all participants regardless of age, or may also reflect participants’ preference or confidence in performing lighter-intensity activities. They also underperform in SSA 5, 6, 8, 9, and 10 indicating that participants' MVPA levels were below expectations based on the validated MET values due to possible activity difficulty or complexity, physical limitations, and motivational or environmental factors. Participants performed at expected levels in SSA 3, 4, and 7, matching the MET values derived from the YCPA, suggesting that these activities likely strike a balance between effort and accessibility, aligning well with the participants' physical abilities and interest levels, making them achievable while providing an appropriate challenge. Incorporating them into PE and recreational programs can offer CAWD opportunities to engage in meaningful and enjoyable PA, tailored to their individual needs and preferences (McGarty et al., 2021).

7.3 Health Factors

The analysis across groups of the different health factors, including both the anthropometric measurements and the more specific body composition metrics highlights several notable trends and differences among CAWD. The findings offer important insights into age, gender, disability-specific factors, and their role in shaping body composition and metabolic rates across various groups.

7.3.1 Age and Growth Trends

Across the groups, there was a clear age-related pattern in body composition. Older adolescents (18–21 years) exhibited significantly higher values in factors such as body fat percentages, lean body mass, basal metabolic rate, and resting metabolic rate, reflecting the body's adaptation to age and developmental changes. In contrast, younger children (12–14 years) showed lower values across most metrics, indicating early stages of physical development.

7.3.2 Gender Differences

Gender-based distinctions were particularly prominent in body fat distribution and metabolic rates. Girls exhibited higher body fat percentages and lower lean body mass compared to boys. They also had slightly lower lean mass indexes, indicating a greater proportion of body fat relative to lean mass. Boys, conversely, had higher lean body weight and lean body mass index, suggesting greater muscle development. These differences align with typical gender-based variations in body composition, particularly during the transition through puberty. These findings are reflected in a population-based study conducted in western Poland (Kaczmarek et al., 2024) on body composition parameters in normal-weight children and adolescents.

7.3.3 Disability-Specific Observations

Participants with LID tended to have higher body fat and lean body weight, suggesting more significant overall weight gain. Their basal metabolic rate and energy expenditure were also higher compared to MHI participants, who exhibited lower body fat percentages and lower lean body mass. Their basal metabolic rates and energy expenditure were also slightly lower, which could result from more sedentary behaviour or other physiological factors related to the disability. The findings about the children with LID aligned with the study's results by Ungurean et al. (2022), which indicated higher body fat percentages and lean body mass, leading to elevated BMI values and basal metabolic rates compared to their typically developing peers.

7.3.4 Age Group Differences

When looking at age groups, the most significant changes occurred in older adolescents (18-21 years), especially in their lean body mass and metabolic rates. The 12-14 years group had the lowest values across almost all body composition metrics, indicating that the children were still developing and gaining lean mass, while in the 15-17 years group, body fat percentage and lean mass indexes began to rise, reflecting the onset of puberty. The basal metabolic rate also increased. The older group displayed the highest levels for both body fat and lean body mass, as well as basal metabolic rate and resting energy expenditure. This suggests a fully matured metabolism and body composition, typical of older adolescents and young adults.

7.3.5 Correlational analysis

The correlation analysis reveals that the relationships between health factors, various PA levels, and sleep are predominantly very weak or weak, with fewer moderate, strong, and very strong correlations. However, the analysis suggests a moderate, but not strong, correlation between Health factors and MVPA aligns with BMI, WHR and WHtR often associated with MVPA levels (Chinmoyee, 2023). Additionally, the analysis reports the following significant CAWD MVPA predictors: school, Waist-to-hip ratio, lean body mass and resting metabolic rate. There are no significant correlations of age with MVPA overall, sedentary behaviour, or other MVPA subcategories. Older CAWD tend to have less in-school MVPA, after-school MVPA, and sleep.

Participants with higher Light activity levels tended to have slightly higher sleep levels, and those with higher MVPA levels exhibited higher sedentary behaviour during other periods. This contradicts some recent findings that insufficient MVPA which often correlates with increased sedentary behaviour, was positively associated with poor sleep quality, sleep disturbances, and other sleep-related issues (Alnawwar et al., 2023). In contrast, MVPA shows no significant correlation with Sleep or Light activity. Participants with more sedentary time might also have more light activity periods. In contrast, no significant relationship was observed between Sedentary behaviour and Age or Sleep.

Overall, age showed an inverse relationship with MVPA Inside School, MVPA in Activity Days Outside School, sleep, and light activity, reflecting a decline in PA and sleep as age increases, aligning with current literature indicating that MVPA levels declined across school levels, from preschool to middle school, for both boys and girls (Schroeder et al., 2020). MVPA exhibited strong correlations with its subcategories but showed no significant association with sleep or light activity while being positively linked to sedentary behaviour. Light activity was positively associated with improved sleep and sedentary behaviour but decreased with age. Sleep demonstrates a weak yet positive relationship with light activity.

Health factors exhibit the strongest influence on PA levels and sleep, with notable proportions of strong and very strong correlations while other clusters—such as family, disability, and PA engagement—predominantly show very weak associations. Family support and school support display more balanced distributions of weak to moderate correlations, highlighting some consistent yet limited relationships while PE engagement shows slightly stronger associations compared to PA engagement. Overall, variability in the strength of correlations reflects differing impacts of these clusters on PA and sleep.

7.4 MVPA Prediction

The study reveals a statistically significant association between meeting PA guidelines and schools and disability and insignificant for gender and age. This association aligns with the crucial role played by the school's factors in MVPA levels (Huang et al., 2021). The model factors do not predict significantly MVPA. However, the corrected model demonstrates statistical significance for MVPA inside the school (MVPA-IS) and activity days MVPA inside the school (MVPA-ADIS), sleep, sedentary and light activity levels, with predictors like age and interaction terms influencing these outcomes, though other MVPA variables are poorly explained. Examining differences in MVPA levels between school days with and without semi-structured activities, the analysis revealed significant differences for S4, girls, and the 12–14 age group, and CAWD with LID show slightly significant differences with lower MVPA. This finding contrasts with several studies. For example, a study found that boys were more physically active than girls at baseline (Huang et al., 2021). Another study reported that the prevalence of meeting PA guidelines declined more sharply for girls than boys across school levels (Nicolai er al., 2020).

Significant differences in MVPA inside and outside the school on days with semi-structured activities were observed in the following groups: higher (S3, MHI and 15-17 years) and lower (S4 and 12-14 years). Similarly, significant differences in MVPA levels were observed for all groups except the 18-21 age group, on School days vs Weekend days, indicating consistently higher MVPA outside the school-on-school days compared to weekend days. This is a recognised pattern in the field (Button et al., 2020).

In conclusion, while some of the study's findings align with recent research, others, particularly regarding gender and age effects on MVPA, appear to diverge from current literature. This suggests that the study might reflect unique aspects of MVPA patterns, possibly due to specific population characteristics. All these findings are supported by the perspectives shared during focus group discussions by the stakeholders, consistently emphasising the minimal impact of disabilities on PA participation and the importance of social and environmental factors.

7.5 Key Qualitative Findings

7.5.1 PE and PA Resources, Organisations, and Support to CAWD

The study revealed poor and ineffective PE and PA resources, organisations, and support for CAWD despite all the sport initiatives undertaken in the KSA. The inadequate provision of PE resources and lack of effective support structures for PA within the schools likely contributed significantly to the observed low MVPA compliance rates and disparities in PA patterns. Without a robust system of organised PA promotion, CAWD may face systemic barriers, including insufficient access to engaging, inclusive, and tailored PA programs. This limitation undermines the schools' capacity to act as critical facilitators of PA participation and restricts the naturalistic generalisability or transferability of findings. The study's reliance on school-based data collection makes it difficult to disentangle the influence of the broader school environment from the outcomes, as poor institutional practices may have negatively biased PA levels and participation rates. This aligns with some literature findings, advocating reinforcing the importance of empowering schools through policy advancement, resource allocation, infrastructure development, and targeted training to promote PA among CAWD (Manojlovic et al., 2023; Corey et al., 2024).

7.5.2 Stakeholders Experience in PA-Promoting Strategies and FGD

The stakeholders' inexperience in PA promotion strategies and FGDs had a twofold impact on the study's outcomes. First, their limited expertise may have constrained their ability to contribute to the richness of qualitative data and implement or suggest effective, evidence-based interventions to address PA gaps identified in the quantitative findings. This might explain the lack of effective solutions for engaging CAWD in sustainable PA practices. Second, their reliance on the researcher's suggestions for SEV clustering in FGDs likely restricted the depth and breadth of qualitative insights. Examining meaningful findings without a collaborative exploration can mean that key contextual or innovative solutions may have been overlooked, limiting the study's potential to generate actionable recommendations for PA promotion among CAWD. Indeed, as reported by Shields and Synnot (2016), the importance of involving experienced stakeholders to identify effective, evidence-based interventions should not be minimised.

7.5.3 School's Role in Data Collection

Placing the responsibility for data collection within schools liaising with parents due to data protection protocol, may introduce potential biases and logistical limitations. First, schools may not have fully understood the data collection procedure to ensure accurate and consistent data was collected which could compromise data reliability; the data may reflect institutional shortcomings rather than the participants' actual PA behaviours. Second, the Education Regulation’s delegation of this responsibility may have discouraged critical oversight or auditing, potentially allowing data quality gaps or consistency to persist. Although practical guidance on how best to approach school-based PA data collection is advocated (Taylor & Owen, 2020), this reliance on school-level data collection limits accountability, as schools' motivations and practices may not always align with the research's rigour or objectives. Furthermore, where schools were ineffective in organising or implementing PA programs, the data collected might reflect not only participants' PA behaviours but also the shortcomings of the institutional environment, complicating interpretations of the results.

7.6 Key Findings Summary

The analysis revealed significant variability in PA participation among CAWD, influenced by factors such as age, gender, disability type, health factors and socio-ecological variables such as family variables, family and school support and child PA engagement. Compliance with weekly MVPA guidelines was low, particularly among older adolescents and participants with MHI, while girls and participants with LID exhibited slightly higher compliance rates. MVPA levels were predominantly achieved outside school, though structured school activities were especially impactful for younger participants (12–14 years).

Daily MVPA patterns showed that most participants accumulated less than 20 minutes per day, with limited instances of exceeding 30 minutes. MPA was more prevalent than VPA, with consistently low VPA levels across groups. Semi-structured activities varied in effectiveness, with younger participants engaging more successfully in high-intensity activities than older ones.

Health factors, such as body composition and metabolic rates, showed age-related and gender-specific trends, with older participants exhibiting higher body fat percentages and metabolic rates. Correlations revealed weak links between PA, sedentary behaviour, and sleep, while health factors showed moderate associations with MVPA. Predictive modelling identified schools, waist-to-hip ratio, and lean body mass as key predictors of MVPA in school settings.

Qualitative findings highlighted systemic barriers to PA participation. Poor and ineffective PE and PA resources, and inadequate organisational support within schools, hindered opportunities for CAWD to engage in inclusive and tailored PA programs. These limitations likely contributed to low MVPA compliance and disparities in PA patterns, undermining schools' roles as facilitators of PA participation. Additionally, the inexperience of stakeholders in PA-promoting strategies and FGDs constrained their ability to identify or implement effective interventions, limiting the study's ability to generate actionable recommendations.

Reliance on school-based data collection revealed logistical and procedural weaknesses. Schools' inconsistent understanding of data collection protocols and limited capacity to implement PA programs may have biased the data and complicated the interpretation of findings. The institutional environment's shortcomings combined with insufficient oversight of the data collection process potentially influenced observed PA behaviours and contributed to the systemic barriers identified in the study.

7.7 Interpretation of Findings

The findings underscore the multidimensional challenges CAWD face in achieving recommended MVPA levels, reflecting systemic barriers such as limited accessibility, insufficient opportunities, and the need for tailored PA programs. Poor and ineffective PE and PA resources, and inadequate organisational support within schools, significantly hindered CAWD's ability to engage in regular, inclusive, and higher-intensity activities. These systemic barriers are further exacerbated by schools' limited capacity to design PE and PA curriculums and implement structured and engaging PA programs. These undermine their critical role as facilitators of PA participation.

Gender and disability type play nuanced roles in shaping PA participation. Slightly higher compliance rates among girls and participants with LID could be attributed to differences in activity preferences, social support, or functional capacities. However, the lack of expertise among stakeholders in PA-promoting strategies and FGDs likely restricted the depth of insights into such differences limiting the development of evidence-based interventions to address disparities.

The dominance of MPA over VPA suggests a significant gap in achieving the intensity required to optimise health outcomes. Addressing this gap requires interventions that not only increase overall PA levels but also prioritise opportunities for higher-intensity activities, particularly for older adolescents and those with MHI. The limited number of days where participants achieved sustained MVPA highlights the urgent need for structured, engaging school programs and accessible out-of-school environments that encourage regular and higher-intensity activity. However, the study's reliance on school-based data collection revealed logistical and procedural weaknesses, including inconsistent adherence to data collection protocols and limited accountability. This may have negatively influenced SEV factors but not the accelerometer-based monitoring of PA patterns.

Age-related declines in PA levels and sleep duration highlight developmental transitions that may reduce motivation or increase competing social priorities. Higher body fat percentages observed in older adolescents align with these trends, emphasising the need for age-specific interventions that promote consistent PA during adolescence. The predictive role of health factors, such as lean body mass and waist-to-hip ratio, underscores the importance of integrating health-focused strategies such as nutrition and fitness education into PA interventions.

These findings reinforce the critical role of schools and communities in fostering inclusive, accessible, and engaging PA opportunities for CAWD. However, the absence of a robust system of organised PA promotion and insufficient institutional practices significantly limit the generalisability of the findings and the capacity to address these challenges effectively. Moving forward, addressing systemic barriers, improving stakeholder expertise, and implementing evidence-based, inclusive interventions will be crucial to fostering meaningful PA participation among CAWD.

7.8 Implications of CAWD PA

The findings of this study reveal profound and multidimensional impacts on the CAWD PA. Key insights highlight systemic barriers, demographic and health-related disparities, and the influence of institutional environments on PA engagement. These impacts underscore a crucial need for systemic changes to support CAWD in achieving recommended MVPA levels.

7.8.1 Systemic Barriers and Institutional Influences

Inadequate PE and PA resources and poor organisational support within schools significantly hindered CAWD's ability to participate in regular and inclusive PA. The lack of tailored, accessible programs exacerbates disparities in PA participation, particularly for older adolescents and those with MHI. Schools, which should serve as critical facilitators of PA, struggle with limited capacity to design and implement structured, engaging activities that align with CAWD's needs. These systemic shortcomings contribute to low MVPA compliance rates, restrict opportunities for higher-intensity activities, and create an environment where sustained PA participation is difficult to achieve.

7.8.2 Demographic and Disability-Specific Disparities

The study highlights nuanced differences in PA participation based on gender, age, and disability type. Girls and participants with LID demonstrated slightly higher compliance with

MVPA guidelines, potentially due to differences in activity preferences, social support systems, or functional capacities. Conversely, participants with MHI faced more pronounced challenges in achieving MVPA, reflecting the need for tailored interventions that address the unique barriers faced by specific disability groups. Additionally, age-related declines in PA levels and sleep duration underscore developmental transitions that reduce motivation and increase competing priorities, particularly among older adolescents.

7.8.3 Health and Activity Intensity Gaps

The dominance of MPA over VPA across all groups highlights a critical gap in achieving the intensity needed to optimise health outcomes. The low prevalence of VPA and age-related increases in body fat percentages, emphasise the importance of interventions that promote higher-intensity activities and consistent PA engagement throughout adolescence. Furthermore, predictive factors such as lean body mass and waist-to-hip ratio underline the necessity of integrating health-focused strategies into PA interventions, including nutrition education, fitness assessments, and personalised exercise prescriptions.

7.8.4 Logistical and Stakeholder Challenges

Reliance on schools for data collection revealed logistical and procedural weaknesses, such as inconsistent adherence to data protocols and limited accountability. These challenges, combined with the inexperience of stakeholders in PA-promoting strategies, constrained the study's ability to uncover deeper insights into CAWD's PA behaviours. The lack of evidence-based interventions and collaborative exploration in FGDs further limited the generation of actionable solutions.

In conclusion, despite the challenges identified, the findings illuminate key opportunities for meaningful change in PA participation among CAWD. Inclusive and engaging structured school PA programs, semi-structured activities, and accessible out-of-school environments can significantly enhance PA participation when tailored to the diverse needs of this population. Addressing systemic barriers, building stakeholder expertise, and fostering collaboration between families, schools, and communities are essential in creating supportive ecosystems that encourage regular and higher-intensity PA for CAWD.

7.9 Practical Recommendations

Practical recommendations to address the findings and implications identified in the study analysis include institutional support and resource improvement, promoting gender-specific interventions, addressing gaps in activity intensity, creating supportive socio-ecological environments, strengthening stakeholder expertise and engagement, and overcoming logical and procedural weaknesses. All these recommendations advocate for a systemic change in the CAWD engagement support.

7.9.1 Institutional Support and Resources

The stakeholders are recommended to provide comprehensive professional development for PE and SN teachers, and support staff, along with enhancing PE resources, integrating technology, and improving the school's physical environment. This provision is crucial for developing structured and inclusive PA programs tailored to the specific needs of CAWD. Training all school staff involved with CAWD in inclusive practices and strategies to engage students in both structured and semi-structured PA activities is essential. The integration of technology, such as wearable fitness trackers, virtual reality (VR) tools for adaptive sports simulations, and gamified PA apps, can enhance engagement, facilitate individualised learning, and support real-time monitoring of PA progress. Collaboration with adaptive PA specialists is encouraged to design activities that cater to various disability types, prioritising engagement and enjoyment. Educational and health authorities play a pivotal role by allocating funding to equip schools with adaptive sports equipment, create accessible facilities, integrate innovative technologies, and provide assistive devices that support children with disabilities in participating actively and confidently in PE and PA programs. It is vital also then that they are involved in supporting PA.

7.9.2 Gender and Disability-Specific Interventions

Leveraging school and social support is crucial to enhance CAWD PE and PA engagement. Schools in collaboration with families and communities encourage boys’ and girls' participation through sports and culturally relevant and gender-sensitive activities, such as dance, yoga, or group or team sports tailored to their preferences. Guided group activities are advocated to expand PA opportunities, emphasising on skill-building, communication and group interaction which align with the CAWD functional abilities to include all the disability types.

7.9.3 Gaps in Activity Intensity

The stakeholders are recommended to address the gaps in the CAWD activity intensity by encouraging VPA participation, introducing short bursts of high-intensity interval training (HIIT) or games involving vigorous activity to increase VPA levels and tailoring these to individual capabilities and gradually build intensity in ways that are fun. Sustained PA to reach 30 or 40 MVPA minutes daily, must be encouraged using gamification, rewards, or competitions to motivate CAWD to engage in longer sessions of MVPA. Age-related PA declines could be addressed by incorporating PA into after-school clubs, mentoring programs, and family-oriented PA initiatives to create sustainable habits during developmental transitions.

7.9.4 Supportive Socio-Ecological Environments

Working with stakeholders is recommended to leverage Out-of-School settings in partnership with community organisations and to provide accessible, inclusive activities outside school hours, such as adaptive sports leagues or recreational classes. This requires effective parent engagement to help families understand the importance of PA and provide resources to encourage active lifestyles at home. This action might be conducted through attending workshops or distributing guides on at-home exercises and games. It requires school collaboration to build partnerships between schools, local governments, and disability advocacy groups to address systemic barriers and collectively implement PA-promoting strategies in the context of PA policy changes and initiatives.

7.9.5 Health-Focused Strategies

Achieving healthier body composition among CAWD necessitates a holistic approach that includes a balanced diet both at home and school, complemented by comprehensive fitness assessments. Regular health and fitness check-ups are essential, if people wish, to monitor their physical and metabolic needs and to ensure PA programs remain adaptable and effective. Personalised PA prescriptions should be developed based on key health factors such as lean body mass, waist-to-hip ratio, and individual functional capacities. This integrated strategy promotes sustainable health improvements while addressing the unique needs of each child or adolescent.

7.9.6 Stakeholder Expertise

The stakeholders are recommended to provide workshops for school administrators, teachers, and PE coordinators to support them in the design and implementation of evidence-based PA interventions for CAWD. These regular workshops help foster collaboration by periodically organising FGDs with educators, parents, and CAWD to gather insights and co-develop solutions. This helps build accountability when implementing, monitoring and evaluating PA-promoting strategies ensuring adherence to PA protocols and regularly reviewing PA programs' effectiveness.

7.9.7 Logistics, Procedures and Policy

The stakeholders are recommended to use their expertise and designate trained staff to supervise PA programs and data collection in order to reduce variability and bias, develop clear, standardised protocols for collecting and analysing PA data, ensure consistency across schools, and use wearable devices with real-time feedback to enhance monitoring and promote sustained PA engagement. They could play a key role in policy advocacy by pushing for legislation mandating the elaboration of PE and PA curricula and inclusive school PA programs, funds for adaptive resources in schools and the community, and awareness of reducing stigma and fostering an inclusive culture.

7.10 Strengths and Contributions

7.10.1 Holistic Approach

The strength and contributions of this research lie in its systemic and holistic approach to studying the CAWD's PA behaviour to determine their PA predictors that enable the design of effective and adequate strategies to enhance their PA participation. The study adopts a comprehensive approach to examining the factors influencing PA participation, integrating multiple levels of analysis individual, interpersonal, organisational, community, and policy within a socio-ecological framework. This multifaceted approach unravels the intricate interplay of biological, social, environmental, and cultural determinants that shape PA behaviour across various population groups in different settings.

7.10.2 Socio-Ecological Variables Clustering

The study is distinguished by its utilisation of an extensive and diverse range of variables to measure the multifaceted influences on PA across the five socio-ecological levels. Specifically, it analysed 34 health-related variables, 275 child and family variables, and 636 school-teacher-specific variables (342 school-related and 294 specifics to PE and SN teachers). This breadth of data allowed for a nuanced and in-depth understanding of the barriers and facilitators to PA participation among CAWD. The variables were systematically grouped into clusters aligned with the SEM structure of PA influence levels, providing a logical and structured foundation for data collection, categorisation, and interpretation.

The systematic clustering of variables aligned with the SEM structure of PA influence levels is a critical strength of this study, ensuring that the chosen variable structure adequately addresses the stakeholders' various specific interests and needs. By organising variables into clusters corresponding to individual, interpersonal, organisational, community, and policy levels, the study establishes a logical and structured framework for data collection, categorisation, and interpretation. This approach not only enhances the clarity and coherence of the analysis but also ensures that stakeholders such as educators, policymakers, healthcare professionals, and community planners can readily identify and focus on the factors most relevant to their roles. By addressing the multifaceted nature of PA participation, this clustering approach facilitates targeted, evidence-based interventions and supports more effective decision-making across all levels of influence.

7.10.3 MVPA Assessment

A significant strength of this study is its comprehensive approach to assessing weekly MVPA, not only by quantifying overall levels but also by classifying MVPA across distinct patterns. These patterns include moderate (MPA) versus vigorous physical activity (VPA), the duration of MVPA over consecutive days, and contextual differences such as MVPA inside versus outside school, on days with versus without semi-structured activities (SSA), and on school days versus weekends. This detailed classification provides a nuanced understanding of PA behaviour, highlighting variations in intensity, timing, and context. Such granularity allows stakeholders to identify specific patterns that may facilitate or hinder PA participation, enabling the development of targeted interventions and policies tailored to the unique needs and environments of CAWD.

7.10.4 Intensity Cut-Points

A notable strength of this study is the use of semi-structured activities to refine and validate intensity cut-points for age groups not originally covered by the Phillips-validated thresholds. This approach allows for age-appropriate corrections to the intensity cut-points, ensuring their applicability across all CAWD age groups. By testing the appropriateness of these adjusted thresholds within the study population, the research enhances the accuracy of PA classification contributing to a more inclusive framework for monitoring and evaluating PA in diverse CAWD age groups. This methodological innovation ensures that the study provides reliable, tailored insights into PA behaviours while addressing gaps in existing validation studies.

7.10.5 Quantitative Results Accuracy

A key strength of this study is the precise implementation of domain-specific formulas within the intelligent group decision support system (IGDSS), which significantly enhanced the accuracy and reliability of the results. This included the elimination of non-wear time data, the aggregation of cumulative SVM values in condensed epochs, the incorporation of additional sleep windows alongside the main sleep duration window, and the calculation and multi-level analysis of data across all CAWD population groups. These advancements ensured that the data processing was both rigorous and reflective of the diverse PA and sleep behaviours of the study CAWD population. By leveraging these tailored methodologies, the IGDSS facilitated more accurate and meaningful insights, strengthening the study's ability to identify critical patterns and relationships in PA and sleep behaviours among CAWD.

7.10.6 Intelligent Group Decision Support System

A notable innovation in this research is the use of an intelligent group decision support system (IGDSS), which significantly enhanced data storage, validation, and analysis processes. This advanced system ensured efficient handling of the complex dataset, allowing for accurate identification and interpretation of relationships and patterns among variables. Moreover, the IGDSS fostered meaningful stakeholder collaboration by providing a platform to share qualitative insights, personal experiences, and context-specific expertise. This collaborative input enriched the analysis by integrating diverse perspectives, ensuring that the findings reflect the real-world complexities of PA behaviour in CAWD. By enabling a robust exploration of the interplay between health, socio-ecological, and school-related factors, the IGDSS facilitated a deeper understanding of how these diverse influences converge to impact PA behaviour and support the co-creation of actionable, stakeholder-informed solutions to design effective and adaptative PA-promoting strategies.

7.10.7 PA Participation Knowledge Iterative Refinement

A key strength of this study lies in its iterative refinement of knowledge regarding PA participation, achieved through the longitudinal design that builds upon the findings of this cross-sectional analysis. This design enables the periodic re-measurement of PA behaviour changes over time, fostering enriched interaction with stakeholders through FGDs that review and refine study requirements. By gradually extending the scope to include a broader range of disability types and severities and enrolling more schools, the study ensures a dynamic, evolving understanding of PA participation. This iterative approach not only strengthens the evidence base but also enhances the relevance and applicability of findings, empowering stakeholders to implement more inclusive, adaptive, and effective interventions. The relevance and applicability are related, for example, to comparing data from other longitudinal studies, providing empirical support for iterative stakeholder engagement, and involving diverse disability groups to enhance generalisability and using real-world policy impact of longitudinal PA research.

Overall, this study contributes to the existing body of knowledge by combining a comprehensive socio-ecological framework, an extensive and diverse dataset, and advanced analytical tools. Comparative data from a longitudinal study, (Suarez-Villadat et al., 2021), which assessed accelerometer-based PA and health-related physical fitness over 2 years in adolescents with Down syndrome, provide additional context and validation for our findings. Empirical evidence supporting iterative stakeholder engagement, as highlighted in the study by Amell et al. (2021) underscores the importance of incorporating feedback loops with health practitioners, educators, parents, and CAWD to refine and enhance intervention strategies. Furthermore, including diverse disability groups within the study dataset enhances the generalizability of its findings, aligning with research that emphasises the value of broader representation in physical activity studies (Wouters et al., 2019). These combined elements provide an evidence-based foundation for understanding the multifaceted influences on PA behaviour among CAWD and inform targeted, inclusive, and sustainable interventions and policies based on effective and adaptable PA-promoting strategies.

7.11 Discussion of Research Questions

The study systematically addressed the research questions through a multi-phase mixed-methods design, integrating quantitative and qualitative approaches to provide comprehensive insights into PA participation among CAWD.

- **Q1: What are the barriers and facilitators of PA participation among children and adolescents with light intellectual disabilities or mild hearing impairments?**

This question addresses the need to understand the factors influencing PA participation in this population. The study identified key barriers and facilitators to PA participation among CAWD with light intellectual disabilities or mild hearing impairments through focus group discussions (FGDs) with parents, teachers, and health practitioners. The barriers predominantly included limited access to adaptive sports equipment, inadequate school-based PA programs, and insufficient parental support due to financial constraints and limited PA-related knowledge. Facilitators highlighted included structured PE classes, supportive school staff, and peer inclusion in sports activities. These findings align with previous studies that emphasise the importance of targeted interventions to address socio-economic and environmental barriers to PA (King et al., 2003; Witt & Dangi, 2018).

- **Q2: What is the amount of PA CAWD do in and outside of school and how do their objectively measured PA levels compare to MVPA recommended guidelines and similar measurements elsewhere?**

This question addresses the need to understand the CAWD PA participation and levels. Quantitative data collected via accelerometers revealed distinct patterns of PA levels in and outside of school across different age groups. The results showed that CAWD aged 15–17 years achieved the highest total MVPA, primarily outside of school, while older adolescents (18–21 years) demonstrated the lowest MVPA levels, indicating a decline with age. This trend reflects similar findings reported in the literature, where PA levels typically decrease as children transition into late adolescence (Ortega et al., 2013). The data also indicated that overall, PA levels for most CAWD fell below the recommended MVPA guidelines, underscoring the need for targeted interventions to increase PA opportunities, particularly in the school setting.

- **Q3: How do socio-ecological variables (SEV) influence objectively measured PA participation and levels in this population?**

This question focuses on the causal influences of SEV on PA participation and levels. Socio-ecological variables were analysed to assess their impact on objectively measured PA levels. Key SEVs such as family support, school PA policies, and environmental accessibility emerged as significant predictors of PA participation, aligning with socio-ecological theory, which posits that PA behaviours are shaped by interactions across multiple levels of influence (Sallis et al., 2006). While some SEV clusters showed moderate to strong associations with PA levels, others, such as family financial resources and parental PA encouragement, demonstrated weak or inconsistent associations, suggesting that other contextual factors, including cultural norms and gender roles, may moderate these influences.

- **Q4: What are the trends of PA behavioural change through the causal influence links between SEV and PA participation and levels in this population?**

This question aims to identify the complex interplay of multiple factors across different levels of influence, as mentioned in the study. The analysis of PA behavioural trends revealed complex interactions between SEVs and PA participation. Younger adolescents (12–14 years) exhibited higher inside-school MVPA, potentially due to structured PE lessons, while older adolescents (15–17 years) engaged more in outside-school PA, reflecting the influence of peer interactions and community sports facilities. However, the lowest PA levels among the oldest group (18–21 years) indicated a decline in structured PA participation, aligning with a broader trend of decreased PA in late adolescence (Farooq et al., 2017). This decline highlights the importance of sustained PA promotion strategies, particularly targeting older adolescents transitioning out of secondary education.

- **Q5: Based on the study results, what are the recommended school-based strategies and policies that enable overcoming most of the barriers to PA and PE participation and engagement for children with disabilities in the educational setting in the Region of Taif (KSA)?**

Based on the findings, the study developed targeted recommendations for school-based strategies to mitigate identified barriers and enhance PA participation among CAWD in the Region of Taif. These strategies include implementing inclusive PA programs, integrating adaptive sports equipment, and fostering teacher and peer support networks to encourage active participation. Additionally, policy recommendations emphasise the need for PA guidelines tailored to CAWD, focusing on adaptive PE curriculum development and accessible PA infrastructure. These recommendations align with Saudi Vision 2030, which prioritises the promotion of inclusive and sustainable PA practices to foster healthier lifestyles across all population groups (General Authority of Statistics, 2020).

7.12 Limitations

The combined influence of poor resources, stakeholder inexperience, and school-driven data collection introduced some limitations that must be addressed in the study requirements review in its longitudinal design to ensure its reliability, validity and generalisability are not affected. The study’s findings may be disproportionately shaped by the schools’ systemic inadequacies rather than reflecting inherent characteristics (personal and family factors) or PA behaviours of CAWD. Poor PE and PA resources, combined with ineffective organisational support, likely suppressed MVPA participation and skewed activity patterns, which makes it difficult to generalise findings to contexts with better resources and support. Furthermore, the lack of robust PA-promoting school and community structures suggests that observed PA behaviours may be more indicative of environmental limitations than participant limitations or capability or motivation.

The stakeholders’ inexperience with PA-promoting strategies and FGDs limited the collaborative exploration of the quantitative findings, narrowing the depth and diversity of the qualitative insights. Their reliance on researcher-driven SEV clustering rather than generating nuanced, context-specific interpretations stifled the ability to produce meaningful, innovative solutions. This limitation may have reduced the translational value of the study, as the lack of robust stakeholder engagement failed to account for the lived experiences and specific needs of CAWD and the broader school community.

Delegating data collection to schools under the constraints of data protection protocols may have added layers of complexity and potential biases. Schools may not have consistently adhered to the study's rigorous data collection standards, leading to data reliability gaps and accuracy. Additionally, the dual role of schools as both data collectors and PA environment providers creates a conflict, where the data might inadvertently reflect institutional shortcomings rather than participant-level outcomes. This conflation complicated the interpretation of results and limited the ability to conclude broader trends or variables association.

7.13 Recommendations for Future Research

The interplay of inadequate resources, limited stakeholder expertise, and school-based data collection responsibilities highlights the need for systemic and methodological changes to enhance future research on PA participation among CAWD. Addressing these limitations requires a multi-faceted approach to prioritise capacity-building, methodological rigour, and a focus on equity and inclusion. The following recommendations for future research form a comprehensive and actionable roadmap for advancing research in enhancing PA participation among CAWD. These recommendations can overcome current limitations, generate robust PA knowledge-based evidence, and foster meaningful changes in schools, communities and families to improve PA participation and health outcomes among CAWD.

7.13.1 Building Capacity Within Schools for CAWD PA Promotion

Schools should be empowered to act as effective facilitators of PA participation through advancing policy and advocacy efforts and targeted investment in resources, infrastructure, and training. This includes providing access to inclusive and adaptable PE equipment, creating tailored PA programs that cater to diverse needs, and integrating PA promotion into school curricula. Training programs for teachers and staff should focus on evidence-based practices for engaging CAWD in meaningful and sustained PA while addressing potential biases or misconceptions about their capabilities. This training should include using technology that can play a crucial role in overcoming accessibility challenges and considerably improving PA participation. Future studies should explore using wearable devices, virtual PA programs, mobile applications, and gamified approaches to engage CAWD, particularly those with limited access to in-person programs.

7.13.2 Equipping Stakeholders with Collaborative Research Skills

To overcome the limitations posed by school PA stakeholders' inexperience in PA promotion and research, future efforts should include capacity-building initiatives to enhance their ability to collaboratively design, implement, and evaluate PA policies, strategies and programs. Workshops, mentorship programs, and knowledge-sharing platforms can equip stakeholders with the needed skills to contribute to qualitative and quantitative research processes. This collaborative approach enhances the quality of data collected but also ensures that PA curriculum and programs are contextually relevant and sustainable. Collaborating with policymakers, educators, and advocacy groups can help translate findings into actionable recommendations that address systemic inequities. Future studies should also explore how funding mechanisms and policy frameworks can support sustainable PA promotion efforts for CAWD. Research should inform policy changes aimed at promoting inclusive PA opportunities in this population.

7.13.3 Establishing Independent Data Collection Protocols

Although standardised data collection protocols such as the International Study of Childhood Obesity, Lifestyle and the Environment – ISCOLE (Tudor-Locke et al., 2015) were elaborated, future research should establish independent, standardised data collection procedures to minimise biases and logistical challenges associated with school-based data collection. Leveraging data collection solutions such as digital platforms, and centralised databases can enhance the accuracy and consistency of data while reducing reliance on school staff.

Ethical considerations, including data protection and participant confidentiality, should be integrated into these protocols to ensure compliance with regulatory standards. This enables separating institutional influences from participant-level outcomes. Future studies must prioritise disentangling the impact of institutional environments from individual-level outcomes to gain a comprehensive understanding of the factors driving PA participation among CAWD. This could involve multi-level modelling approaches to address family, school and community multi-level influences, and longitudinal designs to track changes over time.

Comparative studies across diverse institutional settings including schools with varying levels of resources or differing approaches to PA promotion, can provide deeper insights into the role of systemic factors.

7.13.4 Exploring Systemic Barriers and Facilitators to PA Participation

Qualitative research should prioritise a deeper exploration of systemic barriers and facilitators to PA participation among CAWD. These barriers include policy gaps, insufficient funding, limited accessibility, and prevailing societal attitudes that may marginalise CAWD. Engaging CAWD and their families as co-researchers through participatory action research can uncover hidden or underexplored challenges while also generating practical, context-specific solutions. This approach fosters the development of holistic PA policies, strategies, and programs tailored to the diverse needs of CAWD across different population groups.

Future research should emphasise designing, testing, implementing, and evaluating evidence-based PA participation strategies that align PA patterns with health outcomes. These strategies should adopt a holistic approach that integrates (i) disability assessment and inclusion to ensure accessibility and adaptability for diverse needs, (ii) fitness assessments to track individual progress and behaviour changes and establish personalised activity goals, (iii) objectively measured PA patterns to leverage wearable devices or validated tools to gather accurate data, (iv) combined engagement from families, schools, and communities to foster a supportive ecosystem for sustained PA participation and (v) exercise prescription tailored to individual capabilities, preferences, and health conditions while addressing potential barriers to participation. This collaborative and co-designed approach developed in partnership with CAWD, their families, and key stakeholders ensures that strategies are inclusive, scalable, and adaptable across diverse settings. By integrating health, social, and environmental factors into PA interventions, future research can provide a robust foundation for sustainable, impactful improvements in PA participation and overall well-being among CAWD.

7.14 Conclusion

The findings of this study highlight the pivotal role that socio-ecological factors such as school environments, structured activities, and disability-specific needs play in shaping PA behaviours among CAWD. To enhance PA participation, strategies must adopt a holistic approach that addresses these factors, tailoring programs to the diverse needs, preferences, and capabilities of CAWD. Collaborative efforts among schools, families, and communities are essential to creating inclusive, engaging, and sustainable opportunities for CAWD to engage in a meaningful health-enhancing PA.

The study underscores the need for comprehensive, inclusive, and tailored interventions to address the multidimensional challenges faced by CAWD in achieving recommended PA levels. Effective strategies should incorporate demographic variability, health-related predictors, and systemic barriers while prioritising consistent, higher-intensity, and enjoyable PA opportunities across both school and community settings. By addressing these factors, policymakers, educators, and health practitioners can help reduce disparities, improve health outcomes, and cultivate lifelong PA habits in CAWD.

However, the study also revealed critical systemic barriers, including limited stakeholder engagement with PA in schools, inadequate resources, and challenges with data reliability, which may have constrained the depth and generalisability of its findings. These limitations highlight the need for future research to address these constraints through robust methodologies and meaningful stakeholder collaboration to produce actionable, evidence-based knowledge for informing policy and practice.

Ultimately, this study emphasises the critical importance of holistic, scalable, and inclusive approaches to PA promotion. Schools and communities are central to this effort, and targeted, PA knowledge evidence-based strategies can not only improve PA participation but also transform health outcomes and overall well-being for CAWD. By addressing systemic barriers and fostering collaborative efforts, there is an opportunity to create supportive ecosystems that empower CAWD to lead active, healthy, and fulfilling lives.

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Appendices

Appendices A:

	Appendix
Questionnaires	1. Child and Parents 2. School Management 3. PE and SN Special Needs Teachers 4. Accelerometer wearability assessment
Anthropometric Measurements	5. List of Anthropometric Measurements
Semi-Structured Activities	6. List of School Semi-Structured Activities
Ethical Approval	7. Ethical Application to The University of Durham (UK)
	8. Ethical Approval from The University of Durham (UK)
	9. Ethical Application to The University of Taif (KSA)
	10. Ethical Approval from The University of Taif (KSA)
	11. Taif University Measurement Approval Decision (KSA)
School Aces Authorisation	12. GDET Approaching Letter (KSA)
	13. GDET Approaching Decision (KSA)
Research Summary	14. Summary of the Research Study: Rationale and Aims
Data Management Plan	15. Data Management Plan
Female Researcher	16. Statement for Female Research Assistant Appointment
Risk Assessment	17. General Risk Assessment
	18. Risk Assessment
Private Notice	19. Private Notice
Information Sheet	20. Information Sheet for schools, SN, PE teachers and Support Staff
	21. Information Sheet for Parents and Guardians
	22. Information Sheet for Focus Groups
Consent Form	23. Parent-Guardian Consent form
	24. Teacher-Staff Consent form
	25. Focus Group Consent form
Infographics	26. School Report- Result

Appendix 1-A: Child questionnaire - Google Forms 03-2022

CHILD PERSONAL INFORMATION

Parents and carers are invited to fill up this questionnaire on behalf of their child

* Required

1. Email *

2. What is the child's school code? *

3. Is your child a..........? *

Mark only one oval.

Boy

Girl

4. What is the child's date of birth? *

Example: January 7, 2019

5. What is the child's country of birth? *

Mark only one oval.

Saudi Arabia

Other:

6. What is the child's nationality? *

Mark only one oval.

- Saudi
- Other: ____________________

7. Is the child....... ? *

Mark only one oval.

- Right-handed
- Left-handed
- Both

This information is required for the current academic year 2021-2022.

Academic year

8. Which stage does the child attend? *

Mark only one oval.

- Stage 1 (Year 7)
- Stage 2 (Year 8)
- Stage 3 (Year 9)

9. What is the child's home address? *

____

10. What is the child's home post code? *

____

11. Which school does the child attend? *

Mark only one oval.

- Boys Middle School Al Rayyane
- Girls Middle School 34
- Boys Middle School Hittin
- Girls Middle School 10

12. What is in meters the approximative distance from the child's home to their school? *

Mark only one oval.

- Up to 500 m
- 500 to 1000 m
- 1000 to 1500 m
- 1500 to 2000 m
- More than 2000 m

Family information

13. Are the child's parents alive?

Check all that apply.

	Yes
Father	☐
Mother	☐

14. Are the child's parents............? *

Mark only one oval.

- Married
- Separated
- Divorced

15. Is the child living with ....? *

Check all that apply.

- [ ] Both parents
- [ ] Mother
- [ ] Father
- [ ] Grandparents
- [ ] Carer

16. Is the age of the child's parents................? *

Mark only one oval per row.

	Less than 30 years old	Between 30 and 45	Between 45 and 60	Over 60 years old
Father				
Mother				

17. How many days during the week do the child's parents practice physical activity up to 30 minutes? *

Mark only one oval per row.

	0	1	2	3	Up to 30 min	5 or more	Deceased
Father							
Mother							

18. What is the body shape of the child's parents? *

Mark only one oval per row.

	Underweight	Normal	Overweight	Obese
Father	◯	◯	◯	◯
Mother	◯	◯	◯	◯

19. The child's parents' educational level is .... ? *

Mark only one oval per row.

	No level	Primary	College	Secondary	University
Father	◯	◯	◯	◯	◯
Mother	◯	◯	◯	◯	◯

20. Do the child's parents work? *

Mark only one oval per row.

	Not at all	Part-time	Full-Time	Deceased
Father	◯	◯	◯	◯
Mother	◯	◯	◯	◯

21. The child's parents income level is.................... ? *

Mark only one oval per row.

	No income	Low (< 5000 Riyals)	Medium	High (> 10000 Riyals)	Deceased
Father	◯	◯	◯	◯	◯
Mother	◯	◯	◯	◯	◯

22. Does the child have siblings? *

Mark only one oval per row.

	0	1	2	3	More than 3
Older brothers	◯	◯	◯	◯	◯
Younger	◯	◯	◯	◯	◯
brothers Older	◯	◯	◯	◯	◯
sisters Younger	◯	◯	◯	◯	◯
sisters	◯	◯	◯	◯	◯

Household information

23. How many of the following does the child have at home? *

Mark only one oval per row.

	0	1	2	3	More than 3
Computers	◯	◯	◯	◯	◯
Smart phones	◯	◯	◯	◯	◯
Play stations	◯	◯	◯	◯	◯
Televisions	◯	◯	◯	◯	◯
Children Bikes	◯	◯	◯	◯	◯
Sport accessories	◯	◯	◯	◯	◯
Cars	◯	◯	◯	◯	◯

24. The child's home *

Mark only one oval per row.

	Yes	No
Is connected to the internet	◯	◯
Has a playing area	◯	◯
Is accessible to bikes	◯	◯

Child health information

1. Has your child got the following impairments? *

Mark only one oval per row.

	Very light	Light or Mild	Moderate	Severe
Physical				
Mental				
Hearing				
Vision				

2. How would you rate the child's health? *

Mark only one oval.

- Very good
- Good
- Fair
- Poor
- Very poor

3. Does the child wear glasses or contact lenses? *

Mark only one oval per row.

	Yes	No
Glasses	◯	◯
Contact lenses	◯	◯

4. Does the child have difficulty seeing? *

Mark only one oval per row.

	No difficulty	Some difficulty	A lot of difficulty	Cannot do it at all
Without glasses or lenses	◯	◯	◯	◯
With glasses or lenses	◯	◯	◯	◯

5. Does the child wear a hearing aid? *

Mark only one oval.

◯ Yes
◯ No

6. Does the child have difficulty hearing? *

Mark only one oval per row.

	No difficulty	Some difficulty	A lot of difficulty	Cannot do it at all
Without hearing aid	⬭	⬭	⬭	⬭
With hearing aid	⬭	⬭	⬭	⬭

7. Does the child need assistance for..........................? *

Mark only one oval per row.

	Yes	No
Walking	⬭	⬭
Climbing steps	⬭	⬭
Riding a bike	⬭	⬭

8. Does the child use the following for walking.? *

Mark only one oval per row.

	Not at all	Rarely	Sometime	Often	Always
A wheelchair	⬭	⬭	⬭	⬭	⬭
A walking frame	⬭	⬭	⬭	⬭	⬭
A walking stick	⬭	⬭	⬭	⬭	⬭

9. Can the child walk on ground level the distance in meters of .... ? *

Mark only one oval per row.

	No difficulty	Some difficulty	A lot of difficulty	Cannot do it at all
100 m without Aid	⬭	⬭	⬭	⬭
500 m without aid	⬭	⬭	⬭	⬭
100 m with aid	⬭	⬭	⬭	⬭
500 m with aid	⬭	⬭	⬭	⬭

10. Does the child have a difficulty of being * ?

Mark only one oval per row.

	No difficulty	Some difficulty	A lot of difficulty	Cannot do it at all
Self-dressed	⬭	⬭	⬭	⬭
Understood at home	⬭	⬭	⬭	⬭
Understood outside	⬭	⬭	⬭	⬭

11. Does the child have a difficulty of ? *

Mark only one oval per row.

	No difficulty	Some difficulty	A lot of difficulty	Cannot do it at all
Learning	⬭	⬭	⬭	⬭
Remembering	⬭	⬭	⬭	⬭
Concentrating	⬭	⬭	⬭	⬭
Accepting changes	⬭	⬭	⬭	⬭
Controlling behaviour	⬭	⬭	⬭	⬭
Making friends	⬭	⬭	⬭	⬭

12. How often during the week does the child seem very .... ? *

Mark only one oval per row.

	Never	1 day	2 days	3 days	All week	More than 3 days
Anxious						
Angry						
Depressed						
Nervous						
Sad						

The child's physical activity outside school

13. On a weekday, how long did the child spend on ....? *

Mark only one oval per row.

	up to 30 min	30 - 60 min	60 - 90 min	more than 90 min
Watching TV				
Playing video Game				
Playing inside				
Playing outside				
Doing homework				

14. On a weekend day, how long did the child spend on? *

Mark only one oval per row.

	Less than 1 h	Between 1 and 2 h	More than 2 h
Watching TV	◯	◯	◯
Playing video Game	◯	◯	◯
Playing inside	◯	◯	◯
Playing outside	◯	◯	◯
Doing homework	◯	◯	◯

15. At what time does the child go to bed on .... ? *

Mark only one oval per row.

	Before 20:00	20:00 - 21:00	21:00 - 22:00	After 22:00
Weekday	◯	◯	◯	◯
Weekend day	◯	◯	◯	◯

16. At what time does the child wake-up on .... ? *

Mark only one oval per row.

	Before 5:00	5:00 - 5:30	5:30 - 6:00	6:00 - 6:30	After 6:30
Weekday	◯	◯	◯	◯	◯
Weekend day	◯	◯	◯	◯	◯

17. How would the child rate the quality of your sleep during ....? *

Mark only one oval per row.

	Very good	Good	Fair	Poor	Very poor
Weekdays	◯	◯	◯	◯	◯
Weekend days	◯	◯	◯	◯	◯

18. Does the child have breakfast in the morning during .... ? *

Mark only one oval per row.

	Always	Often	Sometimes	Never
Weekdays	◯	◯	◯	◯
Weekend days	◯	◯	◯	◯

19. Does the child commute independently.................? *

Mark only one oval per row.

	Yes	No
To school	◯	◯
From school	◯	◯

20. On a weekday, how does the child commute to school? *

Check all that apply.

	Walking	Cycling	Bus or car
Sunday	☐	☐	☐
Monday	☐	☐	☐
Tuesday	☐	☐	☐
Wednesday	☐	☐	☐
Thursday	☐	☐	☐

21. On a weekday, how does the child commute from school? *

Check all that apply.

	Walking	Cycling	Bus or car
Sunday	☐	☐	☐
Monday	☐	☐	☐
Tuesday	☐	☐	☐
Wednesday	☐	☐	☐
Thursday	☐	☐	☐

22. What are the child's activity preferences? *

Mark only one oval per row.

	Most preferred	Preferred	Neutral	Less preferred	Least preferred
Athletics Exercise	⬭	⬭	⬭	⬭	⬭
Fitness	⬭	⬭	⬭	⬭	⬭
Gymnastics	⬭	⬭	⬭	⬭	⬭
Games	⬭	⬭	⬭	⬭	⬭
Competitive activities	⬭	⬭	⬭	⬭	⬭
Non-competitive activities	⬭	⬭	⬭	⬭	⬭

23. What are the activity preferences the parents wish to practice at school? *

Mark only one oval per row.

	Most preferred	Preferred	Neutral	Less preferred	Least preferer
Athletics	⬭	⬭	⬭	⬭	⬭
Exercise	⬭	⬭	⬭	⬭	⬭
Fitness	⬭	⬭	⬭	⬭	⬭
Gymnastics	⬭	⬭	⬭	⬭	⬭
Games	⬭	⬭	⬭	⬭	⬭
Competitive activities	⬭	⬭	⬭	⬭	⬭

24. Does the child do any of these activities? *

Mark only one oval per row.

	Always	Often	Sometimes	Rarely	Never
Sports teams					
Dance –					
Martial arts Art					
- Music					

The child's access to sport facilities

25. What are the indoor sport facilities the child can access and attend? *

Check all that apply.

	Accessible	Free access	Walking distance	Booking needed
Indoor facilities with equipment				
Indoor playgrounds				
Swimming pool				

26. What are the outdoor sport facilities the child can access and attend? *

Check all that apply.

	Accessible	Walking distance	equipment
Paths			
Playing			
fields			
Courts			

27. How often in a typical week does the child access the following indoor and outdoor sport facilities? *

Mark only one oval per row.

	Never	1 or 2 times	3 or 4	More than 4 times
Paths	◯	◯	◯	◯
Playing fields	◯	◯	◯	◯
Courts	◯	◯	◯	◯
Public parks	◯	◯	◯	◯
Swimming pool	◯	◯	◯	◯
Indoor	◯	◯	◯	◯
School facilities	◯	◯	◯	◯
playgrounds	◯	◯	◯	◯

28. Walking the child to school, do the parents believe there are ....? *

Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Safe crosswalks	◯	◯	◯	◯	◯
Street signals	◯	◯	◯	◯	◯
Safe walking	◯	◯	◯	◯	◯
Safe biking	◯	◯	◯	◯	◯

29. Walking the child to sports facilities, do the parents believe there are ....? *

Mark only one oval per row.

	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
Safe crosswalks					
Street signals					
Safe walking					
Safe biking					

The child's family support

During this typical week, how often do you or another adult in the household

30. Encourage the child to do sports or physical activity.................... ? *

Mark only one oval per row.

	Never	1-2 days	3-4 days	More than 4 days
At home				
Outside				
At school				

31. Watch the child participate in physical activity or sports ...? *

Mark only one oval per row.

	Never	1-2 days	3-4 days	More than 4 days
At home				
Outside				

32. Do the parents practice a physical activity or play sports with their child during the week *

Mark only one oval per row.

	Never	1-2 days	3-4 days	More than 4 days
At home	◯	◯	◯	◯
Outside	◯	◯	◯	◯

33. Transport the child to a place where they can do physical activity or play sports ....? *

Mark only one oval per row.

	Never	1-2 days	3-4 days	More than 4 days
Outside	◯	◯	◯	◯
School club	◯	◯	◯	◯

The child's physical activity feelings

34. How long would does your child like to be engaged daily in physical activity? *
Mark only one oval.

◯ Not at all

◯ Up to 30 minutes

◯ Up to 45 minutes

◯ Up to one hour

◯ More than one hour

35. The child can be physically active in their free time ?. *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
On week days	◯	◯	◯	◯	◯
On weekend days	◯	◯	◯	◯	◯
At home	◯	◯	◯	◯	◯
At school	◯	◯	◯	◯	◯
Outside	◯	◯	◯	◯	◯
In cold weather	◯	◯	◯	◯	◯
In hot Weather	◯	◯	◯	◯	◯
On busy days	◯	◯	◯	◯	◯

36. The child prefers to be physically active during their free time on most days rather than watching TV or playing video games. *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Week	◯	◯	◯	◯	◯
Weekend days	◯	◯	◯	◯	◯

37. The child can ask someone to be physically active with them during their free time on most days. *

Mark only one oval per row.

	Parents	Sibling	Friend	Carer
At home	◯	◯	◯	◯
At School	◯	◯	◯	◯
Outside	◯	◯	◯	◯

38. The child can have the coordination they need to be physically active during their free time on most days. *

Mark only one oval per row.

	Always	Often	Sometimes	Never
At home	⬭	⬭	⬭	⬭
At school	⬭	⬭	⬭	⬭
Outside	⬭	⬭	⬭	⬭

39. The child takes part in exercise because other people say they should *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Doctors	⬭	⬭	⬭	⬭	⬭
School	⬭	⬭	⬭	⬭	⬭
Family	⬭	⬭	⬭	⬭	⬭
Friends	⬭	⬭	⬭	⬭	⬭

40. It's important to the child to exercise regularly. *

Mark only one oval.

- ⬭ Strongly disagree
- ⬭ Disagree
- ⬭ Neutral
- ⬭ Agree
- ⬭ Strongly agree

41. The child can't see why they should bother exercising *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

42. The child feels like a failure when they haven't exercised *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
In a while					
During PE lessons					
School activities					
Outside					
At home					

43. The child finds exercise a pleasurable activity *

Mark only one oval per row.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
At school					
Outside					
At home					
Holidays					
In groups					
Alone					

The child's physical education behaviour

44. Does the child bring their PE kit to school? *

Mark only one oval.

- Always
- Often
- Sometimes
- Other: ______________________

45. Does the child during their PE lessons get as quickly as possible: *

Mark only one oval per row.

	Always	Often	Sometimes	Rarely	Never
Changed?					
Lined up?					
Ready?					
Understand instructions?					
Following instructions?					

46. During the PE lessons, is the child ....? *

Mark only one oval per row.

	Always	Often	Sometimes	Rarely	No at all
Motivated					
Concentrated					
Confident					

47. During the PE lessons, does the child feel................? *

Mark only one oval per row.

	Always	Often	Sometimes	No
Neglected	⬭	⬭	⬭	⬭
Bullied	⬭	⬭	⬭	⬭
Less confident when underperforming	⬭	⬭	⬭	⬭

48. Does the child ask in PE lessons for assistance when needed from.......................... ? *

Mark only one oval per row.

	Always	Often	Someimes	Not al all
PE teacher	⬭	⬭	⬭	⬭
Support staff	⬭	⬭	⬭	⬭
Class mates	⬭	⬭	⬭	⬭

49. How much does the child like............ ? *

Mark only one oval per row.

	A lot	Average	Neutral	A Little	Not at all
Participating in PE	⬭	⬭	⬭	⬭	⬭
Lessons Engaging	⬭	⬭	⬭	⬭	⬭
in physical activity	⬭	⬭	⬭	⬭	⬭
Organised	⬭	⬭	⬭	⬭	⬭
activities	⬭	⬭	⬭	⬭	⬭
Self-organised activities Competing	⬭	⬭	⬭	⬭	⬭
Helping your peers when needed	⬭	⬭	⬭	⬭	⬭
Teaming up	⬭	⬭	⬭	⬭	⬭

50. Does the child find the PE lessons............... ?
Mark only one oval per row.

	Very often	Often	Sometimes	Not at all
Useful				
Very strict				
Tiring				
Boring				

School and community support

51. What is your level of awareness about the school .... ? *

Mark only one oval per row.

	Not aware at all	Slightly aware	Somewhat aware	Moderately aware	Extremely aware
PE curriculum					
PA curriculum					
Intracurricular activities					
Extracurricular activities					
Intramural activities					
Extramural activities					

52. What is in your opinion the level of appropriateness of the school......................? *

Mark only one oval per row.

	Not appropriate at all	Slightly appropriate	Somewhat appropriate	Moderately appropriate	Extremely appropriate
PE curriculum	⬭	⬭	⬭	⬭	⬭
PA curriculum	⬭	⬭	⬭	⬭	⬭
Intra curricular activities	⬭	⬭	⬭	⬭	⬭
Extracurricular activities	⬭	⬭	⬭	⬭	⬭
Intramural activities	⬭	⬭	⬭	⬭	⬭
Extramural activities	⬭	⬭	⬭	⬭	⬭

53. How often would you like your child to take part in................? *

Mark only one oval per row.

	Very often	Often	Sometimes	Seldom	Never
Intramural extracurricular activities	⬭	⬭	⬭	⬭	⬭
Extracurricular activities	⬭	⬭	⬭	⬭	⬭
Extramural activities	⬭	⬭	⬭	⬭	⬭

54. What would you consider influential for your child to take part in extracurricular and extramural activities? *

Mark only one oval per row.

	Not influential at all	Slightly influential	Moderately influential	Very influential	Extremely influential
Activity					
Distance from home commutation					
Commutation to and from					
Activity fees cost Supervision					
Weather					
Activity					
time Activity					
duration					
Activity organiser					

55. How often would you like to take or drive your child to take part in......................? *

Mark only one oval per row.

	Very often	Often	Sometimes	Seldom	Never
Intramural extracurricular activities	⬭	⬭	⬭	⬭	⬭
Extracurricular activities	⬭	⬭	⬭	⬭	⬭
Extramural activities	⬭	⬭	⬭	⬭	⬭

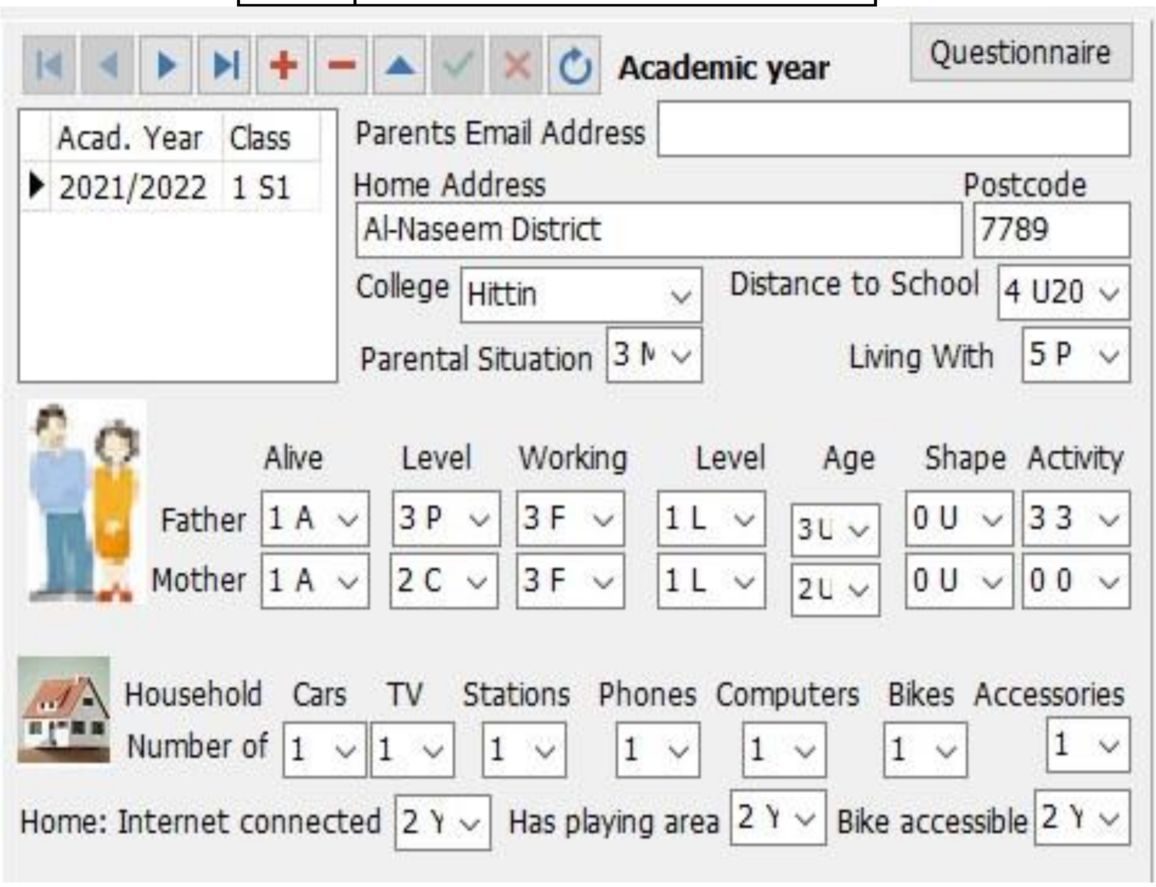
56. What do you think about the quantity of activities offered by the school to your child? *

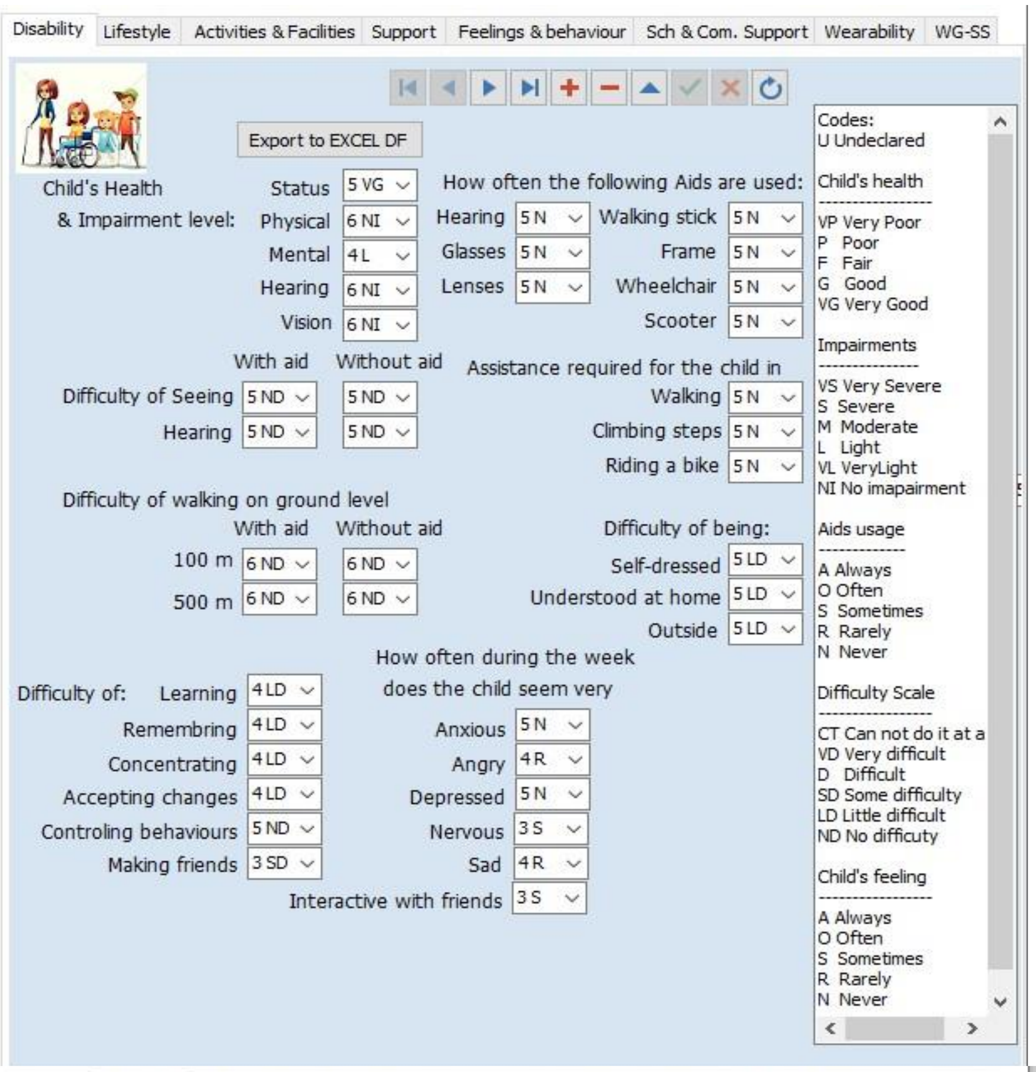
Mark only one oval per row.

	Not satisfied at all	Slightly satisfied	Moderately satisfied	Very satisfied	Extremely satisfied
Extracurricular activities	⬭	⬭	⬭	⬭	⬭
Extramural activities	⬭	⬭	⬭	⬭	⬭

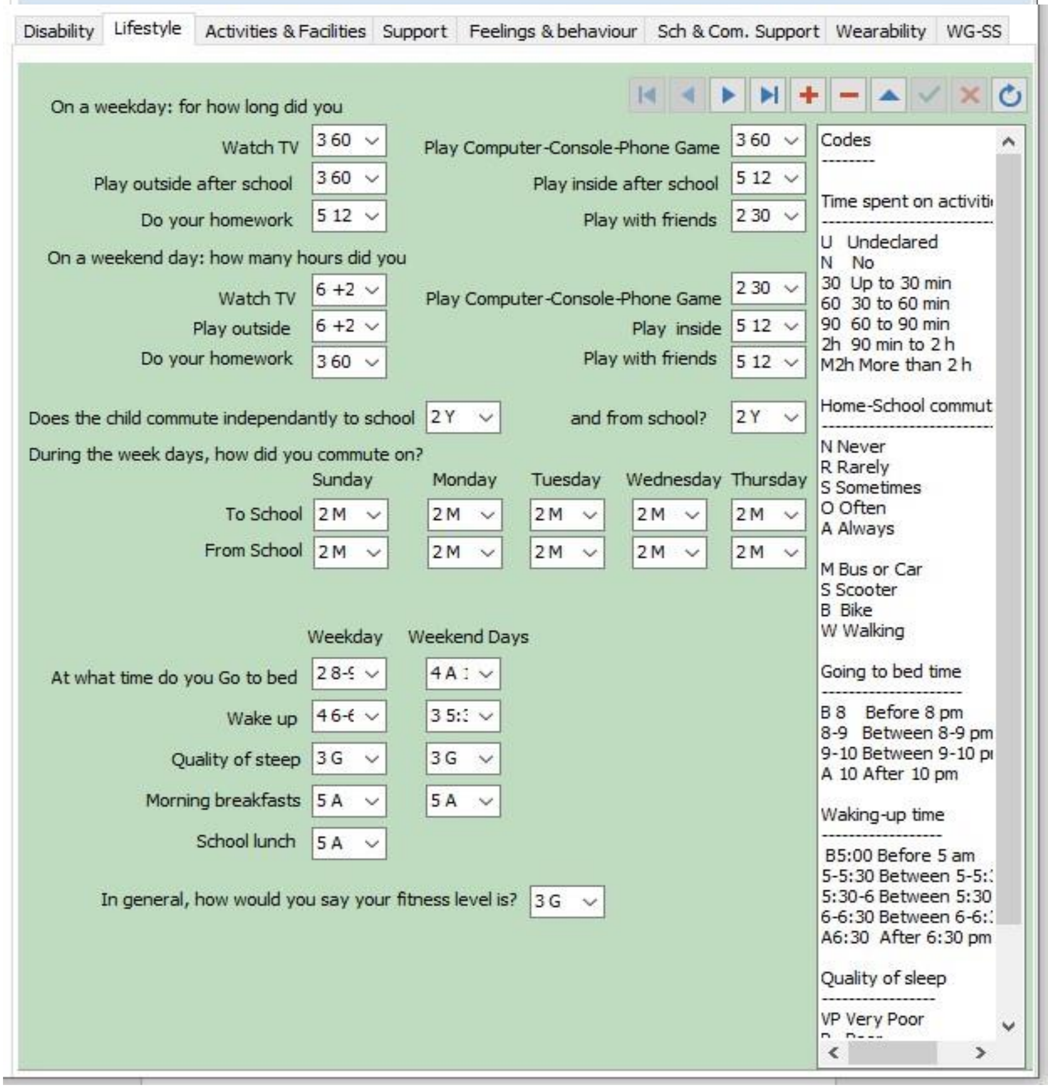
Appendix 1-b: Input the child and parents' questionnaires in (SACYPPADD)

No.	Dataset
1	Family
2	Disability
3	Lifestyle
4	Activities & Facilities Support
5	Feelings & Behaviour
6	School & Community Support
7	Accelerometer wearability
8	

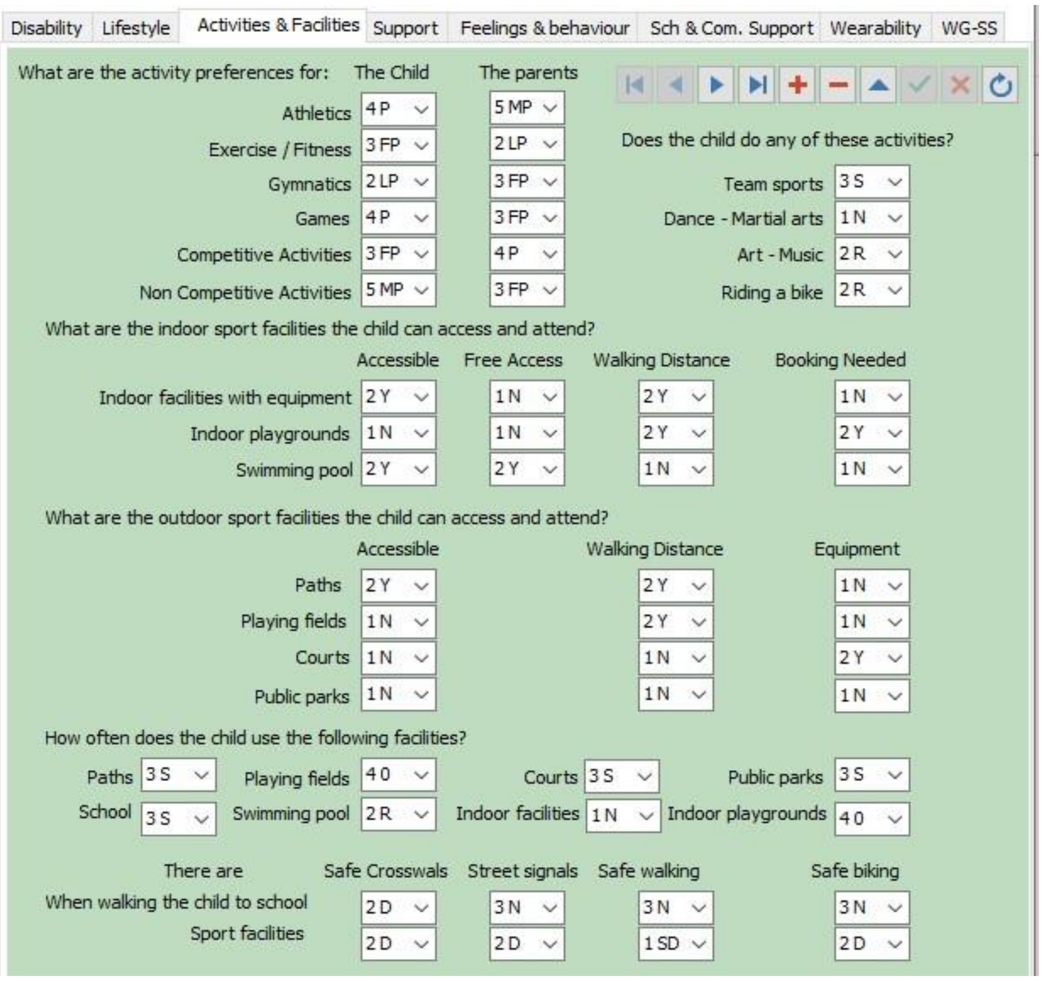




Disability
Lifestyle
Activities & Facilities
Support
Feelings & behaviour
Sch & Com. Support
Wearability
WG-SS
Export to EXCEL DF
Child's Health
& Impairment level:
Status 5 VG
Physical 6 NI
Mental 4 L
Hearing 6 NI
Vision 6 NI
How often the following Aids are used:
Hearing 5 N
Glasses 5 N
Lenses 5 N
Walking stick 5 N
Frame 5 N
Wheelchair 5 N
Scooter 5 N
With aid
Without aid
Difficulty of Seeing 5 ND 5 ND
Hearing 5 ND 5 ND
Assistance required for the child in
Walking 5 N
Climbing steps 5 N
Riding a bike 5 N
Difficulty of walking on ground level
With aid
Without aid
100 m 6 ND 6 ND
500 m 6 ND 6 ND
Difficulty of being:
Self-dressed 5 LD
Understood at home 5 LD
Outside 5 LD
Difficulty of: Learning 4 LD
Remembring 4 LD
Concentrating 4 LD
Accepting changes 4 LD
Controling behaviours 5 ND
Making friends 3 SD
How often during the week
does the child seem very
Anxious 5 N
Angry 4 R
Depressed 5 N
Nervous 3 S
Sad 4 R
Interactive with friends 3 S
Codes:
U Undeclared
Child's health
VP Very Poor
P Poor
F Fair
G Good
VG Very Good
Impairments
VS Very Severe
S Severe
M Moderate
L Light
VL VeryLight
NI No imapairment
Aids usage
A Always
O Often
S Sometimes
R Rarely
N Never
Difficulty Scale
CT Can not do it at a
VD Very difficult
D Difficult
SD Some difficulty
LD Little difficult
ND No difficuty
Child's feeling
A Always
O Often
S Sometimes
R Rarely
N Never



Disability
Lifestyle
Activities & Facilities
Support
Feelings & behaviour
Sch & Com. Support
Wearability
WG-SS
On a weekday: for how long did you
Watch TV 3 60
Play outside after school 3 60
Do your homework 5 12
Play Computer-Console-Phone Game 3 60
Play inside after school 5 12
Play with friends 2 30
On a weekend day: how many hours did you
Watch TV 6 +2
Play outside 6 +2
Do your homework 3 60
Play Computer-Console-Phone Game 2 30
Play inside 5 12
Play with friends 5 12
Does the child commute independantly to school 2 Y
and from school? 2 Y
During the week days, how did you commute on?
Sunday
Monday
Tuesday
Wednesday
Thursday
To School 2 M 2 M 2 M 2 M 2 M
From School 2 M 2 M 2 M 2 M 2 M
Weekday
Weekend Days
At what time do you Go to bed
Wake up
Quality of steep 3 G 3 G
Morning breakfasts 5 A 5 A
School lunch 5 A
In general, how would you say your fitness level is? 3 G
Codes
Time spent on activiti
U Undeclared
N No
30 Up to 30 min
60 30 to 60 min
90 60 to 90 min
2h 90 min to 2 h
M2h More than 2 h
Home-School commut
N Never
R Rarely
S Sometimes
O Often
A Always
M Bus or Car
S Scooter
B Bike
W Walking
Going to bed time
B 8 Before 8 pm
8-9 Between 8-9 pm
A 10 After 10 pm
Waking-up time
B5:00 Before 5 am
5:30-6 Between 5:30
A6:30 After 6:30 pm
Quality of sleep
VP Very Poor



Disability | Lifestyle | Activities & Facilities | Support | Feelings & behaviour | Sch & Com. Support | Wearability | WG-SS

What are the activity preferences for:	The Child	The parents
Athletics	4 P	5 MP
Exercise / Fitness	3 FP	2 LP
Gymnatics	2 LP	3 FP
Games	4 P	3 FP
Competitive Activities	3 FP	4 P
Non Competitive Activities	5 MP	3 FP

Does the child do any of these activities?

Team sports	3 S
Dance - Martial arts	1 N
Art - Music	2 R
Riding a bike	2 R

What are the indoor sport facilities the child can access and attend?

	Accessible	Free Access	Walking Distance	Booking Needed
Indoor facilities with equipment	2 Y	1 N	2 Y	1 N
Indoor playgrounds	1 N	1 N	2 Y	2 Y
Swimming pool	2 Y	2 Y	1 N	1 N

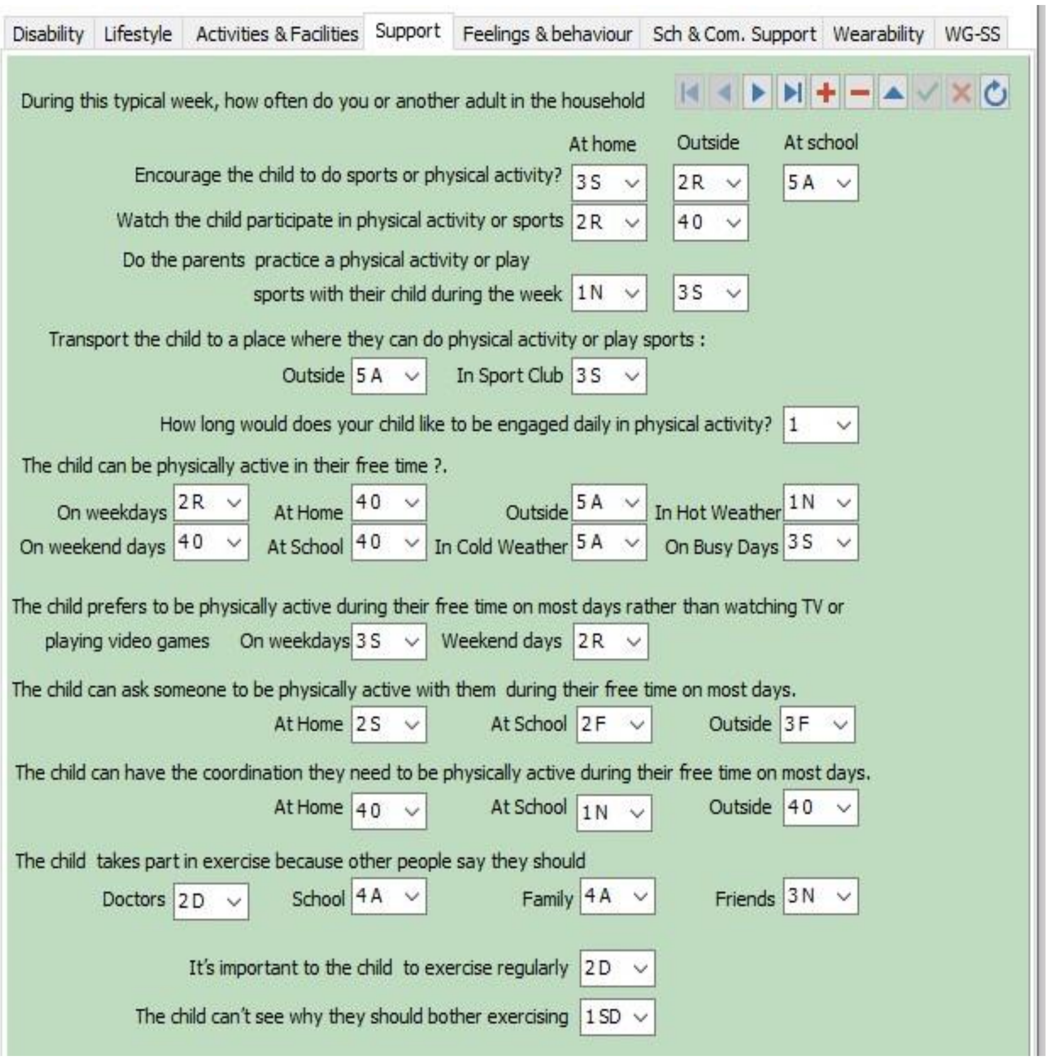
What are the outdoor sport facilities the child can access and attend?

	Accessible	Walking Distance	Equipment
Paths	2 Y	2 Y	1 N
Playing fields	1 N	2 Y	1 N
Courts	1 N	1 N	2 Y
Public parks	1 N	1 N	1 N

How often does the child use the following facilities?

Paths	3 S	Playing fields	4 O	Courts	3 S	Public parks	3 S
School	3 S	Swimming pool	2 R	Indoor facilities	1 N	Indoor playgrounds	4 O

There are	Safe Crosswals	Street signals	Safe walking	Safe biking
When walking the child to school	2 D	3 N	3 N	3 N
Sport facilities	2 D	2 D	1 SD	2 D



Disability | Lifestyle | Activities & Facilities | Support | Feelings & behaviour | Sch & Com. Support | Wearability | WG-SS

During this typical week, how often do you or another adult in the household

	At home	Outside	At school
Encourage the child to do sports or physical activity?	3 S	2 R	5 A
Watch the child participate in physical activity or sports	2 R	4 O	
Do the parents practice a physical activity or play sports with their child during the week	1 N	3 S	

Transport the child to a place where they can do physical activity or play sports :

Outside 5 A In Sport Club 3 S

How long would does your child like to be engaged daily in physical activity? 1

The child can be physically active in their free time ?.

On weekdays	2 R	At Home	4 O	Outside	5 A	In Hot Weather	1 N
On weekend days	4 O	At School	4 O	In Cold Weather	5 A	On Busy Days	3 S

The child prefers to be physically active during their free time on most days rather than watching TV or playing video games On weekdays 3 S Weekend days 2 R

The child can ask someone to be physically active with them during their free time on most days.

At Home 2 S At School 2 F Outside 3 F

The child can have the coordination they need to be physically active during their free time on most days.

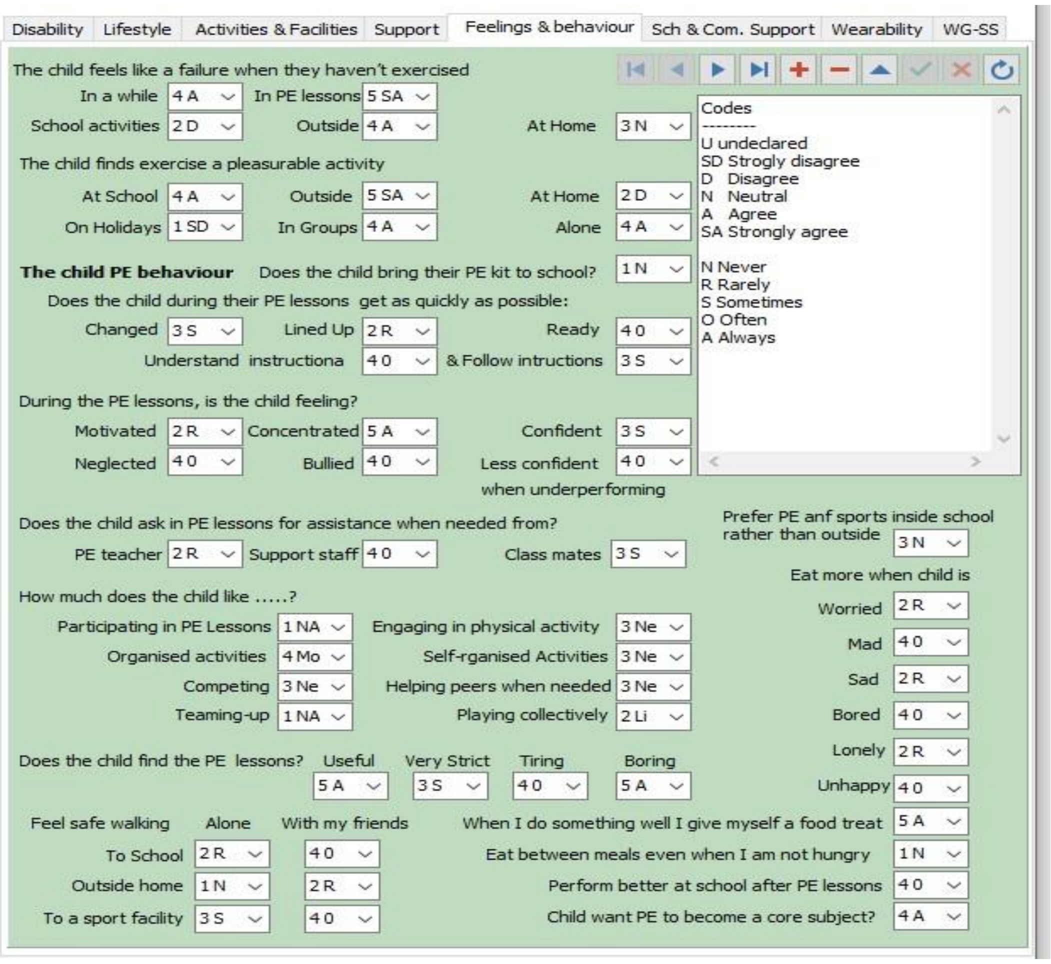
At Home 4 O At School 1 N Outside 4 O

The child takes part in exercise because other people say they should

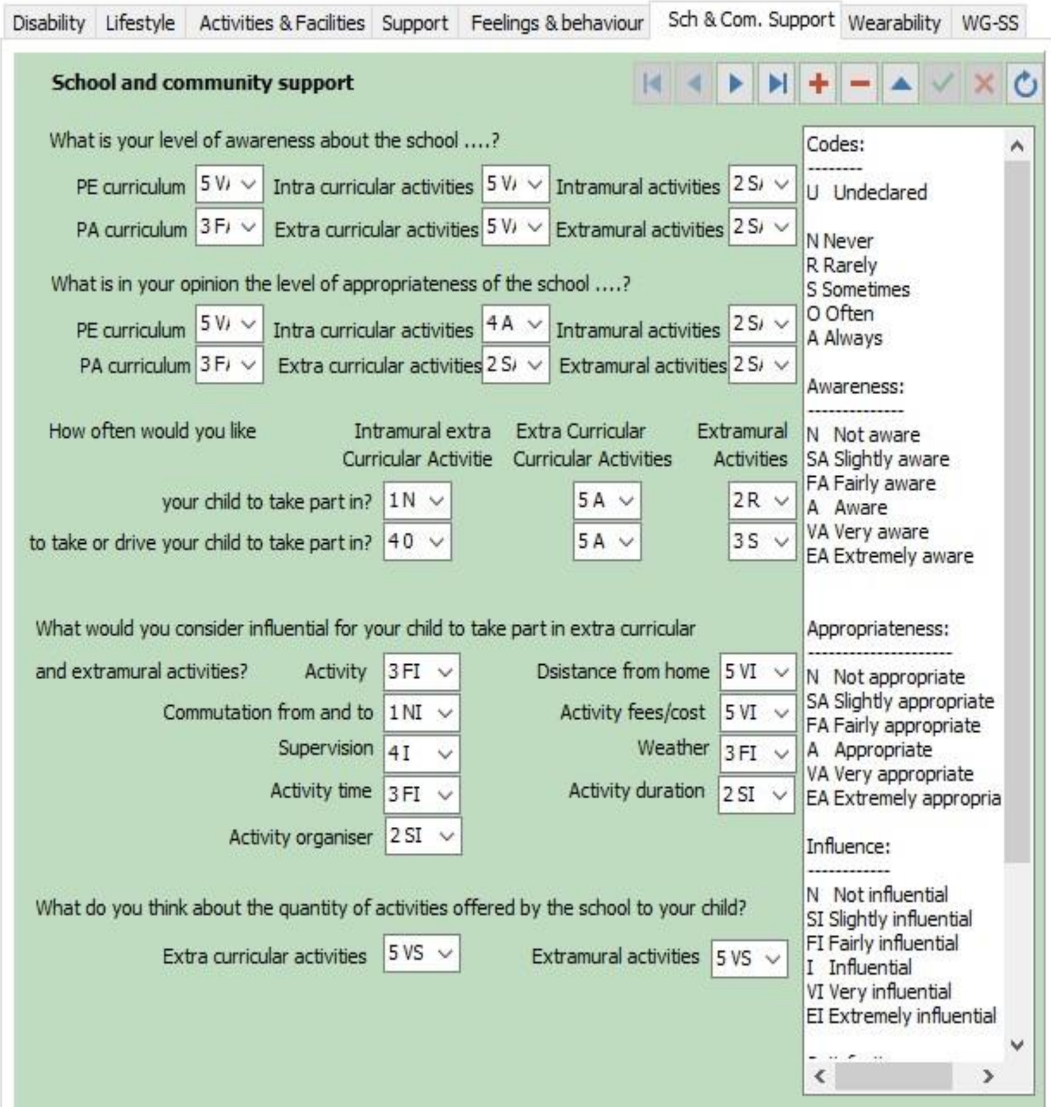
Doctors 2 D School 4 A Family 4 A Friends 3 N

It's important to the child to exercise regularly 2 D

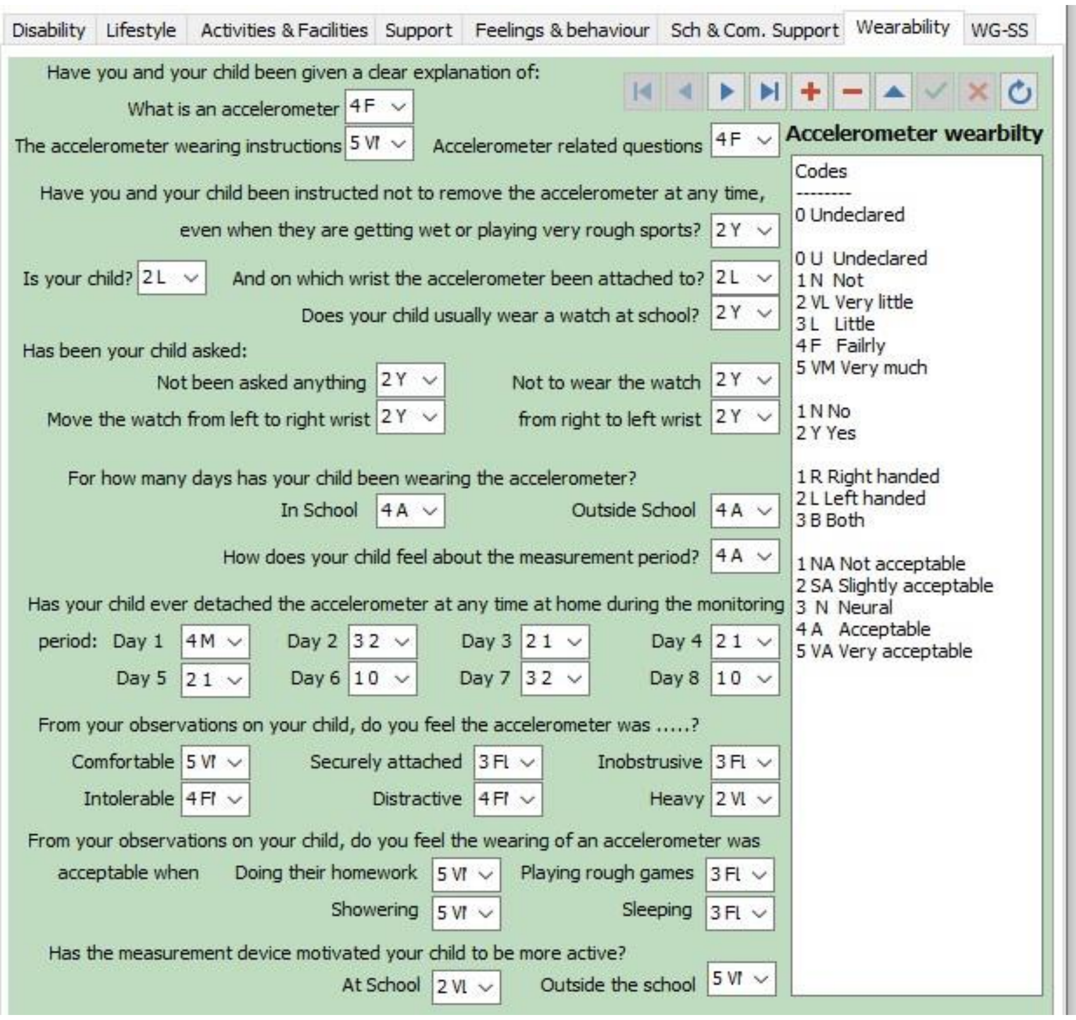
The child can't see why they should bother exercising 1 SD


Disability
Lifestyle
Activities & Facilities
Support
Feelings & behaviour
Sch & Com. Support
Wearability
WG-SS
The child feels like a failure when they haven't exercised
In a while 4 A
In PE lessons 5 SA
School activities 2 D
Outside 4 A
At Home 3 N
Codes

U undeclared
SD Strogly disagree
D Disagree
N Neutral
A Agree
SA Strongly agree
The child finds exercise a pleasurable activity
At School 4 A
Outside 5 SA
At Home 2 D
On Holidays 1 SD
In Groups 4 A
Alone 4 A
The child PE behaviour
Does the child bring their PE kit to school? 1 N
N Never
R Rarely
S Sometimes
O Often
A Always
Does the child during their PE lessons get as quickly as possible:
Changed 3 S
Lined Up 2 R
Ready 4 O
Understand instructiona 4 O
& Follow intructions 3 S
During the PE lessons, is the child feeling?
Motivated 2 R
Concentrated 5 A
Confident 3 S
Neglected 4 O
Bullied 4 O
Less confident 4 O
when underperforming
Does the child ask in PE lessons for assistance when needed from?
PE teacher 2 R
Support staff 4 O
Class mates 3 S
Prefer PE anf sports inside school rather than outside 3 N
Eat more when child is
Worried 2 R
Mad 4 O
Sad 2 R
Bored 4 O
Lonely 2 R
Unhappy 4 O
How much does the child like .....?
Participating in PE Lessons 1 NA
Engaging in physical activity 3 Ne
Organised activities 4 Mo
Self-rganised Activities 3 Ne
Competing 3 Ne
Helping peers when needed 3 Ne
Teaming-up 1 NA
Playing collectively 2 Li
Does the child find the PE lessons?
Useful 5 A
Very Strict 3 S
Tiring 4 O
Boring 5 A
Feel safe walking
Alone
With my friends
To School 2 R 4 O
Outside home 1 N 2 R
To a sport facility 3 S 4 O
When I do something well I give myself a food treat 5 A
Eat between meals even when I am not hungry 1 N
Perform better at school after PE lessons 4 O
Child want PE to become a core subject? 4 A


Disability
Lifestyle
Activities & Facilities
Support
Feelings & behaviour
Sch & Com. Support
Wearability
WG-SS
School and community support
What is your level of awareness about the school ....?
PE curriculum 5 VA
Intra curricular activities 5 VA
Intramural activities 2 SA
PA curriculum 3 FA
Extra curricular activities 5 VA
Extramural activities 2 SA
What is in your opinion the level of appropriateness of the school ....?
PE curriculum 5 VA
Intra curricular activities 4 A
Intramural activities 2 SA
PA curriculum 3 FA
Extra curricular activities 2 SA
Extramural activities 2 SA
How often would you like
Intramural extra Curricular Activitie
Extra Curricular Curricular Activities
Extramural Activities
your child to take part in? 1 N 5 A 2 R
to take or drive your child to take part in? 4 O 5 A 3 S
What would you consider influential for your child to take part in extra curricular and extramural activities?
Activity 3 FI
Dsistance from home 5 VI
Commutation from and to 1 NI
Activity fees/cost 5 VI
Supervision 4 I
Weather 3 FI
Activity time 3 FI
Activity duration 2 SI
Activity organiser 2 SI
What do you think about the quantity of activities offered by the school to your child?
Extra curricular activities 5 VS
Extramural activities 5 VS
Codes:

U Undeclared
N Never
R Rarely
S Sometimes
O Often
A Always
Awareness:
N Not aware
SA Slightly aware
FA Fairly aware
A Aware
VA Very aware
EA Extremely aware
Appropriateness:
N Not appropriate
SA Slightly appropriate
FA Fairly appropriate
A Appropriate
VA Very appropriate
EA Extremely appropria
Influence:
N Not influential
SI Slightly influential
FI Fairly influential
I Influential
VI Very influential
EI Extremely influential


Disability | Lifestyle | Activities & Facilities | Support | Feelings & behaviour | Sch & Com. Support | Wearability | WG-SS

Have you and your child been given a clear explanation of:

What is an accelerometer 4 F

The accelerometer wearing instructions 5 VI Accelerometer related questions 4 F

Accelerometer wearbilty

Have you and your child been instructed not to remove the accelerometer at any time, even when they are getting wet or playing very rough sports? 2 Y

Is your child? 2 L And on which wrist the accelerometer been attached to? 2 L

Does your child usually wear a watch at school? 2 Y

Has been your child asked:

Not been asked anything 2 Y Not to wear the watch 2 Y

Move the watch from left to right wrist 2 Y from right to left wrist 2 Y

For how many days has your child been wearing the accelerometer?

In School 4 A Outside School 4 A

How does your child feel about the measurement period? 4 A

Has your child ever detached the accelerometer at any time at home during the monitoring period: Day 1 4 M Day 2 3 2 Day 3 2 1 Day 4 2 1

Day 5 2 1 Day 6 1 0 Day 7 3 2 Day 8 1 0

From your observations on your child, do you feel the accelerometer was .....?

Comfortable 5 VI Securely attached 3 Fl Inobstrusive 3 Fl

Intolerable 4 FI Distractive 4 FI Heavy 2 VI

From your observations on your child, do you feel the wearing of an accelerometer was acceptable when Doing their homework 5 VI Playing rough games 3 Fl

Showering 5 VI Sleeping 3 Fl

Has the measurement device motivated your child to be more active?

At School 2 VI Outside the school 5 VI

Codes
----
0 Undeclared

0 U Undeclared
1 N Not
2 VL Very little
3 L Little
4 F Failrly
5 VM Very much

1 N No
2 Y Yes

1 R Right handed
2 L Left handed
3 B Both

1 NA Not acceptable
2 SA Slightly acceptable
3 N Neural
4 A Acceptable
5 VA Very acceptable

APPENDIX 2-A: SCHOOL QUESTIONNAIRE - GOOGLE FORMS 03-2022

SCHOOL QUESTIONNAIRE

* Required

1. Email *

2. What is the name of the school? *

Mark only one oval.

- Boys Middle School Al Rayyane
- Boys Middle School Hittin
- Girls Middle School 10
- Girls Middle School 34

3. What is your Staff code?

4. What is your role in the school? *

Mark only one oval.

- Headteacher
- Deputy-Headteacher
- Head of Physical education
- Manager / Senior Management Team

https://docs.google.com/forms/d/1ZPsm9ZMpIT2xK9UCCQsZOB1zgf18LgWs4dNZB31_Rg8/edit

5. In the school, the special needs children have the following impairments .... ?

Check all that apply.

	Very light	Light or Mild	Moderate	Severe
Physical	☐	☐	☐	☐
Mental	☐	☐	☐	☐
Hearing	☐	☐	☐	☐
Vision	☐	☐	☐	☐

6. How many classes of special needs children in the school? *

Check all that apply.

	0	1	2	3	4 or more
Year 7	☐	☐	☐	☐	☐
Year 8	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

7. In the school policy, it is stated that the special needs children are grouped in the following classes?

Check all that apply.

	Physical education (PE) Curriculum lessons	Physical education lessons	Physical activities
Regular classes	☐	☐	☐
Disability classes	☐	☐	☐
Learning ability classes	☐	☐	☐
Physical ability classes	☐	☐	☐
Disability group classes	☐	☐	☐
Sensory circuits classes	☐	☐	☐

8. Does the school have the following to promote PE among special needs children?

Check all that apply.

	Non-Disabled children	Special needs children
Head off PE	☐	☐
PE committee	☐	☐
PE policy	☐	☐
PE Inclusion policy	☐	☐
PE lessons risk assessment PE	☐	☐
code off conduct	☐	☐
PE curriculum	☐	☐
Annual sports equipment budget Annual	☐	☐
sports events budget	☐	☐

9. Has the school integrated fitness activities for children with special needs in their PE curriculum? *

Mark only one oval.

- Yes
- No
- Don't know

10. Does the school have access external sports facilities for special needs PE when not internally available? *

Mark only one oval per row.

	Never	Rarely	Sometimes	Often	Always
Swimming pool					
Gymnasium					
Sports games fields					

11. What is the duration of PE lessons for special needs children? *

Mark only one oval per row.

	30 min	45 min	1 hour	More than 1 hour
Year 7				
Year 8				

12. What is the number of weekly PE lessons for special needs children? *

Check all that apply.

	1	2	3	4	5
Year 7					
Year 8					

13. What is the weekly planning of physical education lessons for special needs children in Year 7? *

Check all that apply.

	7:00	8:00	9:00	10:00	12:00	13:00
Sunday	☐	☐	☐	☐	☐	☐
Monday	☐	☐	☐	☐	☐	☐
Tuesday	☐	☐	☐	☐	☐	☐
Wednesday	☐	☐	☐	☐	☐	☐
Thursday	☐	☐	☐	☐	☐	☐

14. What is the weekly planning of physical education lessons for special needs children in Year 8? *

Check all that apply.

	7:00	8:00	9:00	10:00	12:00	13:00
Sunday	☐	☐	☐	☐	☐	☐
Monday	☐	☐	☐	☐	☐	☐
Tuesday	☐	☐	☐	☐	☐	☐
Wednesday	☐	☐	☐	☐	☐	☐
Thursday	☐	☐	☐	☐	☐	☐

15. What is the weekly planning of physical education lessons for special needs children in Year 9? *

Check all that apply.

	7:00	8:00	9:00	10:00	12:00	13:00
Sunday						
Monday						
Tuesday						
Wednesday						
Thursday						

16. What is the PE lessons absenteeism rate of special needs children? *

Mark only one oval per row.

	up to 5%	6 to 10 %	11 to 20 %	21 to 35 %	36 to 50 %	More than 50%
Year 7						
Year 8						

17. What is the staff - special needs children ratio during PE lessons?

Check all that apply.

	1-1	1-5	1-10	1-15	1-20 or more
PE teacher	☐	☐	☐	☐	☐
PE Assistant	☐	☐	☐	☐	☐
Special Need Teacher	☐	☐	☐	☐	☐
Special Need Assistant	☐	☐	☐	☐	☐
Playworker	☐	☐	☐	☐	☐
Volunteers	☐	☐	☐	☐	☐

18. What is the qualification of the support staff involved in PE lessons with special needs children?

Check all that apply.

	No qualification	Diploma	Bachelor	Master
PE teacher	☐	☐	☐	☐
PE Assistant	☐	☐	☐	☐
Special Needs Teacher	☐	☐	☐	☐
Special Needs Assistant	☐	☐	☐	☐
Playworker	☐	☐	☐	☐
Volunteers	☐	☐	☐	☐

19. What is the experience of the support staff involved in PE lessons with special needs children?

Check all that apply.

	No experience	1-2 years	3-6 years	7-10 years	More than 10
PE teacher	☐	☐	☐	☐	☐
PE Assistant	☐	☐	☐	☐	☐
Special Needs Teacher	☐	☐	☐	☐	☐
Special Needs Assistant	☐	☐	☐	☐	☐
Playworker	☐	☐	☐	☐	☐
Volunteers	☐	☐	☐	☐	☐

20. The general skill quality level of the workforce supporting special needs children during their PE lessons regarding training, skills and knowledge is *

Mark only one oval per row.

	Poor	Fair	Good	Very good	Excellent
Trained	◯	◯	◯	◯	◯
Skilled	◯	◯	◯	◯	◯
Knowledgeable	◯	◯	◯	◯	◯

21. What level of priority does the school give to each of the following goals within your PE curriculum .... ? *

Mark only one oval per row.

	Not a priority	Low priority	Medium Priority	High priority	Essential
Acquiring and developing students" PE knowledge and skills	⬭	⬭	⬭	⬭	⬭
Increasing students' PE confidence	⬭	⬭	⬭	⬭	⬭
Improving students" agility, balance and speed	⬭	⬭	⬭	⬭	⬭
Improving students" cardiovascular fitness, muscular endurance	⬭	⬭	⬭	⬭	⬭
Raising students" awareness off the health benefits off PA	⬭	⬭	⬭	⬭	⬭
Promoting positive attitudes in students toward PA	⬭	⬭	⬭	⬭	⬭
Maintaining off student's physical skills	⬭	⬭	⬭	⬭	⬭
Physical activity engagement feedback from families	⬭	⬭	⬭	⬭	⬭

22. What is the priority set by the school to the following activities for the special needs children? *

Mark only one oval per row.

	Not a priority	Low priority	Medium priority	High priority	Essential
Athletic activities ((e.g., running, jumping, throwing))	⬭	⬭	⬭	⬭	⬭
Exercise/fitness activities ((e.g., aerobics, circuit training))	⬭	⬭	⬭	⬭	⬭
Games activities open to all'll abilities ((e.g.. football,, volleyballs))	⬭	⬭	⬭	⬭	⬭
Gymnastic activities ((e.g.. balancing,, rolling))	⬭	⬭	⬭	⬭	⬭
Inter--school games competitions ((e.g.. league))	⬭	⬭	⬭	⬭	⬭
Inter–school non-competitive events or displays ((e. g., gym, martial arts))	⬭	⬭	⬭	⬭	⬭

23. Does the school test the physical fitness of the special need's children? *

Mark only one oval per row.

	Never	Yearly	Termly	Occasionally
Year 7	◯	◯	◯	◯
Year 8	◯	◯	◯	◯
	◯	◯	◯	◯

24. Does the school measure the physical activity levels of the special need's children? *

Mark only one oval per row.

	Never	Yearly	Termly	Occasionally
Year 7	⬭	⬭	⬭	⬭
Year 8	⬭	⬭	⬭	⬭
	⬭	⬭	⬭	⬭

25. Does the school record the fitness and physical activity levels of the special needs children to: *

Mark only one oval per row.

	Physical activity needs	Fitness levels	Physical activity levels
Parents and carers	⬭	⬭	⬭
Locall autthorriittiies	⬭	⬭	⬭

26. Does the school report the fitness and physical activity levels of the special needs children to: *

Mark only one oval per row.

	Physical activity needs	Fitness levels	Physical activity levels
Parents and carers	⬭	⬭	⬭
Locall autthorriittiies	⬭	⬭	⬭

27. Does the school report specifically the children's critical fitness and activity levels to? *

Mark only one oval per row.

	Never	Always	On request
Parents and carers	⬭	⬭	⬭
Local education authorities Local	⬭	⬭	⬭
medical authorities	⬭	⬭	⬭

28. What is the special needs children's commitment level to physical training and learning? *

Mark only one oval per row.

	Low	Very low	Moderate	High	Very high
Year 7	⬭	⬭	⬭	⬭	⬭
Year 8	⬭	⬭	⬭	⬭	⬭
	⬭	⬭	⬭	⬭	⬭

29. What is the special needs children's physical literacy level? *

Mark only one oval per row.

	Very low	Low	Moderate	High	Very high
Yearr 7	⬭	⬭	⬭	⬭	⬭
Yearr 8	⬭	⬭	⬭	⬭	⬭
	⬭	⬭	⬭	⬭	⬭

30. What is the special needs children's physical competence level? *

Mark only one oval per row.

	Very low	Low	Moderate	High	Very high
Year 7	⬭	⬭	⬭	⬭	⬭
Year 8	⬭	⬭	⬭	⬭	⬭
	⬭	⬭	⬭	⬭	⬭

31. In general, how significant would you rate the contribution to the promotion of physical education among special needs children of .... ? *

Mark only one oval per row.

	Not significant at all	Slightly significan t	Moderately t Significant	Significan	Very significan t
School	⬭	⬭	⬭	⬭	⬭
Support Staff	⬭	⬭	⬭	⬭	⬭
External SN bodies	⬭	⬭	⬭	⬭	⬭
Children	⬭	⬭	⬭	⬭	⬭
Parents	⬭	⬭	⬭	⬭	⬭
Community	⬭	⬭	⬭	⬭	⬭

32. How satisfied with the promotion of special needs PE in the school are you? *

Mark only one oval per row.

	Not all satisfied	Slightly satisfied	Moderately Satisfied	Very satisfied	Extremely satisfied
School support to special needs PE	⬭	⬭	⬭	⬭	⬭
Special needs PE curriculum	⬭	⬭	⬭	⬭	⬭
Number off days off PE per week	⬭	⬭	⬭	⬭	⬭
Number off hours off PE per day	⬭	⬭	⬭	⬭	⬭
Special needs PE equipment	⬭	⬭	⬭	⬭	⬭
Internal sports facilities for special needs PE	⬭	⬭	⬭	⬭	⬭
External sports facilities for special needs PE	⬭	⬭	⬭	⬭	⬭
staff support to special needs PE	⬭	⬭	⬭	⬭	⬭
External support to special needs PE	⬭	⬭	⬭	⬭	⬭
Special needs children physical levels achievement	⬭	⬭	⬭	⬭	⬭

33. How important to you is that PE becomes a core subject in the school curriculum? *

Mark only one oval.

- Not important at all
- Slightly important
- Moderately important
- Important
- Very important

Physical activities (PA)

34. Does the school have the following to promote PA among special needs children?

Check all that apply.

	Regular children	Special needs children
PA policy	☐	☐
PA Inclusion policy PA	☐	☐
code off conduct PA	☐	☐
committee	☐	☐
PA curriculum	☐	☐
Annual sports activity budget	☐	☐
Self-monitoring off activity levels	☐	☐

35. Has the school integrated for special needs children the following? *
Mark only one oval per row.

	Yes	No	Don't know
Physical activity in the learning curriculum	◯	◯	◯
Fitness activities in the PA curriculum	◯	◯	◯

36. Does your school have the following for special needs children concerning?

Check all that apply.

	Policy	Practice	Committee
Physical rehabilitation Maintenance	☐	☐	☐
off physical skills School physical	☐	☐	☐
activities Home physical activities	☐	☐	☐
Waking and riding to/from school	☐	☐	☐
	☐	☐	☐
Healthy eating	☐	☐	☐

37. Does your school organise during the week for special needs children the following activities? *

Mark only one oval per row.

	Not at all	Once	Twice	More than twice
Intramural extracurricular activities ((School time))	⬭	⬭	⬭	⬭
Intramural extracurricular activities ((After school))	⬭	⬭	⬭	⬭
Extramural competitive activities ((outside school))	⬭	⬭	⬭	⬭

38. Does your school organise during the week for special needs children the following activities? *

Mark only one oval per row.

	Year 7	Year 8	Year 9	Column 4
Intramural extracurricular activities ((School time))				
Intramural extracurricular activities ((After school))				
Extramural competitive activities ((outside school))				

39. Does the school offer a variety of activities for special needs children? *

Mark only one oval per row.

	Never	Rarely	Sometimes	Often	Always
Physical education					
Physical activities					

40. Does the school ask special needs children what are their preferred activities during? *

Mark only one oval per row.

	Never	Rarely	Sometimes	Often	Always
Physical education lessons					
Physical activities sessions					

41. How important is to your school the promotion of special needs physical education (PE) and physical activity (PA) through? *

Mark only one oval per row.

	Not important	Slightly important	Moderately important	Important	Very importan t
A physical and sensory individual profile					
A physical and sensory individual circuit activities					

42. Does your school have specifically for every special need child ....?

Check all that apply.

	Year 7	Year 8	Year 9
A physical and sensory profile			
A physical and sensory circuit activities			

43. To the best of your knowledge, how well do each of the following statements characterise your school in promoting physical activity among special needs children as a ? *

Mark only one oval per row.

	Not true at all	Somewhat true	True	Fairly true	Very true
Physical activity guideline requirement					
Physical and sensory circuit					
Reward					
Punishment for misbehaving					
Extramural competitive sports					

44. How many sports event days does the school organise during the academic year for the special need's children ....? *

Mark only one oval per row.

	0	1	2	3	4 or more
Year 7	○	○	○	○	○
Year 8	○	○	○	○	○
Year 9	○	○	○	○	○

45. How many physical activity event days does the school organise during the academic year for the special needs children.....................................? *

Mark only one oval per row.

	0	1	2	3	4 or more
Year 7	○	○	○	○	○
Year 8	○	○	○	○	○
Year 9	○	○	○	○	○

46. In general, how would you rate the contribution to the promotion of physical activity among special needs children of? *

Mark only one oval per row.

	Insignificant	Somehow significant	Significant	Fairly significant	Very significant
School Support	⬭	⬭	⬭	⬭	⬭
Staff External	⬭	⬭	⬭	⬭	⬭
Bodies Children	⬭	⬭	⬭	⬭	⬭
Parents	⬭	⬭	⬭	⬭	⬭
Community	⬭	⬭	⬭	⬭	⬭
Local medical authorities	⬭	⬭	⬭	⬭	⬭
Local education authorities	⬭	⬭	⬭	⬭	⬭
	⬭	⬭	⬭	⬭	⬭

School provision and support

47. What are the sports facilities accessible to the special needs children in the school to run? *

Mark only one oval per row.

	PE Lessons	Physical activities	Individual use	School events
School hall				
Gymnasium				
Sports hall				
Fitness room/Centre Classroom				
Playing field				
Hard play area ((Tarmac))				
Changing facilities Showers				
Medical treatment room ((physiotherapy))				
Bikes racks				

48. Does the school use sports facilities in the community? *

Check all that apply.

- [ ] Swimming pool
- [ ] Gymnasium
- [ ] Sports games fields

49. How adequate are the sports facilities in the school? *

Mark only one oval per row.

	Inadequate	Slightly inadequate	Neutral	Slightly adequate	Adequate
School hall					
Gymnasium					
Sports hall					
Fitness room/Centre					
Classroom					
Playing field					
Hard play area ((Tarmac))					
Changing facilities					
Bikes racks					

50. How appropriately active is the physical school environment? *

Mark only one oval per row.

	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate

51. **Does the school provide for the special needs children the following**.......................? *

Mark only one oval per row.

	No	1 for 1	1 for 10	1 for 20	1 for more then 20
PE kits	◯	◯	◯	◯	◯
Team kits	◯	◯	◯	◯	◯
Bikes	◯	◯	◯	◯	◯
treadmill	◯	◯	◯	◯	◯
Tennis table	◯	◯	◯	◯	◯
Play equipment	◯	◯	◯	◯	◯
Skipping ropes	◯	◯	◯	◯	◯
Weights	◯	◯	◯	◯	◯

52. Does the school provide for promoting PE and PA among special needs children regular refresher courses and training in the following domains...?

Check all that apply.

	Special needs teachers	PE teachers	Playworkers	Volunteers
Reducing children sedentary time	☐	☐	☐	☐
Disability behaviour	☐	☐	☐	☐
Disability confidence	☐	☐	☐	☐
Intellectual and developmental disabilities	☐	☐	☐	☐
Psychology and learning disabilities	☐	☐	☐	☐
Autism studies	☐	☐	☐	☐
Physical and sensory needs assessment	☐	☐	☐	☐
Learning to support the delivery off physical exercise	☐	☐	☐	☐
Therapeutic exercise and recreation	☐	☐	☐	☐
Sensory circuits activities	☐	☐	☐	☐
Social work	☐	☐	☐	☐

53. Does the school organise during the year the following awareness events regarding? *

Mark only one oval per row.

	Children	Parents & carers	School support staff
Reducing children sedentary time and behaviour			
Physical & sensory needs			
Sensory sports profile Virtual			
sports exercise Indoor physical			
activities Outdoor			
physical activities Home			
physical activities			

54. Does the school record for special needs children their...? *

Mark only one oval per row.

	Never	Yearly	Termly
Fitness levels			
Physical activity levels			

55. Does the school report the children's fitness and activity levels to? *

Mark only one oval per row.

	Never	Yearly	Termly
Parents and carers			
Local education authorities			

56. Does the school report specifically the children's critical fitness and activity levels to? *
Mark only one oval per row.

	Never	Always
Parents and carers Local		
health authorities		
Local education authorities		

Government support

57. How often the school receives guidance to increase physical activity among children and young people in schools and colleges from ....? *
Mark only one oval per row.

	Never	Yearly	Randomly
The government			
The local government			

58. Does this guidance insist on the link between physical activity and ...? *

Mark only one oval per row.

	Not at all	Moderately	A lot
Healthy development			
Cognitive benefits			
Academic performance			

59. Does this guidance insist on ...? *

Mark only one oval per row.

	Not at all	Moderately	A lot
Physical activity guidelines	⬭	⬭	⬭
A variety off types and intensities off physical activity across the week	⬭	⬭	⬭
Physical activity aims	⬭	⬭	⬭

60. Is the budget allowed to the following activities? *

Mark only one oval per row.

	No budget	Insufficient	Moderate	Sufficient	Very sufficient
Physical education	⬭	⬭	⬭	⬭	⬭
Physical activities	⬭	⬭	⬭	⬭	⬭
School sports events	⬭	⬭	⬭	⬭	⬭
Outside school sport events	⬭	⬭	⬭	⬭	⬭

61. Does the school get inspected by the educational authorities regarding ...? *

Mark only one oval per row.

	Never	Yearly	Randomly
Physical education curriculum	⬭	⬭	⬭
Physical activities curriculum	⬭	⬭	⬭
Sports facilities	⬭	⬭	⬭
Fixed equipment	⬭	⬭	⬭
Loose equipment	⬭	⬭	⬭
Staffing	⬭	⬭	⬭

Appendix 3- A: Special Need, PE Teacher and Support Staff Questionnaire

* Required

1. Email *

2. In which school do you work? *

Mark only one oval.

- Boys Middle School Al Rayyane
- Boys Middle School Hittin
- Girls Middle School 10
- Girls Middle School 34

3. What is your Staff code?

4. What is your role in the school? *

Mark only one oval

- Head of PE
- PE teacher
- Special needs
- PE teacher PE and/or PA support staff
- Special needs support staff
- Other: ____________

5. What is your age group? *

Mark only one oval.

- Less than 21 years old
- Between 21 and 30 years old
- Between 31 and 40 years old
- Between 41 and 50 years old
- Over 50 years old

6. What is your qualification in teaching or supporting special needs children during their PE lessons? *

Mark only one oval.

- No qualification
- Diploma
- Bachelor
- Master

7. What is your experience in teaching or supporting special needs children during their PE lessons? *

Mark only one oval.

- No experience
- 1-2 years
- 3-6 years
- 7-10 years
- More than 10

8. What is your level in supporting special needs children during PE lessons in relation with *

Mark only one oval per row.

	Poor	Fair	Good	Very good	Excellent
Training					
Skill's					
Knowledge					

9. In how many classes of special needs children do you teach? *

Mark only one oval per row.

	0	1	2	3	More than 3
Year 7					
Year 8					
Year 9					

Physical education (PE) practice

10. How would you prefer to group special needs children in PE lessons?

Check all that apply.

	Physical education lessons	Physical activities
Regular classes		
Learning ability		
classes Physical		
ability classes		
Disability group		

11. How important to you is the promotion of PE among special needs children through? *

Mark only one oval per row.

	Not important	Slightly important	Moderately important	Important	Very important
A physical and sensory individual profile					
A physical and sensory individual circuit activities					

12. Do your PE classes have specifically for every special needs child......................... ?

Check all that apply.

	Year 7	Year 8	Year 9
A physical and sensory profile			
A physical and sensory circuit activities			

13. Do your PE classes have specifically for every special needs child........................... ?

Check all that apply.

	Physical impairment	Mental impairment	Vision impairment	Hearing impairment
A physical and sensory profile				
A physical and sensory circuit activities				

14. What is the staff - special needs children ratio during PE lessons in your classes?

Check all that apply.

	0	1-1	1-5	1-10	1-15	1-20 or more
PE teacher	☐	☐	☐	☐	☐	☐
PE Assistant	☐	☐	☐	☐	☐	☐
Special Need Teacher	☐	☐	☐	☐	☐	☐
Special Need Assistant	☐	☐	☐	☐	☐	☐
Playworker	☐	☐	☐	☐	☐	☐
Volunteers	☐	☐	☐	☐	☐	☐

15. What level of priority do you give to each of the following goals within your PE curriculum ? *

Mark only one oval per row.

	Not a priority	Low priority	Medium Priority	High priority	Essential
Acquiring and developing students" PE knowledge and skills					
Increasing student's PE confidence					
Improving students" agility, balance and speed					
Improving students" cardiovascular fitness, muscular					
Raising students" awareness off the health benefits of PA					
Promoting positive attitudes in students toward PA					
Maintaining off student's physical skills					
Physical activity engagement feedback from families					

16. What is the priority you set in supporting special needs children during the following activities ? *

Mark only one oval per row.

	Not a priority	Low priority	Medium priority	High priority	Essential
Athletic activities ((e.g.. running,, jumping,, throwing))					
Exercise/fitness activities ((e.g.. aerobics, circuit training))					
Games activities open to all abilities ((e.g.. football,, volleyballs))					
Gymnastic activities ((e.g. balancing, rolling))					
Inter--school games competitions ((e.g.. league))					
Inter–school non-competitive events or displays ((e.g.. gym, martial arts))					

17. Do you integrate the following fitness skills for children with special needs in their PE lessons? *

Mark only one oval per row.

	Never	Rarely	Sometimes	Often	Always
Agility					
Ballance					
Coordination					
Power					
Reaction time					

18. Do you integrate the following skills for children with special needs in their PE lessons? *

Mark only one oval per row.

	Never	Rarely	Sometimes	Often	Always
Space awareness					
Locomotor skills					
Non–Locomotor skills					
Manipulative skills					
Movements skills					

19. How many sports event days for special needs children do you support during the academic year? *

Mark only one oval per row.

0	1	2	3	4 or more

20. Do you ask special needs children what are their preferred activities during their? *

Mark only one oval per row.

	Never	Rarely	Sometimes	Often	Always
PE lessons					
PA sessions					

21. What is your preferred PE lesson duration for special needs children? *

Mark only one oval per row.

	30 min	45 min	1 hour	More than 1 hour
Year 7	◯	◯	◯	◯
Year 8	◯	◯	◯	◯
Year 9	◯	◯	◯	◯

22. What is your preferred number of weekly PE lessons for special needs children? *

Mark only one oval per row.

	1	2	3	4	5	More than 5
Year 7	◯	◯	◯	◯	◯	◯
Year 8	◯	◯	◯	◯	◯	◯
Year 9	◯	◯	◯	◯	◯	◯

23. Do you ask the school to use external sports facilities for special needs PE lessons when not internally available? *

Mark only one oval per row.

	Never	Rarely	Sometimes	Often	Always
Swimming pool	◯	◯	◯	◯	◯
Gymnasium	◯	◯	◯	◯	◯
Sports games grounds	◯	◯	◯	◯	◯

24. How important to you is that PE becomes a core subject in the school curriculum? *

Mark only one oval.

- Not important at all
- Slightly important
- Moderately important
- Important
- Very important

Special needs children PE and behaviour

25. Are PE lessons compulsory for all special needs children? *

Mark only one oval.

- Yes
- No

26. Are some children in your class dispensed from physical education lessons for the following reasons? *

Mark only one oval per row.

	Week	Month	Term	Academic year
Medical problem				
Parental choice				
Child choice				
Other				

27. During a typical class period, how long the children take to? *

Mark only one oval per row.

	5 min or less	6 -10 min	11 min or more
Get changed to start			
Warm up			
Receive instructions			
Cool down			
Get changed to finish			

28. What is the special needs children's commitment level to physical training and learning during their PE lessons? *

Mark only one oval per row.

	Very low	Low	Moderate	High	Very high
Year 7					
Year 8					
Year 9					

29. Regularity of special needs children during PE lessons in your class in *

Mark only one oval per row.

	Always	often	Sometimes	Not at all
Bringing their PE kits				
Being changed				
Being motivated				
Being concentrated				
Following instructions				
Asking for help				
Self-organising activities				
Teaming up				
Helping their peers				
Liking competing feeling				
less confident				
Preferring outdoor activities				

30. During the PE lessons, the children moan about *

Mark only one oval per row.

	Very often	Sometimes	Rarely	Not at all
The pain	⬭	⬭	⬭	⬭
The physical effort	⬭	⬭	⬭	⬭
The fatigue	⬭	⬭	⬭	⬭
The session duration The	⬭	⬭	⬭	⬭
Lack off interest	⬭	⬭	⬭	⬭
The lack off concentration The	⬭	⬭	⬭	⬭
weather	⬭	⬭	⬭	⬭
When fasting ((Ramadan))	⬭	⬭	⬭	⬭

31. How Is the special needs children PE attendance during ? *

Mark only one oval per row.

	Very good	Good	Fair	Poor	Very poor
Ordinary days	⬭	⬭	⬭	⬭	⬭
Hot weather	⬭	⬭	⬭	⬭	⬭
Cold weather	⬭	⬭	⬭	⬭	⬭
Ramadan	⬭	⬭	⬭	⬭	⬭

32. How Is the special needs children PE performance during ? *

Mark only one oval per row.

	Very good	Good	Fair	Poor	Very poor
Ordinary days					
Hot weather					
Cold weather					
Ramadan					

33. What is the absenteeism rate of special needs children in your classes? *

Mark only one oval per row.

	up to 5%	6 to 10 %	11 to 20 %	21 to 35 %	36 to 50 %	More than 50%
Year 7						
Year 8						
Year 9						

34. Do you test the physical fitness of the special needs children? *

Mark only one oval per row.

	Never	Monthly	Termly	Yearly	Occasionally
Year 7					
Year 8					
Year 9					

35. Do you measure the physical activity levels of the special needs children? *

Mark only one oval per row.

	Never	Monthly	Termly	Yearly	Occasionally
Year 7	◯	◯	◯	◯	◯
Year 8	◯	◯	◯	◯	◯
Year 9	◯	◯	◯	◯	◯

36. What is the special needs children's physical literacy level in your PE classes? *

Mark only one oval per row.

	Very low	Low	Moderate	High	Very high
Year 7	◯	◯	◯	◯	◯
Year 8	◯	◯	◯	◯	◯
Year 9	◯	◯	◯	◯	◯

37. What is the special needs children's physical competence level in your PE classes? *

Mark only one oval per row.

	Very low	Low	Moderate	High	Very high
Year 7	◯	◯	◯	◯	◯
Year 8	◯	◯	◯	◯	◯
Year 9	◯	◯	◯	◯	◯

38. In general, how significant would you rate the contribution to the promotion of PE among special needs children of? *

Mark only one oval per row.

	Not significant at all	Slightly significant	Moderately Significant	significant	Very significant
School	◯	◯	◯	◯	◯
Support Staff	◯	◯	◯	◯	◯
External SN bodies	◯	◯	◯	◯	◯
Children	◯	◯	◯	◯	◯
Parents	◯	◯	◯	◯	◯
Community	◯	◯	◯	◯	◯

39. How satisfied with the promotion of special needs PE in the school are you? *

Mark only one oval per row.

	Not all satisfied	Slightly satisfied	Moderately Satisfied	Very satisfied	Extremely satisfied
School support to special needs PE	⬭	⬭	⬭	⬭	⬭
Special needs PE curriculum	⬭	⬭	⬭	⬭	⬭
Number off days off PE per week	⬭	⬭	⬭	⬭	⬭
Number off hours off PE per day	⬭	⬭	⬭	⬭	⬭
Special needs PE equipment	⬭	⬭	⬭	⬭	⬭
Internal sports facilities for special needs PE	⬭	⬭	⬭	⬭	⬭
External sports facilities for special needs PE	⬭	⬭	⬭	⬭	⬭
staff support to special needs PE	⬭	⬭	⬭	⬭	⬭
External support to special needs PE	⬭	⬭	⬭	⬭	⬭
Special needs children physical levels achievement	⬭	⬭	⬭	⬭	⬭

Physical activities (PAs)

40. Are you involved in supporting special needs children with their PA curriculum? *

Mark only one oval.

- Never
- Rarely
- Sometimes
- Often
- Always

41. Do you participate in any of the following programmes for the promotion of PE and PA among special needs children?

Check all that apply.

	Policy	Practice	Committee
Physical rehabilitation	☐	☐	☐
physical skills Outdoor	☐	☐	☐
learning and play School	☐	☐	☐
physical activities Home	☐	☐	☐
physical activities	☐	☐	☐
Waking and riding to/from school	☐	☐	☐
Healthy eating	☐	☐	☐

42. How many times during the week do you support special needs children with the following activities? *

Mark only one oval per row.

	0	1	2		More than 3 times
Extrac urricular activities ((After school))	⬭	⬭	⬭	⬭	⬭
Intramural activities ((non-PE activities))	⬭	⬭	⬭	⬭	⬭
Extramural competitive activities ((outside school))	⬭	⬭	⬭	⬭	⬭

43. Which classes of special needs children do you support with the following activities?

Check all that apply.

	Year 7	Year 8	Year 9
Extrac urricular activities ((After school))	☐	☐	☐
IInttramurrall activities ((non-PE activities))	☐	☐	☐
Extramural competitive activities ((outside school))	☐	☐	☐

44. To the best of your knowledge, how well do each of the following statements characterise your role in promoting physical activity among special needs children as a? *

Mark only one oval per row.

	Not true at all	Somewhat true	True	Fairly true	Very true
Physical activity guideline requirement					
Physical and sensory					
circuit Reward					
Punishment for misbehaving					
Extramural competitive sports					

45. In general, how would you rate the contribution to the promotion of physical activity among special needs children you support ? *

Mark only one oval per row.

	Insignificant	Somehow significant	Significant	Fairly significant	Very significant
School Support Staff	◯	◯	◯	◯	◯
	◯	◯	◯	◯	◯
External bodies	◯	◯	◯	◯	◯
Children	◯	◯	◯	◯	◯
Parents	◯	◯	◯	◯	◯
Community	◯	◯	◯	◯	◯
Local medical authorities	◯	◯	◯	◯	◯
Local education authorities	◯	◯	◯	◯	◯

Physical activity levels monitoring

46. How do the special needs children feel about the measurement period? *

Mark only one oval per row.

	Very acceptable	acceptable	Moderately acceptable	Slightly acceptable	Not acceptable at all
Year 7					
Year 8					
Year 9					

47. How do the special needs children feel about the remeasurement period? *

Mark only one oval per row.

	Very acceptable	acceptable	Moderately acceptable	Slightly acceptable	Not acceptable at all
Physical impairment					
Mental impairment					
Vision impairment					
Hearing impairment					

48. Have the special needs children ever detached the accelerometer at any time at school during the monitoring period? *

Mark only one oval per row.

	Not at all	Rarely	Rather	Often	Very often
Sunday	◯	◯	◯	◯	◯
Monday	◯	◯	◯	◯	◯
Tuesday	◯	◯	◯	◯	◯
Wednesday	◯	◯	◯	◯	◯
Thursday	◯	◯	◯	◯	◯

49. From your observations on the special needs children, do you feel the accelerometers were...................................? *

Mark only one oval per row.

	Very much	Rather	Little	Not at all
Comfortable Securely	◯	◯	◯	◯
attached Unobtrusive	◯	◯	◯	◯
Non–tolerated	◯	◯	◯	◯
Distractive	◯	◯	◯	◯
Weight–related	◯	◯	◯	◯
	◯	◯	◯	◯

50. From your observations on the special needs children, do you feel the wearing of an accelerometer was tolerated when? *

Mark only one oval per row.

	Very much	Rather	Little	Not at all
Attending PE lessons				
Playing rough games				
Having class breaks				

51. Has the measurement device motivated your child to be more active during? *

Mark only one oval per row.

	Very much	Rather	Little	Not at all
PE lessons				
Class breaks				

School provision and support

52. What are the internal sports facilities do you effectively use for your PE lessons and PA activities? *

Mark only one oval per row.

	Inexistant	Never	Rarely	Sometimes	Often	Always
School hall	◯	◯	◯	◯	◯	◯
Sports hall	◯	◯	◯	◯	◯	◯
Gymnasium	◯	◯	◯	◯	◯	◯
Fitness room/Centre	◯	◯	◯	◯	◯	◯
Class room	◯	◯	◯	◯	◯	◯
Playing field	◯	◯	◯	◯	◯	◯
Hard play area ((Tarmac))	◯	◯	◯	◯	◯	◯
Changing facility room	◯	◯	◯	◯	◯	◯
Showers	◯	◯	◯	◯	◯	◯
Medical treatment room	◯	◯	◯	◯	◯	◯
Bikes racks	◯	◯	◯	◯	◯	◯

53. Do you use external sports facilities in the community for your special needs children classes?

Check all that apply.

	PE lessons	PA sessions	Daily sports events
Swimming pool	☐	☐	☐
Gymnasium	☐	☐	☐
Sports games fields	☐	☐	☐

54. How adequate are in your opinion, the school sports facilities to promote PE and PA among special needs children? *

Mark only one oval per row.

	Inadequate	Slightly inadequate	Neutral	Slightly adequate	Adequate
School hall					
Gymnasium					
Sports hall					
Fines room/Canter					
Classroom					
Playing field					
Hard play area ((tarmac))					
Changing facilities					
Bike racks					

55. How appropriately active is the school physical school environment? *

Mark only one oval per row.

	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate
School					
Environment ((outside school))					

56. What are the preferences of the children among these activities? *
Mark only one oval per row.

	High	Moderate	Low
Athletics activities			
Exercise/Fitness			
Gymnastics			
Games activities			
Competitive activities			
Non-competitive activities			

57. Does your class provide for special needs children the following? *
Mark only one oval per row.

	No	1 for 1	1 for 10	1 for 20	1 for more then 20
Sparre PE kiitts					
Team kiitts					
Biikes					
Actiivitty moniittoriing deviices					
Sporrtts accessorriies					

58. As a support staff promoting PE and PA among special needs children, have you been supported in your personal development in the following domains...?

Check all that apply.

	Course	Training	Refresher
Reducing children sedentary time	☐	☐	☐
Disability behaviour	☐	☐	☐
Disability confidence	☐	☐	☐
Intellectual and developmental disabilities	☐	☐	☐
Psychology and learning disabilities	☐	☐	☐
Autism studies	☐	☐	☐
Physical and sensory needs assessment	☐	☐	☐
Learning to support the delivery off physical exercise	☐	☐	☐
Therapeutic exercise and recreation Sensory	☐	☐	☐
circuits activities	☐	☐	☐
Physical activity self-monitoring	☐	☐	☐

59. Have you been involved in discussing the following topics with?
Check all that apply.

	Children in your class	Parents & carers	School support staff	Local authorities
Reducing children sedentary time and behaviour	☐	☐	☐	☐
Physical & sensory needs	☐	☐	☐	☐
Physical activity self-monitoring	☐	☐	☐	☐
Sensory sports profile	☐	☐	☐	☐
Virtual sports exercise	☐	☐	☐	☐
Indoor physical activities	☐	☐	☐	☐
Outdoor physical activities	☐	☐	☐	☐
Home physical activities	☐	☐	☐	☐
Barriers to PE & PA participation	☐	☐	☐	☐
Facilitators off PE and PA participation	☐	☐	☐	☐

60. Do you record the fitness and physical activity levels of the special needs children to: *
Mark only one oval per row.

	Regularly	School Tests	Never
Physical activity needs	◯	◯	◯
Physical activity levels	◯	◯	◯
Fitness levels	◯	◯	◯

61. Do you report the fitness and physical activity levels of the special needs children to: *

Mark only one oval per row.

	Physical activity needs	Fitness levels	Physical activity levels
School			
Parents and carers			

62. Do you report specifically the children's critical fitness and activity levels to? *

Mark only one oval per row.

	Never	Always	On request
School			
Parents and carers			

Government support

63. How often do you receive guidance to promote PE and PA among special needs children from? *

Mark only one oval per row.

	Never	Yearly	Termly
The government			
The local government			
The local education authorities			
The local health authorities			

64. Does this guidance insist on the link between physical activity and? *
Mark only one oval per row.

	Not at all	Moderately	A lot
Healthy development			
Cognitive benefits			
Academic performance			

65. Does this guidance insist on? *

Mark only one oval per row.

	Not at all	Moderately	A lot
Physical activity guidelines			
A variety off types and intensities off physical activity across the week			
Physical activity aims			

66. Is the budget allowed by the school to the following activities? *

Mark only one oval per row.

	No budget	Insufficient	Moderate	Sufficient	Very sufficient
Physical education					
Physical activities					
School sports events					
Outside school sport events					

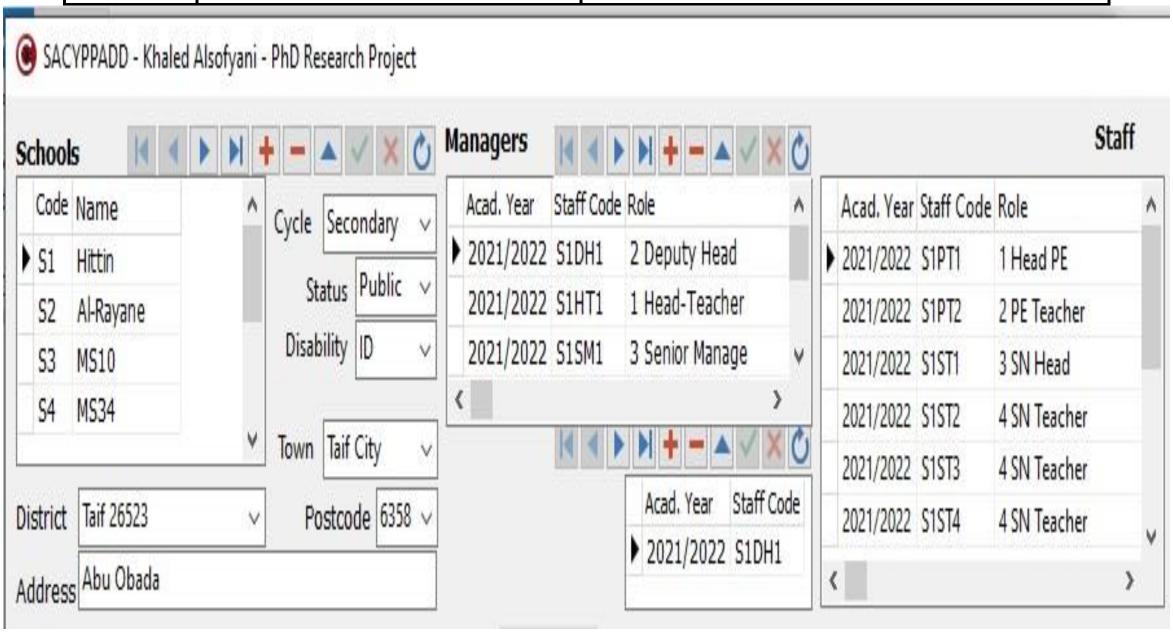
67. Do you get inspected by the educational authorities regarding? *

Mark only one oval per row.

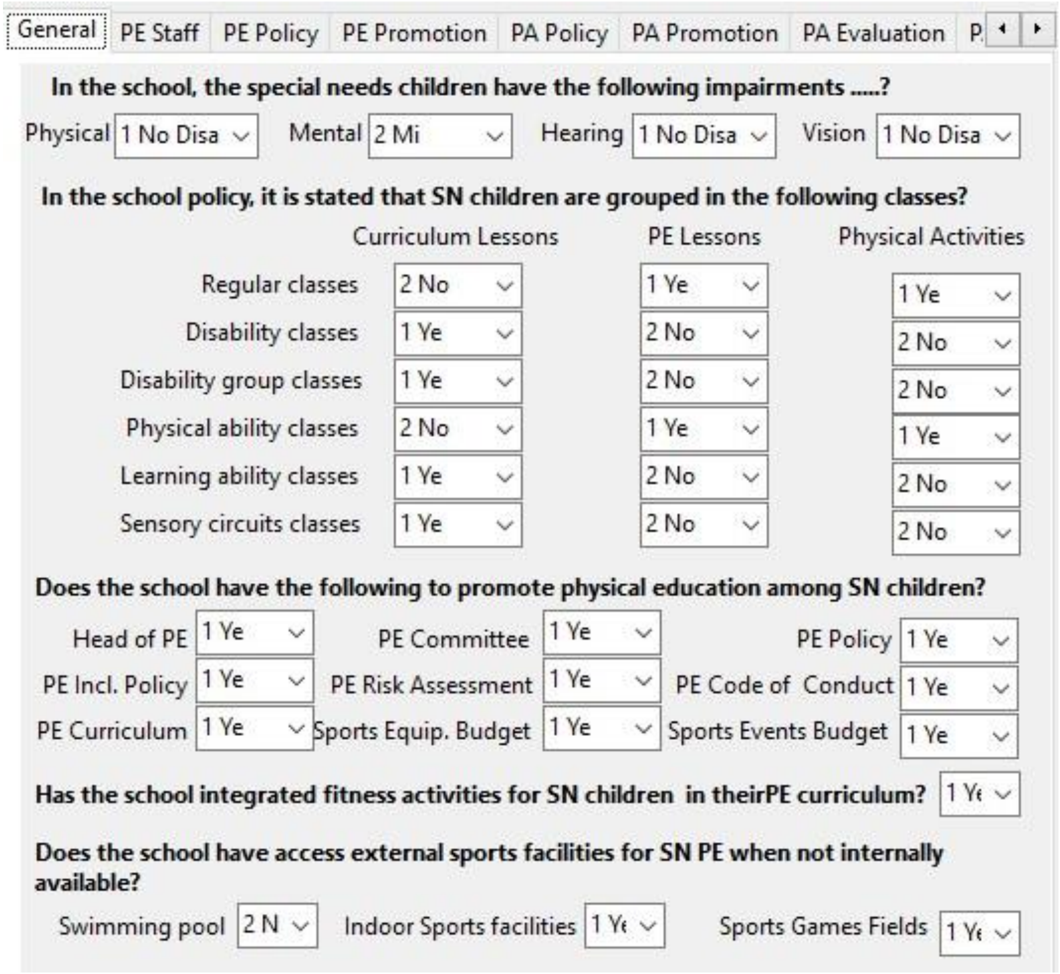
	Neve	Term	Yearly
Physical education curriculum			
Physical activities curriculum			
Sports facilities			
Fixed equipment			
Loose equipment			
Staffing			
PE practice			
PA practice			

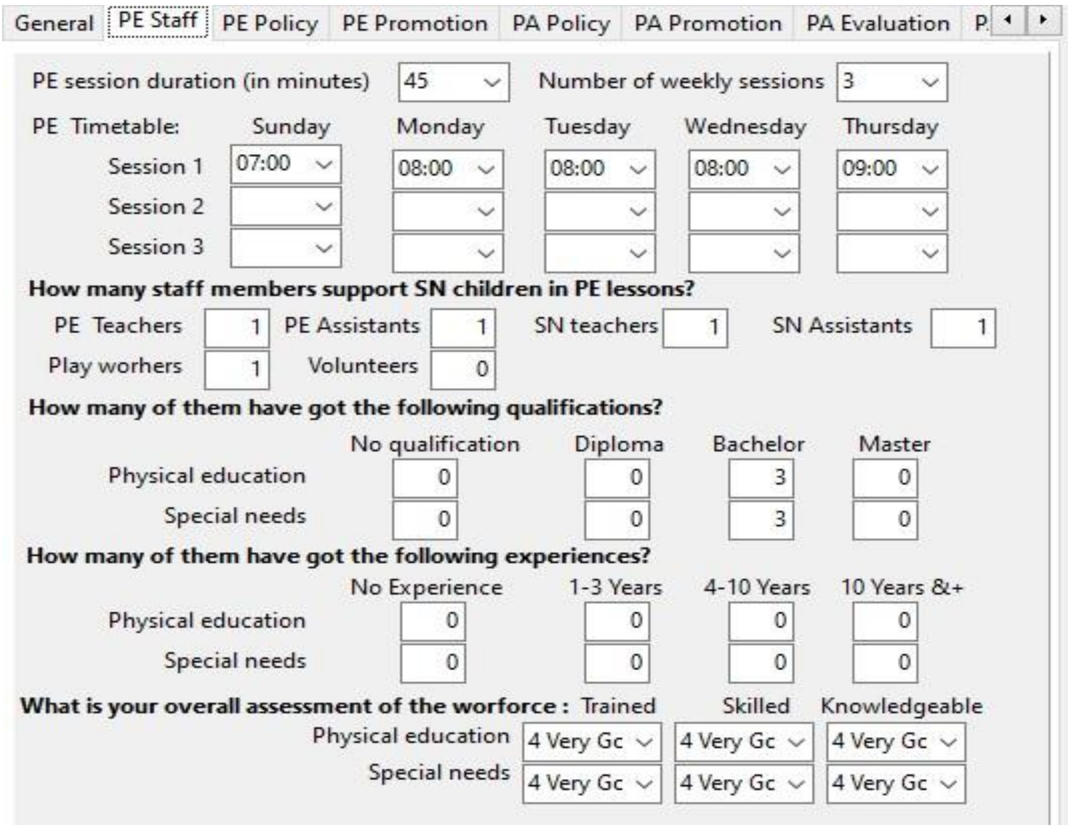
APPENDIX 2 &3: INPUT SCHOOL AND TEACHER QUESTIONNAIRES IN SOFTWARE (SACYPPADD)

No.	School Dataset	Teacher Dataset
1	General	Profile
2	PE Policy	Priorities
3	PE Promotion	Children's PE
4	PA Policy	PE Lessons
5	PA Promotion	PE Evaluation
6	PA Evaluation	Training
7	PA Facilities	PA Measurement
8	Training	Facilities
9	Government Support	Promoting PA
10		PA Practice



Appendix 2-b: Input school questionnaire in software (SACYPPADD)





General | PE Staff | PE Policy | PE Promotion | PA Policy | PA Promotion | PA Evaluation | P.

How many children are enrolled in PE lessons? 0 Average absenteeism (%) 5

What is the PE Session Staff composition: Teachers 0 Assistants 0 Volunteers 0

What level of priority does the school give to each of the following goals within your PE curriculum.....?

Acquiring and developing students' PE knowledge and skills	5 Essential
Increasing student's physical education confidence	5 Essential
Improving students' agility, balance and speed	4 High priority
Improving students' cardiovascular fitness, muscular endurance	4 High priority
Raising students' awareness of the health benefits of physical activity	4 High priority
Promoting positive attitudes in students toward physical activity	4 High priority
Maintaining of student's physical skills	4 High priority
Physical activity engagement feedback from families	5 Essential

What is the priority set by the school to the following activities for the SN children?

Athletic activities (e.g. running, jumping, throwing)	5 Essential
Exercise/fitness activities (e.g. aerobics, circuit training)	5 Essential
Games activities open to all abilities (e.g. football, volleyball)	5 Essential
Gymnastic activities (e.g. balancing, rolling)	5 Essential
Inter-school games competitions (e.g. league)	5 Essential
Inter-school non-competitive events or displays (e.g. gym, martial arts)	5 Essential

General | PE Staff | PE Policy | PE Promotion | PA Policy | PA Promotion | PA Evaluation | P.

Does the school measure the physical fitness of the SN children?	2 Rarely
Does the school measure the physical activity levels of the SN children?	1 Never
Does the school assess the physical activity needs of the SN children?	1 Never

Does the school report the fitness and physical activity levels of the SN children to:

	Physical fitness	Physical activity levels	Physical activity needs
Parents or Carers	2 No	2 No	2 No
Local medical autthorities	2 No	2 No	2 No
Local education autthorities	2 No	2 No	2 No

Does the school report crtitical fitness and physical activity levels of the SN children to:

Parents or Carers	Local medical autthorities	Local medical autthorities
1 Never	1 Never	1 Never

What is the SN children's

Commitment level to physical training and learning 5 Very Hi

Physical literacy level 3 Moder. Physical competence level 3 Moder.

In general, how significant would you rate the contribution to the promotion of physical education among special needs children of ....?

School	5 Very sig	Support Staff	5 Very sig	External SN Bodies	5 Very sig
Children	5 Very sig	Parents	5 Very sig	Community	5 Very im

How important to you is that physical education becomes a core subject in the school curriculum? 3 Moder.

General | PE Staff | PE Policy | PE Promotion | PA Policy | PA Promotion | PA Evaluation | P.

How satisfied with the promotion of special needs PE in the school are you?

School support to SN PE	3 Moderately	SN PE curriculum	3 Moderately
Number of: Days of PE / week	3 Moderately	Hours of PE / day	3 Moderately
Special needs PE equipment	3 Moderately		
Indoor SN PE facilities	3 Moderately	Outdoors SN PE facilities	3 Moderately
Staff support to SN PE	3 Moderately	External support to SN PE	4 Satisfied
		SN children's physical levels achievement	4 Satisfied

Does the school have the following to promote physical activity among SN children?

Head of PAs	2 No	PA Committee	2 No	PA Policy	2 No
PA Incl. Policy	2 No	PA Risk Assessment	2 No	PA Code of Conduct	2 No
PA Curriculum	2 No	Sports Equip. Budget	2 No	Sports Events Budget	2 No
		PA self-monitoring	2 No		

Does your school have the following for special needs children concerning?

	Physical Rehabilitation	Maintenance of physical skills	School PAs	Home PAs	Walking/Riding to/from School	Healthy Eating
Policy	2 No	2 No	2 No	2 No	2 No	2 No
Practice	2 No	2 No	2 No	2 No	2 No	2 No
Committee	2 No	2 No	2 No	2 No	2 No	2 No

General | PE Staff | PE Policy | PE Promotion | PA Policy | PA Promotion | PA Evaluation | P.

Has the school integrated for special needs children the following:?

PA in the learning curriculum: 2 No — Fitness activities in the PA curriculum: 2 No

Does the school offer a variety of physical activities for special needs children? 3 Somet

Does the school ask special needs children what are their preferred activities? 4 Often

Does your school organise during the week for special needs children the following

Intramural extra curricular activities (School time): 2 Once

Intramural extra curricular activities (After School): 2 Once

Extramural competitive activities (outside School): 2 Once

How important is to your school the promotion of special needs physical education (PE) and physical activity (PA) through?

A physical and sensory individual profile: 1 Not importan

A physical and sensory individual circuit activities: 1 Not importan

Does your school have specifically for every special need child.....?

A physical and sensory individual profile: 2 No

A physical and sensory individual circuit activities: 2 No

To the best of your knowledge, how well do each of the following statements characterise your school in promoting physical activity among special needs children as a.....?

Reward	3 True		
PA guideline requirement	3 True	Physical and sensory circuit	3 True
Punishment for misbehaving	3 True	Extramural competitive sports	3 True

General | PE Staff | PE Policy | PE Promotion | PA Policy | PA Promotion | PA Evaluation | P.

How many days does the school organise during the academic year for the SN children....?

Sports Events 3 Physical activities 3

In general, how significant would you rate the contribution to the promotion of physical activity among special needs children of ....?

School	2 Somewh	Support Staff	2 Somewh	External SN Bodies	1 Insignific
Children	1 Insignific	Parents	1 Insignific	Community	1 Insignific
		Health LA	1 Insignific	Education LA	1 Insignific

What are the sports facilities accessible to the special needs children in the school to use

	PE Lessons	Physical Activities	Individual Use	School Events
School Hall	1 Yes	2 No	2 No	1 Yes
Gymnasium/Sports hall	1 Yes	2 No	2 No	1 Yes
Fitness room	1 Yes	2 No	2 No	1 Yes
Playfield/Hard play area	1 Yes	2 No	2 No	1 Yes
Classroom	1 Yes	2 No	2 No	2 No
Changing facilities	1 Yes	2 No	2 No	1 Yes
Showers	2 No	2 No	2 No	2 No
Physiotherapy room	2 No	2 No	2 No	2 No
Bike racks	2 No	1 Yes	2 No	2 No

Does the school have external sports facilities access for SN PA when not internally available?

Swimming pool 2 No Indoor Sports facilities 1 Yes Sports Games Fields 1 Yes

PE Policy | PE Promotion | PA Policy | PA Promotion | PA Evaluation | PA Facilities | Trainin

How adequate are the sports facilities in the school? *

School Hall	3 Adequate	Gymnasium/Sports hall	3 Adequate
Fitness room	3 Adequate	Playfield/Hard play area	3 Adequate
Claassroom	3 Adequate	Changing Facilities	1 Inadequate
Showers	1 Inadequate	Physiotherapy Room	1 Inadequate
Bike racks	1 Inadequate		

How appropriately active is the physical school environment? **

School 4 Fairly active School Environment 4 Fairly active

Does the school provide for the special needs children the following ....?

PE kits	2 No	Team kits	2 No	Bikes	2 No
Treadmill	2 No	Tennis table	1 Yes	Playing Equipment	2 No
Weights	2 No	Skipping ropes	1 Yes	Playing accessories	1 Yes

Does the school organise during the year the following awareness events regarding? *

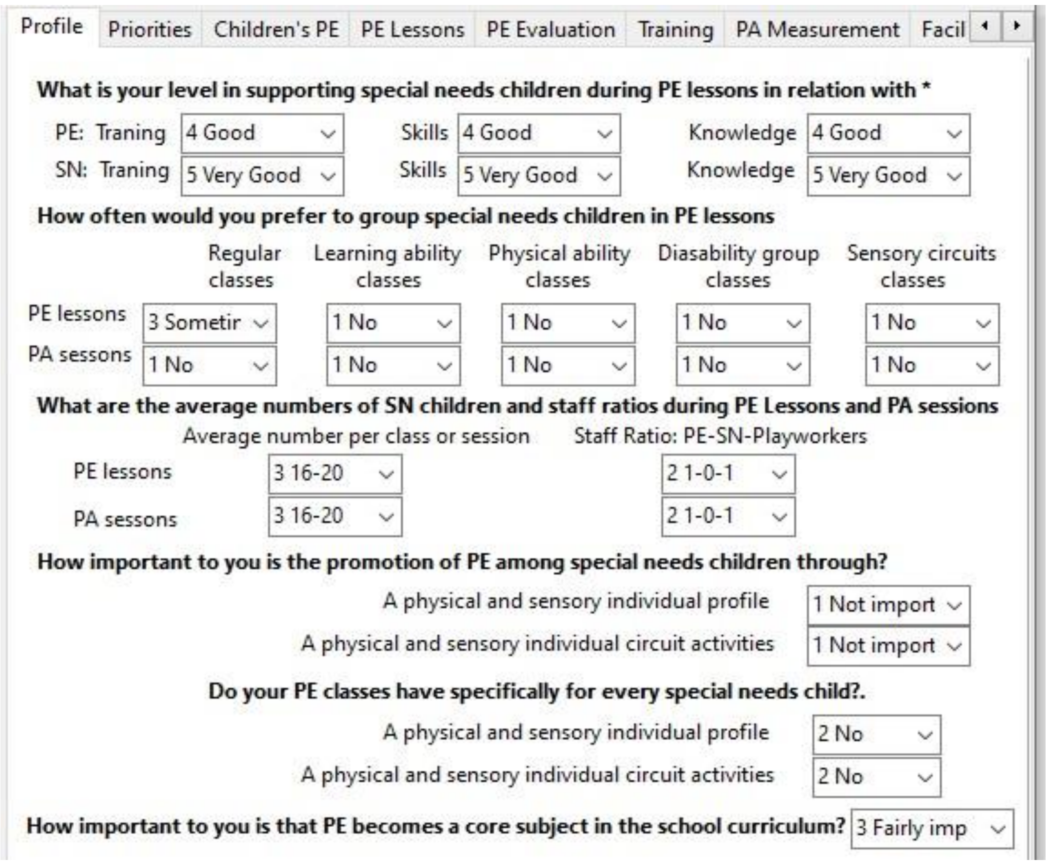
	Children	Parents/Carers	School Staff
Reducing children sedentary time and behaviour	2 No	2 No	2 No
Physical _sensory needs	2 No	2 No	2 No
Sensory sports profile	2 No	2 No	2 No
Virtual sports exercise	2 No	2 No	2 No
Indoor physical activities	1 Yes	2 No	1 Yes
Outdoor physical activities	1 Yes	2 No	1 Yes
Home physical activities	1 Yes	2 No	1 Yes

PE Promotion | PA Policy | PA Promotion | PA Evaluation | PA Facilities | Training | Gov. Su

Does the school provide for promoting physical education and physical activity among special needs children regular refresher courses and training in the following domains...?

	SN Teachers	PE Teachers	Play Workers	Volun-teers
Reducing children sedentary time	1 Yes	1 Yes	2 No	2 No
Disability behaviour	2 No	2 No	2 No	2 No
Disability Confidence	2 No	2 No	2 No	2 No
Intellectual and developmental disabilities	2 No	2 No	2 No	2 No
Psychology and learning disabilities	2 No	2 No	2 No	2 No
Autism studies	2 No	2 No	2 No	2 No
Physical and sensory needs assessment	2 No	2 No	2 No	2 No
Learning to support the delivery of physical exercise	2 No	2 No	2 No	2 No
Therapeutic exercise and recreation	2 No	2 No	2 No	2 No
Sensory circuits activities	2 No	2 No	2 No	2 No
Social work	2 No	2 No	2 No	2 No

APPENDIX 3-B: INPUT TEACHER QUESTIONNAIRE IN SOFTWAR (SACYPPADD)



Profile | Priorities | Children's PE | PE Lessons | PE Evaluation | Training | PA Measurement | Facil

What is your level in supporting special needs children during PE lessons in relation with *

PE:	Traning	4 Good	Skills	4 Good	Knowledge	4 Good
SN:	Traning	5 Very Good	Skills	5 Very Good	Knowledge	5 Very Good

How often would you prefer to group special needs children in PE lessons

	Regular classes	Learning ability classes	Physical ability classes	Diasability group classes	Sensory circuits classes
PE lessons	3 Sometir	1 No	1 No	1 No	1 No
PA sessons	1 No	1 No	1 No	1 No	1 No

What are the average numbers of SN children and staff ratios during PE Lessons and PA sessions

	Average number per class or session	Staff Ratio: PE-SN-Playworkers
PE lessons	3 16-20	2 1-0-1
PA sessons	3 16-20	2 1-0-1

How important to you is the promotion of PE among special needs children through?

A physical and sensory individual profile: 1 Not import

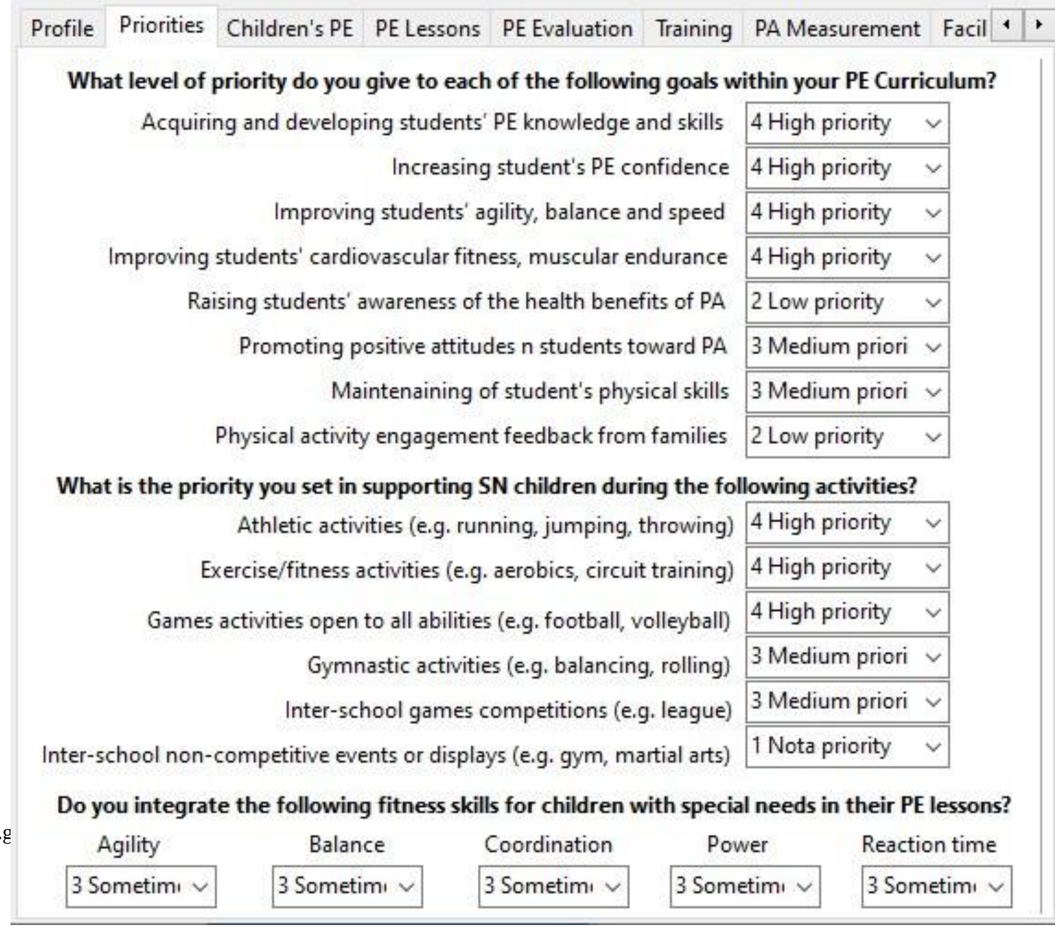
A physical and sensory individual circuit activities: 1 Not import

Do your PE classes have specifically for every special needs child?.

A physical and sensory individual profile: 2 No

A physical and sensory individual circuit activities: 2 No

How important to you is that PE becomes a core subject in the school curriculum? 3 Fairly imp



Profile | Priorities | Children's PE | PE Lessons | PE Evaluation | Training | PA Measurement | Facil

What level of priority do you give to each of the following goals within your PE Curriculum?

Acquiring and developing students' PE knowledge and skills	4 High priority
Increasing student's PE confidence	4 High priority
Improving students' agility, balance and speed	4 High priority
Improving students' cardiovascular fitness, muscular endurance	4 High priority
Raising students' awareness of the health benefits of PA	2 Low priority
Promoting positive attitudes n students toward PA	3 Medium priori
Maintenaining of student's physical skills	3 Medium priori
Physical activity engagement feedback from families	2 Low priority

What is the priority you set in supporting SN children during the following activities?

Athletic activities (e.g. running, jumping, throwing)	4 High priority
Exercise/fitness activities (e.g. aerobics, circuit training)	4 High priority
Games activities open to all abilities (e.g. football, volleyball)	4 High priority
Gymnastic activities (e.g. balancing, rolling)	3 Medium priori
Inter-school games competitions (e.g. league)	3 Medium priori
Inter-school non-competitive events or displays (e.g. gym, martial arts)	1 Nota priority

Do you integrate the following fitness skills for children with special needs in their PE lessons?

Agility	Balance	Coordination	Power	Reaction time
3 Sometim	3 Sometim	3 Sometim	3 Sometim	3 Sometim

Profile | Priorities | Children's PE | PE Lessons | PE Evaluation | Training | PA Measurement | Facil

Do you integrate the following skills for children with special needs in their PE lessons?

Space awareness	Locomotor skills	Non-Locomotor skills	Manipulative skills	Movement skills
2 Rarely	2 Rarely	2 Rarely	2 Rarely	3 Sometim

Do you ask special needs children what are their preferred activities during their?

PE lessons: 4 Often — PA sessions: 1 Never

Do you ask the school to use external sports facilities for SN PE when not internally available?

Swimming Pool: 1 Never — Indoor Sports Facilities: 3 Sometime — Sports Field Games: 3 Sometime

How many sports event days for SN children do you support during the acad year? 1 None

What is your preferred PE lesson duration for special needs children? 2 45 min

What is your preferred number of weekly PE lessons for special needs children? 3 3 sessi

Are PE lessons compulsory for all special needs children in your class? 2 No

Do you report the absence of the SN children to: School: 1 Yes — Parents: 2 No

Are some children in your class dispensed from PE lessons for the following reasons?

Medical reason: 1 Yes — Parent choice: 1 Yes — Child choice: 2 No — Other: 1 Yes

During a typical class period, how long the children take to? Get changed to start: 2 6-10

Receive instrucrions: 1 1-5 r — Warm-up: 1 1-5 r — Cool down: 1 1-5 r

Get changed to finish: 2 6-10

What is the SN children's commitment level to physical training and learning during their PE lessons 2 Low

Profile | Priorities | Children's PE | PE Lessons | PE Evaluation | Training | PA Measurement | Facil

Regularity of special needs children during PE lessons in your class in

Bringing their PE kits	4 Often	Being changed	4 Often
Being motivated	4 Often	Being concentrated	3 Sometimes
Following instructions	4 Often	Asking for help	3 Sometimes
Self-organising activities	4 Often	Teaming-up	3 Sometimes
Helping their peers	4 Often	Liking competing	3 Sometimes
Feeling less confident	2 Rarely	Preferring outdoor activities	3 Sometimes

During the PE lessons, the children moan about

The pain	4 Often	The physical effort	3 Sometimes
The fatigue	3 Sometimes	The session duration	3 Sometimes
The lack of interest	4 Often	The lack of concentration	4 Often
The weather	3 Sometimes	When fasting (Ramadan)	4 Often

How is the children's attendance and performance during:

	Ordinary days	Hot weather	Cold weather	Ramadan
Attendance	4 High	2 Low	3 Medium	3 Medium
Performance	3 Medium	3 Medium	3 Medium	3 Medium

What is the absenteeism rate of special needs children in your classes? 2 Low

Profile | Priorities | Children's PE | PE Lessons | **PE Evaluation** | Training | PA Measurement | Facil

Do you measure the SN children's Physical Fitness 3 Sometime **& PALevels** 1 Never

Do you record and report the fitness and physical activity levels of the SN children to:

	Physical fitness	Physical activity levels	Physical activity needs
School	3 Sometime	1 Never	1 Never
Parents or Carers	1 Never	1 Never	1 Never

What is in your classes, your assessment of the SN children'

Physical literacy 2 Poor | Physical competence 2 Poor

In general, how significant would you rate the contribution to the promotion of physical education among SN children of ....?

School	2 Slightly sign	Support Staff	1 Not signific	External SN Bodies	3 Fairly signif
Children	3 Fairly signif	Parents	1 Not signific	Community	1 Not signific
		Health LA	2 Slightly sign	Education LA	2 Slightly sign

How satisfied with the promotion of special needs PE in the school are you?

School support to SN PE	1 Not satisfiec	SN PE curriculum	2 Slightly sati
Number of: Days of PE / week	2 Slightly sati	Hours of PE / day	2 Slightly sati
Special needs PE equipment	2 Slightly sati		
Indoor SN PE facilities	2 Slightly sati	Outdoors SN PE facilities	1 Not satisfiec
Staff support to SN PE	1 Not satisfiec	External support to SN PE	1 Not satisfiec
		SN children's physical levels achievement	2 Slightly s

Are you involved in supporting SN children with their PA curriculum? 2 Rarely

Profile | Priorities | Children's PE | PE Lessons | PE Evaluation | **Training** | PA Measurement | Facil

Do you participate in any of the following programmes for the promotion of PE and PA among special needs children?

	Policy	Ptractice	Committee
Physical rehabilitation	1 Yes	1 Yes	2 No
Maintenance of physical skills	1 Yes	1 Yes	2 No
Outdoor learning and play	1 Yes	1 Yes	2 No
School physical activities	2 No	2 No	2 No
Home physical activities	2 No	2 No	2 No
Waking and riding to/from school	2 No	2 No	2 No
Healthy eating	2 No	2 No	2 No

Does your classe organise during the week for special needs children the following

Intramural extra curricular activities (School time)	3 Sometimes
Intramural extra curricular activities (After School)	1 Never
Extramural competitive activities (outside School)	1 Never

To the best of your knowledge, how well do each of the following statements characterise your school in promoting physical activity among special needs children as a.....?

Reward	1 Not tru		
PA guideline requirement	1 Not tru	Physical and sensory circuit	1 Not tru
Punishment for misbehaving	1 Not tru	Extramural competitive sports	1 Not tru

Profile | Priorities | Children's PE | PE Lessons | PE Evaluation | Training | PA Measurement | Facil

In general, how significant would you rate the contribution to the promotion of physical activity among SN children of ....?

School	2 Slightly sign	Support Staff	2 Slightly sign	External SN Bodies	1 Not significa
Children	2 Slightly sign	Parents	1 Not significa	Community	1 Not significa
		Health LA	2 Slightly sign	Education LA	2 Slightly sign

How do the special needs children feel about the PA measurement period? 3 Fairly a

Have the special needs children ever detached the accelerometer at any time at school during the monitoring period?

Day 1	Day 2	Day 3	Day 4	Day 5
2 Rarely	2 Rarely	2 Rarely	2 Rarely	2 Rarely

From your observations on the SN children, do you feel the accelerometers were:

Confortable	5 Very muc	Securely attached	5 Very muc	Unobstrusive	5 Very muc
Non tolerated	2 Very little	Distractive	3 Little	Weight-related	5 Very muc

From your observations on the SN children, do you feel the wearing of an accelerometer was tolerated when?

Atteding PE Lessons	Playing rough games	Having class breaks
5 Very muc	4 Rather	5 Very muc

Has the measurement device motivated your child to be more active during?

PE Lessons: 5 Very muc — Class breaks: 5 Very muc

Priorities | Children's PE | PE Lessons | PE Evaluation | Training | PA Measurement | Facilities | Prc

What are the sports facilities accessible to the SN childrenof your class to use in PE lessons and how asequate are they?

	PE Lessons	Adeqaute?
School Hall	5 Often	4 Adequatre
Gymnasium/Sports hall	5 Often	4 Adequatre
Fitness room	1 Inexistant	
Playfield/Hard play area	4 Sometimes	4 Adequatre
Classroom	2 Never	
Changing facilities	7 Always	4 Adequatre
Showers	1 Inexistant	
Physiotherapy room	1 Inexistant	
Bike racks	1 Inexistant	

How appropriately active is the physical school environment? **

School: 3 Neutral — School Environment: 3 Neutral

What are the preferences of the children among these activities?

Athletics activities	2 slightly p	Exercise/Fitness activities	2 slightly p
Gymanastics	2 slightly p	Game activities	5 Preferred
Competitive activities	3 Somehow pr	Non-Competitive activities	2 slightly p

PE Lessons | PE Evaluation | Training | PA Measurement | Facilities | Promoting PA | PA Practice

Do you use in your class for the special needs children the following ....?

PE kits		Team kits		Bikes	
Tradmill		Tennis table		Playing Equipment	
Weights		Skipping ropes		Playing accessories	

Does the school provide for promoting physical education and physical activity among special needs children regular refresher courses and training in the following domains...?

Reducing children sedentary time		Disability behaviour	
Intellectual and developmental disabilities		Disability Confidence	
Psychology and learning disabilities		Autism studies	
Physical and sensory needs assessment		Social work	
Therapeutic exercise and recreation		Learning to support the delivery of physical exercise	
Sensory circuits activities			

Do you receive guidance to increase physical activity among children and young people in schools and colleges from ....?

The Governement	Local Government	Local Medical Authorities	Local Education Authorities	Health & Sports Agencies
2 No	2 No	1 Yes	1 Yes	2 No

Does this guidance insist on the link between physical activity and ...?

Healthy development	1 Yes	Cognitive benefits	2 No
Academic performance	2 No		

PE Lessons | PE Evaluation | Training | PA Measurement | Facilities | Promoting PA | PA Practice

Does this guidance insist on the link with....?

		PA Aims	2 No
Types and intensities of PA variety across the week	2 No	PA guidelines	2 No

Have you, included in your PE practice the discussion of the following .... with ...?

	Your PE Team	Children	Parents/Carers	School SMT
Reducing children sedentary time and behaviour	3 Sometime	3 Sometime	1 Never	3 Sometime
Physical _sensory needs				
PA self-monitoring				
Sensory sports profile				
Virtual sports exercises				
Indoor physical activities				
Outdoor physical activities				
Home physical activities				
Barriers to PE and PA participation				
Facilitators to PE and PA participation				

Is the budget allowed to the following activities......?

PE	PA	School Sports	Outside Sports
3 Insufi	2 Inexis	2 Inexis	2 Inexis

Do you get inspected regarding your practice of .... par...?

PE: School	PE: L E Authorities	PE: Other	PA: School	PA: L E Authorities	PA: Other
3 Some	2 Rarel	1 Neve	1 Neve	1 Neve	1 Neve

Appendix 5: Input Anthropometric Measurement in Software (SACYPPADD)

Medical Check Questionnaire

Code [ ] Age & Gender [ ] [ ] Date [ ]

Anthropometric Measurements

Breadths (Width (in cms)

Shoulder	0
Bi-Iliac Breadth	0
Wrist	0
Elbow	0
Hand	0
Foot	0

Weight (in kgs)

Body weight	87
Subscapular Skinfold	0
Suprailiac Skinfold	0
Biceps skinfold	0
Triceps skinfold	0
Thigh Skinfold	0

----------- Girth (Circumference in cms) -----

Head	0	Neck	38
Arm Flexed	0	Arm Relaxed	0
Forearm	0	Wrist	0
Chest	0	Shoulder	0
Waist	90	Hip	65
Thigh (Gluteal)	0	Thigh (Mid)	0
Calf	0	Ankle	0

----------- Lengths (in cms) ----------

Standing Height	180		
Sitting Height	0	Knee Height	0
Standing Reach	0	Hand Length	0
Upper Arm Length	0	Foot Length	0
Arm Length	0	Arm Span	0
Upper Leg Length	0	Hand Span	0
Leg Length	0	Leg Span	0

Washington Group Short Set of Questions

[Do/Does] [you/he/she]	1	2	3	4	7	9
have difficulty seeing, even if wearing glasses?						
have difficulty hearing, even if using a hearing aid(s)?						
have difficulty walking or climbing steps?						
have difficulty remembering or concentrating?						
have difficulty with self-care, such as washing all over or dressing?						
have difficulty communicating, for example understanding or being understood?						
1. No difficulty 2. Some difficulty 3. A lot of difficulty 4. Cannot do at all *7. Refused* *9. Don't know*	Observations					

Appendix 8: Ethical Approval by The University of Durham (UK)

Dear Khaled,
The following project has received ethical approval:
Project Title: *The promotion of physical activity for special needs children within middle schools in the Kingdom of Saudi Arabia;*
Start Date: *01 October 2020*;
End Date: *30 September 2023;*
Reference: *SPORT-2021-05-01T20_32_26-vktf55*
Date of ethical approval: *07 May 2022.*

Thank you for addressing my previous comments and queries.
Thank you for submitting revised risk assessments which have been approved by the Chair of the Department H&S committee.
Also, thank you for confirming that a DBS type check is not required in the KSA, and including child (participant) consent. I hope your project goes well.

Please be aware that if you make any significant changes to the design, duration or delivery of your project, you should contact your department ethics representative for advice, as further consideration and approval may then be required.
If you have any queries regarding this approval or need anything further, please contact ses.researchadmin@durham.ac.uk

APPENDIX 10: ETHICAL APPROVAL BY THE UNIVERSITY OF TAIF (KSA)

جامعة الطائف
TAIF UNIVERSITY

Saudi Arabia Kingdom
Ministry of Education
Taif University
Research Ethics Committee

رؤية VISION 2030
المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA

لجنة أخلاقيات البحث العلمي

لجنة أخلاقيات البحث العلمي

COMMITTEE DECISION

سعادة الباحث / خالد عالي مستور السفياني

التاريخ: 2022-04-24

رقم البحث / 43-703

قامت لجنة الأخلاقيات بجامعة الطائف مؤخرًا بمراجعة الطلب المقدم من قبلكم الخاص بالحصول على موافقة اللجنة على المقترح البحثي الموضح أدناه. علماً بان اللجنة معتمدة من اللجنة الوطنية للأخلاقيات الحيوية برقم (HAO-02-T-105) ورأت اللجنة أن المقترح مستوفيًا لمتطلبات جامعة الطائف وعليه تم منح الموافقة الأخلاقية .

عنوان المشروع البحثي:

تعزيز النشاط البدني لذوي الاحتياجات الخاصة لطلاب المدارس المتوسطة في المملكة العربية السعودية

القرار

- موافق عليه ☑
- يوافق عليه بعد إجراء التعديلات المرفقة ☐
- غير موافق عليه ☐

رئيس اللجنة

لجنة أخلاقيات البحث العلمي
RESEARCH ETHICS COMMITTEE
TU جامعة الطائف TAIF UNIVERSITY

أ.د / خالد بن عبدالله السواط

Mohammed

APPENDIX 11: MEASUREMENTS APPROVAL BY THE UNIVERSITY OF TAIF

جامعة الطائف
TAIF UNIVERSITY
(٠٤١)

VISION رؤية 2030
المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA

سعادة مدير الإدارة العامة للتعليم بمحافظة الطائف المحترم

السلام عليكم ورحمة الله وبركاته اما بعد:

أفيد سعادتكم بأن الأستاذ/ خالد عالي مستور السفياني، المبتعث من قسم علوم الريـاضة بكلية التربية بجامعة الطائف، يقوم بإجراء بحث بعنوان (تعزيز النشاط البدني لذوي الاحتياجات الخاصة لطلاب المدارس المتوسطة في المملكة العربية السعودية).

عليه، ارجو من سعادتكم التكرم بمساعدة الأستاذ/ خالد، على تطبيق أداة البحث على المدارس المتوسطة بمدينة الطائف، حيث ان البحث متمم للحصول على درجة الدكتوراه في علوم الريـاضة والصحة.

مرفقا لسعادتكم تفاصيل أدوات البحث العلمي المستخدمة بالدراسة،،،،،،،

شاكرا لسعادتكم حسن تفهمكم وتقديركم سلفـا

وتقبلوا خالص تحياتي وتقديري.

رئيس قسم علوم الرياضة

١٤٤٢هـ

د/ عطية بن عبد الله حدادي

كلية التربية
قسم علوم الرياضة
Dept of Sport Sciences
جامعة الطائف TAIF UNIVERSITY

الرقم:
التاريخ: / / ١٤هـ
المرفقات:
الموضوع:

www.tu.edu.sa

المملكة العربية السعودية – وزارة التعليم
الطائف الحوية ص ب ٨٨٨ الرمز البريدي ٢١٩٧٤
هاتف ٠١٢٧٢٧٢٠٢٠ فاكس ٠١٢٧٢٧٤٢٩٩

APPENDIX 12: ARABIC COPY GDET APPROACHING LETTER (KSA)

Durham University
Department of Sport and Exercise Sciences

الباحث: خالد عالي السفياني
(1002568903)
طالب دكتوراة بجامعة دورهام
قسم علوم والرياضة والتمارين
المملكة المتحدة البريطانية
عنوان البريد الإلكتروني والهاتف:
khaled.a.alsofyani@durham.ac.uk
(0044) 7427508087

الإدارة العامة للتعليم بالطائف

سيدي العزيزمديرإدارة التربية الخاصة بالطائف،
أنا المبتعث خالد عالي السفاني من جامعة الطائف، والذي أقوم حاليا بإجراء بحث دكتوراة في قسم علوم الرياضة والتمارين بجامعة دورهام (المملكة المتحدة). يتضمن بحث الدكتوراة دراسة بحثية سيتم إجراؤها في المدارس المتوسطة العامه في المملكه العربية السعودية بمحافظة الطائف.
تتضمن هذه الدراسة استخدام مقاييس التسارع (مثل ساعات اليد) التي يرتديها الطلاب والطالبات المعاقين علي المعصم لقياس النشاط البدني لديهم والذي تتراوح أعمارهم بين 12 و 14 سنة والمنتسبين لـبرنامج التربية الخاصة كما سيشمل جمع بيانات شخصية وعائلية وبيئية عن الطفل والأسرة والمدرسة، للتمكن من إجراء تحليل متعدد المستويات لتحديد الارتباطات اللازمة لفهم الحواجز والميسرات لمشاركة الأطفال المعاقين في النشاط البدني داخل المدرسة وخارجها. وسيشرف على هذا البرنامج الإدارة العليا للمدارس المشاركة، وسيتم ضمان سرية المعلومات وعدم الكشف عن الهوية على الإطلاق.

ستساعد هذه الدراسة على معرفة ما إذا كان هؤلاء الأطفال يستوفون أولا يستوفون المبادئ التوجيهية الدولية للنشاط البدني المعتدل والقوي. وعلاوة على ذلك، سيساعد على فهم أفضل لتأثير المتغيرات الاجتماعية والبيئية على مستويات النشاط البدني للأطفال المعاقين ودراسة وتطوير خيارات السياسة العامة لصياغة استراتيجيات فعالة وكافية لتعزيز النشاط البدني بين هؤلاء الأطفال في المدارس السعودية المتوسطة في سياق رؤية المملكة 2030.

تفرض متطلبات أخلاقيات البحث في جامعة دورهام في المملكة المتحدة إدراج ما يلي:
- ان تشتمل عينة الدراسة على بنين وبنات من مجموعة المدارس المختارة،

حيث تم اختيار المدارس بناء على أكبرعدد من الأطفال المعاقين الدارسين في مدارس التعليم العام للمرحله المتوسطه بمحافظة الطائف من المصدر("مبادرة إحصاء 2022/1443"، 2021)،
- أنواع مختلفة من الإعاقة،
- عينة دراسة سكانية تمثيلية.

سوف يكون الاختيارحسب الجدول المبين أدناه:
- اختيار 3 مدارس للبنات،

- اختيار 3 مدارس للبنين من بين 6 مدارس الموضحه في الجدول أدناه، واستنادا إلى نوع الإعاقة التي للأسف لم يتم الإشارة إليها في مصدرالبيانات ("مبادرة إحصاء 2022/1443"، 2021).

القطاع	مدرسة		عدد		نوع الإعاقة
	الرمز	الإسم	الأطفال	الفصول	
	إجمالي المدارس		92	26	
بنات	130553	برنامج العوق السمعي ملحق المتوسطة العاشرة	17	3	برنامج العوق السمعي
	31590	برنامج العوق الفكري مع المتوسطة 34	42	6	برنامج العوق الفكرية
	31591	برنامج العوق الفكري مع المتوسطة 8 بالحوية	10	3	برنامج العوق الفكرية
	المدارس المختارة		**69**	**12**	
	إجمالي المدارس		209	55	
بنين	29979	مجمع الأمير محمد بن عبدالرحمن المتوسطة تربية خاصة	23	3	برنامج التربية الخاصة
	30134	الريان المتوسطه تربية خاصة	17	3	برنامج التربية الخاصة
	29902	العلاء بن الحضرمي المتوسطة تربية خاصة	19	3	برنامج التربية الخاصة
	29978	حطين المتوسطه تربية خاصة	26	4	برنامج التربية الخاصة
	29949	خالد بن الوليد المتوسطة تربية خاصة	20	3	برنامج التربية الخاصة
	29977	دار التوحيد المتوسطة تربية خاصة	22	3	برنامج التربية الخاصة
	المدارس المختارة		**127**	**19**	

سأكون ممتن لك جدا لدراسة هذا المشروع من حيث:

1. تحديد طبيعة أونوع الإعاقة المدرجة في برامج التربيه الخاصة التي تنفذ في مدارس البنين المختاره أعلاه،
2. مدي إمكانية مشاركة مدارس البنات في هذه الدراسة البحثية بتعيين مساعدة باحث من المدارس المختاره،
3. إمكانيه عمل البحث والإجراءات المعمول بها وطريقة الاتصال بالمدارس المذكورة أعلاه.

حاليا، لقد أجريت تجارب على كيفية تنفيذ قياس التسارع وتحليل البيانات علي بناتي والتي كانت ناجحة جدا. وتشتمل الخطوه التالية التقديم علي لجنة أخلاقيات البحث لكل من جامعة دورهام (المملكة المتحدة) وجامعة الطائف (المملكة العربية السعودية).

ردكم الخاص علي هذه الرسالة له أهمية بالغة للغاية لدعمي في الخطوات التالية من البحث.

هذا ولكم جزيل الشكروالتقدير،،،

خالد السفياني

المشرف الدراسي الرئيسي: البروفوسور برت سمث.

٢٣جماد الثاني 2022/1443.

أدوات البحث

المشروع البحثي:

تشجيع النشاط البدني لذوي الاحتياجات الخاصة لطلاب المدارس المتوسطة في المملكة العربية السعودية

1. تفاصيل البحث

(i) درجة البحث: دكتوراه.
(ii) الجهة الراعية للبحث: جامعة الطائف.
(iii) الاهتمام البحثي: تعزيز حقوق الأطفال المعوقين في المشاركة في النشاط البدني في سياق تنفيذ رؤية المملكة 2030.
(iv) الباحث: خالد عالي السفياني

Khaled.a.alsofyani@durham.ac.uk

- 637020 555 (0) 966+
- 508087 7427 (0) 44+

العنوان في المملكة العربية السعودية:

شارع 20، الشهداء، 21944 الطائف، المملكة العربية السعودية

العنوان في المملكة المتحدة:

قسم علوم الرياضة والتمارين الرياضية، جامعة دورهام.
42 Old Elvet, DH1 3HB Durham ، المملكة المتحدة.
الهاتف: 44+ (0) 191 334 2000

2. أهداف البحث

تهدف هذه الدراسة إلى:

(i) تحديد مقدار النشاط البدني الذي يقوم به الأطفال ذوي الاحتياجات الخاصة داخل المدرسة وخارجها وتحديد ما إذا كانوا نشطين بما فيه الكفاية ويصلون إلى 20 دقيقة يوميا على مدار الأسبوع وفقا للمبادئ التوجيهية الدولية الموصى بها بشأن النشاط البدني المعتدل والقوي (MVPA). وسيشمل ذلك تحديد الاختلافات في مستوى نشاطهم لكل فئة من فئات الإعاقة والفئة العمرية والمدرسة وأهميتها بسبب اختلاف إعدادات الأطفال داخل المدرسة وخارجها (في المنزل وخارجه).

(ii) تقييم قابلية ارتداء أجهزة قياس التسارع بين الأطفال ذوي الاحتياجات الخاصة.

(iii) تحسين تصنيف النشاط البدني باستخدام مجموع مقاييس المتجهات (SVM) المسجلة ل 10 أنشطة شبه منظمة يتم تنفيذها في المدرسة لتصحيح فروق نقاط القراءات القياسية.

(iv) التحقيق في العقبات والتسهيلات أمام الأطفال ذوي الاحتياجات الخاصة لممارسة الأنشطة البدنية ومشاركتهم في دروس التربية البدنية، والذي يرتبط بأسباب عدم مشاركة أو تقليل مشاركة الأطفال ذوي الاحتياجات الخاصة في برامج النشاط البدني والتربية البدنية.

(v) وضع استراتيجيات قائمة على الأدلة لتعزيز النشاط البدني بين الأطفال ذوي الإعاقة في المدارس المتوسطة في المملكة العربية السعودية في سياق رؤية المملكة 2030.

(vi) يقدم للأطفال والأسر والمدارس والمنظمات الاستراتيجيات القائمة والموصى بها للتعليق على ما إذا كانت مناسبة لهذا الغرض.

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أدوات البحث

3. المهام المدرسية المطلوبة

يتعلق المشروع البحثي فقط بالتلاميذ الذين تتراوح أعمارهم بين 12 و 14 عاما، ذوي الإعاقات المختلفة الذين يحضرون مدرستك المتوسطة. يتطلب من المدرسة القيام بالمهام التالية:

أ. جمع البيانات الشخصية والعائلية والاجتماعية والبيئية للأطفال باستخدام الرموز بواسطة الاستبانات التالية:

(i) استبانة الطفل والوالدين.
(ii) استبانة المدرسة.
(iii) استبانة معلم التربية البدنية وموظفي دعم ذوي الاحتياجات الخاصة.

ب. جمع البيانات الأنثروبومترية برمز الطفل وباستخدام القياسات التالية:

- قياسات الطول والوزن والمحيط للجسم (بالسنتيمتر)

Child Code	Weight (in Kg)	Height (in cm)	Sitting Height (in cm)	Circumference (in cm) Neck	waist	Arm	Thigh	Hips
S3C01								
S3C02								
S3C03								

- قياسات الدهون (بالملليمتر) التي يجب تكرارها 3 مرات

Child Code	N.	Bicep	Tricep	Shoul-der	Iliac Crest	Abdo-minal	Tigh	Calf
S3C01	1							
	2							
	3							
S3C02	1							
	2							
	3							

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أدوات البحث

ت. مراقبة النشاط البدني للأطفال لمدة 7 أيام باستخدام مقاييس تسارع GeneActiv للمعصم المهيمن.

ث. جمع بيانات مسحي بمساعدة الآباء والمعلمين المتعلقة بقابلية ارتداء أجهزة قياس التسارع من قبل الأطفال ذوي الاحتياجات الخاصة باستخدام استبيان تقييم قابلية ارتداء مقياس التسارع.

ج. سيطلب من الأطفال القيام ب 10 نوبات من النشاط لمدة 5 دقائق لكل منها في يوم ووقت يتم ترتيبه مع المدرسة. سيتم ملاحظة استراحة لمدة 5 دقائق بعد كل نشاط. هذه الأنشطة هي: وضع السوبرين, الجلوس ثم الوقوف، ممارسة رياضة افتراضية، اللعب مع الليغو، رمي والتقاط الكرة ، خطوة تمرير كرة القدم، المشي البطيء، المشي السريع, الجري البطيء ، والجري المتوسط.

ح. سيتم تنظيم مناقشات مجموعات مركزة تشمل إدارة المدرسة ومعلمي التربية البدنية وموظفي دعم ذوي الاحتياجات الخاصة ومجموعة من الآباء والأطفال لمناقشة الحواجز والميسرين أمام المشاركة في النشاط البدني والاستراتيجيات اللازمة لتعزيزه.

4. الاعتبارات البحثية:

أ. يتم إجراء هذا البحث تحت مسؤولية المدرسة ويشرف عليه منسق المشروع البحثي المعين من قبل المدرسة بالتعاون مع الباحث للقيام بمهام البحث.

ب. سيتم إعطاء الأطفال وموظفي المدرسة من قبل المدرسة رمزا لاستخدامه لإخفاء هوية بياناتهم ويتكون هذا الرمز من:

(i) رمز مدرسة الطفل (S1 و S2 و S3 و S4) والرقم التسلسلي للطفل (C01 و C02 و ...). على سبيل المثال ، يتوافق S1C04 مع الطفل الرابع من المدرسة الأولى.

(ii) رمز المدرسة للموظف (S1 و S2 و S3 و S4) والرقم التسلسلي للموظفين الذي يحتوي على رمز دور الموظف في المدرسة وتسلسل ضمن فئة الدور.

ت. سيطلب من الأطفال وأولياء أمورهم وموظفي المدرسة إعطاء موافقتهم قبل المشاركة في هذا البحث بعد تلقي حزمة معلومات البحث التي تحتوي على:

(i) إشعار الخصوصية
(ii) ورقة معلومات المشاركين
(iii) نموذج موافقة المشارك

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APPENDIX 13: GDET DECISION TO APPROACH SCHOOLS

المملكة العربية السعودية
وزارة التعليم
الإدارة العامة للتعليم بمحافظة الطائف
إدارة التخطيط والتطوير
البحوث والدراسات

وزارة التعليم
Ministry of Education

الرقم: 51075
التاريخ: 1443/09/12
المشفوعات:

الموضوع: تسهيل مهمة الباحث: خالد عالي مستور السفياني
في تطبيق دراسة علمية (دكتوراه)

المكرم قائد مدرسة ....المتوسطة
المكرمة قائدة مدرسة ....المتوسطة

وفقكم الله

اسم الباحث	خالد عالي مستور السفياني		
الجامعة	جامعة الطائف		
الكلية	كلية التربية	**التخصص**	علوم الرياضة والنشاط البدني
الغرض من الدراسة	دكتوراه		
عنوان الدراسة	تعزيز النشاط البدني لذوي الاحتياجات الخاصة لطلاب المدارس المتوسطة في المملكة العربية السعودية		
أدوات الدراسة	استبانة	**عينة الدراسة**	طلاب
	مقياس		طالبات
			معلمين
			معلمات
			مدراء
			مديرات
			إداريين
			إداريات

السلام عليكم ورحمة الله وبركاته,,, وبعد:

فبناءً على ما تقدّم به الباحث الموضح اسمه أعلاه لتطبيق الأداة الخاصة بدراسته, ونظراً لاكتمال إجراءات الدراسة نأمل منكم تسهيل مهمته في التطبيق على العينة المشار إليها .

شاكرين لكم ومقدرين تعاونكم ,,,

المدير العام للتعليم بمحافظة الطائف

Web site : researches.taifedu.gov.sa - الطائف - هاتف : 0127321754 - فاكس : 0127329316

المملكة العربية السعودية
وزارة التعليم
الإدارة العامة للتعليم بمحافظة الطائف
إدارة التخطيط والتطوير
البحوث والدراسات

وزارة التعليم
Ministry of Education

الرقم: 51075
التاريخ: 1443/09/12
المشفوعات:

الموضوع: تسهيل مهمة الباحث: خالد عالي مستور السفياني
في تطبيق دراسة علمية (دكتوراه)

محمد بن عامر النفيعي

APPENDIX 20: INFORMATION SHEET FOR PARENTS

Information Sheet for Parents/Guardians

Research Study:

The promotion of physical activity of special needs children within secondary middle schools in the Kingdom of Saudi Arabia.

Investigators details:
Khaled aali M Alsofyani
- Khaled.a.alsofyani@durham.ac.uk
- +44(0) 7427 508087

Professor Brett Smith
- Brett.smith@durham.ac.uk
- +44(0) 7902 968035

Postal address and telephone (Investigators and University):
- Department of Sport and Exercise Sciences, Durham University, 42 Old Elvet, DH1 3HB Durham, United Kingdom.
- +44(0) 191 334 2000

What is the purpose of the research study?

The improvement of people's physical and mental health through physical activity (PA) remains a worldwide life challenge that starts at an early age for children even before starting their school education. PA at home, school, and in the community is essential for every child, including those with special needs. In the Kingdom of Saudi Arabia (KSA), this challenge has been highlighted in the Saudi Vision 2030 in terms of enhancing the national policy encouraging active living and discouraging sedentary behaviour with contributions from all involved parties and government bodies.

The proposed research is in the context of rigorous study designs and advanced methods of PA assessment which are required to enhance existing knowledge and understanding of not only how much PA Saudi special needs children participate in, but also where and when they can be physically active. Such research will be instrumental in outlining and informing future health policies and interventions, aimed at tackling physical inactivity (PI) within a country such as KSA, in which currently children are among being less active and obese, and more specifically special needs children sedentary behaviour has not been examined.

What is the aim of the research study?

This study aims at:

(i) determining what amount of PA disabled children do in and outside of school and establishing whether they are sufficiently active and reach the 30 minutes per day across the week of Moderate and Vigorous PA (MVPA) international recommended guidelines. This will include identifying their activity level differences per category of impairment, age group, school, and their importance because of the children's different settings inside and outside school (at home and outside).

(ii) Assessing the wearability of accelerometers among special needs children.

(iii) Examining physical activity classification differences based on cut-points differences.

(iv) Investigate the barriers and facilitators to the special needs children's PA and PE participation using elaborate PA correlates to understand the reasons for the non-participation or less engagement of special needs children in PA and PE programmes.

(v) Create evidence-based strategies to promote PA among children with a disability in primary schools and impairment centres in KSA.

(vi) Give to children, families, schools, and organisations existing and recommended strategies to comment on whether they are fit for the purpose.

This research study involves:

(i) The monitoring of children's physical activity who will be asked to wear a wrist attached accelerometer (GENEActiv) in their dominant wrist for 7 days.

(ii) The children's parents and guardians will be asked to fill up a questionnaire about their child's personal, familial and socio-environmental life.

(iii) The school and the physical education teachers and physical activity support staff to fill up a questionnaire about the school policies, resources and support provided to special needs children during sports lessons and physical activities inside the school and the community.

(iv) The children's parents and guardians, the physical education teachers and support physical activity staff will be asked to fill up a questionnaire about the children's reactions to wearing an accelerometer for 7 days.

(v) Online group discussions including children, parents, physical education teachers and physical activity support staff and the school senior management will be organised to discuss barriers and facilitators for special needs children's physical education and activity participation.

Are there any inclusion or exclusion criteria?

We would like as many special needs children as possible from boys' and girls' secondary middle schools in the region of Taif (KSA) to take part in the study. However, we have limited resources allocated to this research study in terms of time (3 months) and the number of accelerometers available (??). This limitation of resources resulted in considering only a few schools and classes. So, we have selected the schools with the highest number of special needs children with intellectual disabilities and hearing impairments and only? classes per school.

What will my child be asked to do?

This research study is taking part on the school premises under the full supervision of the school authorities and appointed project coordinator. We will explain the study requirements to your child and take some measurements, including height, sitting height, weight, body fat percentage (using special scales) and waist circumference. After that, we will attach a GENEActiv accelerometer to your child's dominant wrist and ask them to wear the monitor for 8 days, which will include two weekend days. With your help, we would like his device must not to be removed even when your child is showering, sleeping and playing rough games. On the 8th day, we will collect the device and the accelerometer wearability assessment questionnaire. Any problem resulting from wearing this device must be reported to the school project coordinator.

What is the GENEActiv accelerometer?

The GENEActiv accelerometer is like a watch and can be worn by all age groups, from young children through to the elderly. It is designed for 24-hour wear free-living public health research and academic and clinical trials and is lightweight, waterproof and neutral in design. It is low in burden and its ambient light and temperature sensors provide valuable information about the subject's environment. It is robust in objectively monitoring physical activity, sleep and everyday living behaviour change reliably.

Will my child be required to undertake additional tasks?

Your child among his peers will be asked to undertake 10 bouts of activity of 5 minutes each at a day and time arranged with the school during the monitoring week. A break of 5 minutes will be observed after each activity. These activities which will be first practiced in PE lessons are:

- Lay supine
- Sitting
- Playing a virtual sport
- Playing with legos
- Overarm throwing and catching
- Instep passing a football
- Slow walk
- Fast walk
- Slow run
- Medium run

Are there any disadvantages or risks in participating?

Monitoring physical activity for 7 days can stimulate your child to participate more efficiently and effectively in PE lessons and physical activities. More importantly, this monitoring will result in classifying the physical activity undertaken by your child for a week and will provide them, you and the school with valuable information about their living behaviour changes during this period. Your child will be asked to tell you and the schoolteachers or project coordinator if they experience any discomfort or irritation from wearing the device, and should the situation become unbearable which is unlikely, the device will be removed without any prejudice to your child. Although accelerometers are expensive, you will not be charged for equipment that is lost or damaged, and the school project coordinator must be informed.

Once my child takes part, can they change their mind?

Yes. If at any time, before, during or after the monitoring described above your child wishes to withdraw from the study, please contact the school project coordinator. Your child can withdraw at any time for any reason, and they will not be asked to explain their reasons for withdrawing. You will also be able to withdraw their data from the study until it has been anonymised and combined with other data before the end of June 2022.

Who is doing this research and why?

This study is the practical work of a Saudi PhD student research project supported by Durham University, undertaken in the context of the Saudi Vision 2030 in terms of enhancing the national policy encouraging active living and discouraging sedentary behaviour. The data may be published in one or several research papers and disseminated via various outlets in future (e.g., conferences, public outreach events and the media) so that other special needs children, their families and schools, can benefit from the findings. In doing so, it will not be possible to link the data in any way to your child (i.e., no names will be used, and only group data will be presented).

Data Protection Privacy Notice
Durham University will be using anonymised information/data from your child strictly without any personal identifying information in order to undertake this research study and will act as the data controller for this study. This means that the University is responsible for looking after the anonymised information and using it properly. Durham University will keep this information for 4 years upon completion of the Ph. D. The University's Data Protection Officer can be contacted: Kristina Holt, Head of Information Governance and Data Protection Officer, email: info.access@durham.ac.uk

What personal information will be required?
This information is detailed in the child and parents' questionnaire
Will my child's data be shared with others?
The data collected from your child in this study will be anonymised and only shared with the researchers directly involved in the study at Durham University. No personal identifying information will be used in any communication of the study results in conference presentations, in academic journals or in Khaled's PhD thesis.
Will data collected from my child be kept confidential?
All paper copies of consent forms, participant questionnaires and data recording sheets will be kept in a locked secure office at the school. All electronic data will be encrypted and stored by the researcher anonymously on the University's IT system. Participants will be assigned a code so that a set of data cannot be related back to any individual in order to ensure the confidentiality of data collected during the study. Investigators will ensure that no information is published that would allow individuals to be identified.
How will the data collected from my child be used?
The study results will be submitted to Durham University as part of a PhD thesis. They will be published in relevant journals and/or presented at conferences (no identifying details will be used in any communication).
How long will the anonymised data/samples be retained?
The anonymised data collected in the study will be stored permanently in the University's repository.
What is the legal basis for processing the data?
Personal data will be processed on a public task basis. Individuals' rights to erasure and data portability do not apply if you are processing based on the public task. However, individuals do have a right to object. Under the GDPR, some of the personal data which will be collected from your child are categorised as "sensitive data". The processing of this data is necessary for scientific research in accordance with safeguards. This means that the study has gone through an ethical committee to ensure that the appropriate safeguards are put in place with respect to the use of your child's personal data.
I have some more questions; who should I contact?
All questions should be directed to Khaled Aali M Alsofyani or Professor Brett Smith. Their contact details are on Page 1.
What if I am not happy with how the research was conducted?
If you are not happy with how the research was conducted, please contact the ethics committee secretary:

- **Maria Towes**
- m.l.towes@durham.ac.uk
- +44(0) 191 334 6264

The University of Durham also has policies relating to research integrity and a code of good practice which are available online at http:// https://www.durham.ac.uk/research/research-policy/research-integrity/research-integrity-policy-and-code-of-good-practice/
How can I find out whether the accelerometer is correctly positioned?

GENEActiv accelerometer attached to the left-hand wrist.

APPENDIX 21: INFORMATION SHEET FOR SN AND PE TEACHERS

Information Sheet for schools, Special Needs PE teachers and Physical activity Special Needs and Support Staff

Research Study:

The promotion of physical activity of special needs children within secondary middle schools in the Kingdom of Saudi Arabia.

Investigators Details:
Khaled Aali M Alsofyani
- Khaled.a.alsofyani@durham.ac.uk
- +44(0) 7427 508087
- +996(0) 5556 37020

Professor Brett Smith
- Brett.smith@durham.ac.uk
- +44(0) 7902 968035

Postal address and telephone (Investigators and University):
- Department of Sport and Exercise Sciences, Durham University, 42 Old Elvet, DH1 3HB Durham, United Kingdom.
- +44(0) 191 334 2000

What is the purpose of the research study?

The improvement of people's physical and mental health through physical activity (PA) remains a worldwide life challenge that starts at an early age for children even before starting their school education. PA at home, school, and in the community is essential for every child, including those with special needs. In the Kingdom of Saudi Arabia (KSA), this challenge has been highlighted in the Saudi Vision 2030 in terms of enhancing the national policy encouraging active living and discouraging sedentary behaviour with contributions from all involved parties and government bodies.

The proposed research is in the context of rigorous study designs and advanced methods of PA assessment which are required to enhance existing knowledge and understanding of not only how much PA Saudi special needs children participate in, but also where and when they can be physically active. Such research will be instrumental in outlining and informing future health policies and interventions, aimed at tackling physical inactivity (PI) within a country such as KSA, in which currently children are among being less active and obese, and more specifically special needs children sedentary behaviour has not been examined.

What is the aim of the research study?

This study aims to:

(vii) Determine what amount of PA disabled children do in and outside of school and establish whether they are sufficiently active and reach the 30 minutes per day across the week of Moderate and Vigorous PA (MVPA) international recommended guidelines. This will include identifying their activity level differences per category of impairment, age group, school, and their importance because of the children's different settings inside and outside school (at home and outside).

(viii) Assess the wearability of accelerometers among special needs children.

(ix) Improve the physical activity classification by using the sum of vector magnitudes (SVM) recorded for 10 structured activities undertaken at school to correct the cut points differences.

(x) Examine physical activity classification differences based on cut-points differences

(xi) and the sum of vector magnitudes (SVM) recorded for 10 structured activities

(xii) undertaken at school

(xiii) Examine physical activity classification differences based on cut-points differences

(xiv) and the sum of vector magnitudes (SVM) recorded for 10 structured activities

(xv) undertaken at school.

(iv) Investigate the barriers and facilitators to the special needs children's PA and PE participation using elaborate PA correlates to understand the reasons for the non-participation or less engagement of special needs children in PA and PE programmes.

(v) Create evidence-based strategies to promote PA among children with a disability in secondary middle schools in KSA.

(vi) Give to children, families, schools, and organisations existing and recommended strategies to comment on whether they are fit for the purpose.

This research study involves:

(vi) The monitoring of children's physical activity who will be asked to wear a wrist attached accelerometer (GENEActiv) in their dominant wrist for 7 days.
(vii) The children's parents and guardians will be asked to fill up a questionnaire about their child's personal, familial and socio-environmental life.
(viii) The school and the physical education teachers and physical activity support staff to fill up a questionnaire about the school policies, resources and support provided to special needs children during sports lessons and physical activities inside the school and the community.
(ix) The children's parents and guardians, the physical education teachers and support physical activity staff will be asked to fill up a questionnaire about the children's reactions to wearing an accelerometer for 7 days.
(x) Online group discussions including children, parents, physical education teachers and physical activity support staff and the school senior management will be organised to discuss barriers and facilitators for special needs children's physical education and activity participation.

Are there any inclusion or exclusion criteria?

We would like as many special needs children as possible from boys' and girls' secondary middle schools in the region of Taif (KSA) to take part in the study. However, we have limited resources allocated to this research study in terms of time (3 months) and the number of accelerometers available (??). This limitation of resources resulted in considering only a few schools and classes. So, we have selected the schools with the highest number of special needs children with intellectual disabilities and hearing impairments and only? classes per school.

What will the special needs children be asked to do?

This research study is taking part in the school premises under the full supervision of the school authorities and appointed project coordinator. We will explain the study requirements to the special needs children and take some measurements, including height, sitting height, weight, body fat percentage (using special scales) and waist circumference. After that, we will attach a GENEActiv accelerometer on the children's dominant wrist and ask them to wear the monitor for 8 days, which will include two weekend days. With your help, we would like his device must not to be removed even when the children are showering, sleeping and playing rough games. On the 8th day, we will collect the device and the school and special needs support staff questionnaires. Any problem resulting from wearing this device must be reported to the school project coordinator.

What is the GENEActiv accelerometer?
The GENEActiv accelerometer is like a watch and can be worn by all age groups, from young children through to the elderly. It is designed for 24-hour wear free-living public health research and academic and clinical trials and is lightweight, waterproof and neutral in design. It is low in burden and its ambient light and temperature sensors provide valuable information about the subject's environment. It is robust in objectively monitoring physical activity, sleep and everyday living behaviour change reliably.

Will the special needs child be required to undertake additional tasks?
Special needs children will be asked to undertake 10 bouts of activity of 5 minutes each at a day and time arranged with the school during the monitoring week. A break of 5 minutes will be observed after each activity. These activities which will be first practiced in PE lessons are:

- Lay supine
- Sitting
- Playing a virtual sport
- Playing with legos
- Overarm throwing and catching
- Instep passing a football
- Slow walk
- Fast walk
- Slow run
- Medium run

Are there any disadvantages or risks in participating?

Monitoring physical activity for 7 days can stimulate special needs children to participate more efficiently and effectively in PE lessons and physical activities. More importantly, this monitoring will result in classifying the physical activity undertaken by the children for a week and will provide them, parents and the school with valuable information about their living behaviour changes during this period. The children will be asked to tell the schoolteachers or project coordinator if they experience any discomfort or irritation from wearing the device, and should the situation become unbearable which is unlikely, the device will be removed without any prejudice to them. Although accelerometers are expensive, parents will not be charged for equipment that is lost or damaged, and the school project coordinator must be informed.

Once a child takes part, can they change their mind?

Yes. If at any time, before, during or after the monitoring described above a child wishes to withdraw from the study, the school project coordinator must be contacted. The child can withdraw at any time for any reason, and they will not be asked to explain their reasons for withdrawing. The child's parents will also be able to withdraw their data from the study until it has been anonymised and combined with other data before the end of June 2022.

Who is doing this research and why?

This study is the practical work of a Saudi PhD student research project supported by Durham University, undertaken in the context of the Saudi Vision 2030 in terms of enhancing the national policy encouraging active living and discouraging sedentary behaviour. The data may be published in one or several research papers and disseminated via various outlets in future (e.g., conferences, public outreach events and the media) so that other special needs children, their families and schools, can benefit from the findings. In doing so, it will not be possible to link the data in any way to your child (i.e., no names will be used, and only group data will be presented).

Data Protection Privacy Notice

Durham University will be using anonymised information/data from children and the school strictly without any personal identifying information in order to undertake this research study and will act as the data controller for this study. This means that the University is responsible for looking after the anonymised information and using it properly. Durham University will keep this information for 4 years upon completion of the Ph. D. The University's Data Protection Officer can be contacted: Kristina Holt, Head of Information Governance and Data Protection Officer, email: info.access@durham.ac.uk

What personal information will be required?

This information is detailed in the questionnaires related to the child and parents and the special needs PE teachers and physical activity support staff.

Will the collected data be shared with others?

The data collected from the children and the school in this study will be anonymised and only shared with the researchers directly involved in the study at Durham University. No personal identifying information will be used in any communication of the study results in conference presentations, in academic journals or in Khaled's PhD thesis.

Will the data collected be kept confidential?

Paper copies of consent forms, participant questionnaires and data recording sheets will be kept in a locked secure office. All electronic data will be encrypted and stored anonymously on the University's IT system. Participants will be assigned a code so that a set of data cannot be related back to any individual in order to ensure the confidentiality of data collected during the study. Investigators will ensure that no information is published that would allow individuals to be identified.

How will the data collected be used?

The study results will be submitted to Durham University as part of a PhD thesis. They will be published in relevant journals and/or presented at conferences (no identifying details will be used in any communication).

How long will the anonymised data/samples be retained?
The anonymised data collected in the study will be stored permanently in the University's repository.

What is the legal basis for processing the data?

Personal data will be processed on a public task basis. Individuals' rights to erasure and data portability do not apply if you are processing based on the public task. However, individuals do have a right to object. Under the GDPR, some of the personal data which will be collected from children and support staff are categorised as "sensitive data". The processing of this data is necessary for scientific research in accordance with safeguards. This means that the study has gone through an ethical committee to ensure that the appropriate safeguards are put in place with respect to the use of personal data.

I have some more questions; who should I contact?

All questions should be directed to Khaled aali M Alsofyani or Professor Brett Smith. Their contact details are on Page 1.

What if I am not happy with how the research was conducted?
If you are not happy with how the research was conducted, please contact the ethics committee secretary:

- **Maria Towes**
- m.l.towes@durham.ac.uk
- +44(0) 191 334 6264

How can I find out whether the accelerometer is correctly positioned?

GENEActiv wrist position

<u>School consent</u>

Name:

Position in the school:

Signature:

Date:

Appendix 22: Information Sheet for Focus Groups

The promotion of physical activity of special needs children within secondary middle schools in the Kingdom of Saudi Arabia.

Durham University

Participant Information Sheet

Thank you for agreeing to take part in my research. The focus group shouldn't take more than 45-90 minutes, but you can leave or take a break whenever you wish. It will form part of my doctoral research project, which is investigating the participation of special needs young children in physical activities, and in particular the strategies that help them to increase their physical activity levels. The aim is for the research to assess whether these children are meeting or not the international physical activity guidelines and understand the nature and the magnitude of both barriers and facilitators to participation in the familial and socio-environment context to seek strategies participation. In turn, it is hoped that this will help to further our understanding of how family and school physical activity policies, campaigns and research around children's sedentary behaviours can be developed in the future. I am therefore interested in what parents and carers, teachers and support staff think about physical activity barriers at home, school and in the community, and discuss the positive impact of facilitators to increase the children's physical participation and performance.

The purpose of the focus groups is to share more generally your views on different aspects of barriers and facilitators to physical activity participation among special needs children within secondary middle schools in the region of Taif in the Kingdom of Saudi-Arabia (KSA). More particularly it is thus of interest to fully understand how these barriers encourage the children's sedentary behaviours. Please, therefore, don't be afraid to speak your mind and be as honest as possible about what you think. There should be between 5 and 8 other people in the group that includes the main stakeholders and the project facilitator and the researcher, and you will be asked a series of questions based around examples of children's sedentary behaviours to be linked with the facilitators that may be effective and appropriate to eradicate the discussed barriers.

The findings from these focus groups will be included in my doctoral thesis and possibly in other academic publications and presentations. Anything that you share in the group will be kept confidential and reported anonymously, and your real name will not be mentioned in my research (instead you will be assigned with a pseudonym). I will video-record the session and will then transcribe and analyse the recording. These files will be stored securely on a password protected Durham University server.

You can also leave the focus group whenever you want, and you are free to withdraw from the research project at any point. There will be no repercussions to this so please just let me know if you wish to do so. Finally, please make sure that you always treat all other members of the group with respect. It is important that whatever is said within the focus group does not leave the room, and you must not share anything that is said, or the identities of anyone within the group, with anyone once it is over. It is also possible that other participants may express views that you disagree with, or which may even make you feel uncomfortable. If this takes place and is causing you distress, please make this known to the facilitator, in which case individuals may be asked to leave. If you would like to feedback on anything raised in the group setting but were not able to bring it up at the time, please contact me using the details below, and you can do so anonymously if you wish.

Any issues or questions? Please, contact me!

Researcher: Khaled Aali M Alsofyani
Khaled.a.alsofyani@durham.ac.uk
+44(0) 7427 508087
+996(0) 5556 37020
Supervisor: Professor Brett Smith
Brett.smith@durham.ac.uk
+44(0) 7902 968035

Consent Name: Role: Signature: Date:

APPENDIX 23: CONSENT PARENTS FORM

Consent Form Parents & Guardians

Project title: The promotion of physical activity of special needs children within secondary middle schools in the Kingdom of Saudi Arabia.

Researcher(s): Khaled Aali M Alsofyani
- Khaled.a.alsofyani@durham.ac.uk
- +44(0) 7427 508087

Department: Department of Sport and Exercise Sciences, Durham University.
Contact details:
- 42 Old Elvet, DH1 3HB Durham, United Kingdom.
- +44(0) 191 334 2000

Supervisor name: Professor Brett Smith
Supervisor contact details:
- +44(0) 7902 968035
- Department of Sport and Exercise Sciences, Durham University, 42 Old Elvet, DH1 3HB Durham, United Kingdom.
- Email address: Brett.smith@durham.ac.uk

This form is to confirm that you understand what the purposes of the project, what is involved and that you are happy to take part. Please initial each box to indicate your agreement:

I confirm that I have read and understood the Information Sheet dated [17/03/2022] and the Privacy Notice for the above project.	
I have had sufficient time to consider the information and ask any questions I might have, and I am satisfied with the answers I have been given.	
I understand who will have access to the data I have provided and anonymised at the school, how the data will be stored, and what will happen to the data at the end of the project.	
I agree to take part in the above project.	
I understand that my participation is entirely voluntary and that I am free to withdraw at any time without giving a reason.	
I understand that anonymised (i.e. not identifiable) versions of my data may be archived and shared with others for legitimate research purposes.	
I understand that my words may be quoted in publications, reports, and other research outputs. *Please choose one of the following two options* ○ EITHER I agree to my real name being used in the above ○ OR I do **not** agree to my real name being used in the above	

Participant's Signature_______________________________ Date______________
(NAME IN BLOCK LETTERS)____
Researcher's Signature______________________________ Date______________
(NAME IN BLOCK LETTERS)__
____

APPENDIX 24: PE AND SN TEACHERS CONSENT FORM

Consent Form

Project title: The promotion of physical activity for special needs children within secondary middle schools in the Kingdom of Saudi Arabia.

Researcher(s): Khaled Aali M Alsofyani
- Email address: Khaled.a.alsofyani@durham.ac.uk
- +44(0) 7427 508087

Department: Department of Sport and Exercise Sciences, Durham University.
Contact details:
- 42 Old Elvet, DH1 3HB Durham, United Kingdom.
- +44(0) 191 334 2000

Supervisor: Professor Brett Smith
- Address: Department of Sport and Exercise Sciences, Durham University, 42 Old Elvet, DH1 3HB Durham, United Kingdom.
- Email address: Brett.smith@durham.ac.uk
- +44(0) 7902 968035

This form is to confirm that you understand the purposes of the project, what is involved, and that you are happy to take part. Please initial each box to indicate your agreement:

I confirm that I have read and understood the Information Sheet dated [.........................] and the Privacy Notice for the above project.	
I have had sufficient time to consider the information and ask any questions I might have, and I am satisfied with the answers I have been given.	
I understand who has access to the data I have provided, how the data will be stored, and what will happen to the data at the end of the project.	
I agree to take part in the above project.	
I understand that my participation is entirely voluntary and that I am free to withdraw at any time without giving a reason.	
I understand that anonymised (i.e., not identifiable) versions of my data may be archived and shared with others for legitimate research purposes.	
I consent to be audio recorded/being video recorded/having my photo taken and understand how recordings/photos will be used in research outputs.	
I understand that my words may be quoted in publications, reports, and other research outputs. *Please choose one of the following two options* EITHER I agree to my real name being used in the above OR I do **not** agree to my real name being used in the above	

Researcher
Signature:
NAME (IN BLOCK LETTERS)
Date:

Participant	
School staff	Parent
Role: PE teacher Special needs support staff Support staff Other	Child school code: ________________
Signature:	Signature:
NAME (IN BLOCK LETTERS)	NAME (IN BLOCK LETTERS)
Date: ___________________________	Date: ___________________________

APPENDIX 25: FOCUS GROUP CONSENT FORM

The promotion of physical activity of special needs children within secondary

Focus Group Consent Form

Everyone who takes part in this research project is required to give their informed consent. This means that I have a responsibility to make sure that you fully understand what being a participant will involve for you before you agree to do so. Please, therefore, familiarise yourself with the attached information sheet, and don't hesitate to ask me if you have any questions about the research project and your involvement in it.

	Yes	No
I have read the information sheet and been given the opportunity to ask questions about the research project, with satisfactory responses.		
I agree to take part in a focus group with the researcher and other participants.		
I understand that I have the right not to answer any question I do not feel comfortable with and that I can leave or take a break from the focus group at any time.		
I give my permission for the focus group to be audio-recorded and transcribed.		
I understand that the audio recording and all data will be stored securely, that when the recording has been transcribed it will be destroyed, and that any identifiable information about myself or others will not be included in the transcript.		
I am aware that my name will not be used and that my identity will be kept anonymous in any publications related to this research project.		
I understand that what is discussed in the focus group will be kept confidential by the researcher, but that if the interviewer feels that I or somebody else is at risk of serious harm, they may need to disclose this to relevant agencies.		
I will not discuss the identities of participants or anything they express with anyone else after the focus group is over, and I commit to being always respectful towards other focus group members.		
I am aware that the researcher has asked all members of the focus group to commit to not discussing the identities of other participants or anything they say outside of the focus group setting but understand that this cannot be guaranteed.		

I understand that I am free to choose whether to take part in this research project and that I am also free to withdraw from it at any point both during and after the interview has been completed, up until the analysis stage in January 2024.		
I understand that I can keep a copy of this consent form for my records.		

Having read the information sheet and consent form, I confirm that I understand what is required of me for this research project and that I am happy to take part.

Participant: Signed: ___________________________________ Relation to the child: ____________
Researcher: Signed: ___________________________________ Date: ___ / ___ /_______

Khaled Aali M Alsofyani Email: Khaled.a.alsofyani@durham.ac.uk
Phone : +44(0) 7427 508087 +996(0)5556 37020

APPENDIX 26 : SCHOOL REPORT- RESULT

1. Introduction

We would like to thank you for your valuable participation in our research project aimed at promoting physical activity among disabled children in Saudi middle schools and are pleased to give you the outcomes of the health factor analysis and physical activity classification detailed in this report.

2. Collected data processing

The raw data extracted from the accelerometer and converted into a one-second epoch was based on the use of the GENEActive PC software available in the public domain from the ActivInsights company which supplied the accelerometers. The analysis of the resulting data and the data collection from the child and the school have been processed using the research software support SACYPPADD (Saudia Arabia Children and Young People Physical Activity Disability Data. These data are kept anonymously under strict confidentiality.

3. Anthropometric measurements and health factors

3.1. Anthropometric measurements

Below are listed the children's anthropometric measurements taken during our visit to the school. These measurements have been used to calculate the children's health factors listed in the next section.

Anthropometric Measurements (School: S1)

1 Neck, 2 Arm, 3 Waist, 4 Hip, 5 Thigh
6 Weight, 7 Biceps Skinfold, 8 Triceps Skinfold, 9 Shoulder Skinfold, 10 Abdominal Skinfold
I1 lliac Crest Skinfold, 12 Thigh Skinfold, 13 Calf Skinfold, 14 Standing Height, 15 Sitting Height (Aj)
16 Sitting Height

Child	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
S1C01	33	27	82	0	46	54	6	10	13	23	17	19	16	154	78	121
S1C02	36	28	77	0	50	64	3	16	11	15	12	21	15	164	84	127
S1C03	37	29	75	0	48	46	4	11	14	17	13	12	12	150	77	120
S1C04	42	37	106	0	59	95	12	25	24	35	30	29	27	180	88	131
S1C05	28	19	60	0	33	28	2	4	5	5	3	7	4	146	67	110
S1C06	41	41	113	0	75	106	11	27	35	51	35	59	39	166	81	124
S1C07	31	23	63	0	39	41	3	5	10	7	6	9	12	165	79	122
S1C08	37	34	98	0	56	82	6	20	19	22	21	25	26	175	86	129
S1C09	30	28	86	0	50	57	7	13	7	16	13	23	20	173	81	124
S1C10	30	20	59	0	40	30	4	10	7	7	10	19	6	141	83	126
S1C11	33	24	66	0	42	51	4	7	9	8	6	18	10	180	97	140
S1C12	36	32	87	0	57	67	8	20	23	26	31	50	29	162	85	128
S1C13	37	37	106	0	66	77	18	28	43	42	35	51	33	146	84	127
S1C14	34	24	66	0	42	47	3	6	8	6	5	9	6	165	83	126
S1C15	35	25	70	0	46	59	3	9	10	10	8	17	15	168	90	133
S1C16	33	20	63	0	35	43	2	4	9	5	4	4	3	173	81	124
S1C17	37	31	83	0	53	60	6	12	13	24	16	25	9	153	80	123

Figure 1: Children's health factors.

3.2. Health Factors

The children's health factors listed below will be analysed in the second research study which aims to find the physical activity correlates among disabled children in Saudi middle schools when examining the personal and socio-environmental factors of the children.

Health Factors (School: S1)

1 Gender	2 Age	3 Weight	4 Standing Height	5 BMI
6 Target BMI	7 Ponderal Index	8 Ideal Weight	9 Ideal Weight (Hamwi)	10 Ideal Weight (Devine)
11 Ideal Weight (Ronison)	12 Ideal Weight (Miller)	13 Wait-Hip Ratio	14 Body Density 4 skinfolds	15 Body Density 7 skinfolds
16 Body Density USM	17 Body Fat 4 skinfolds	18 Body Fat 7 skinfolds	19 Body Fat USM	20 Body Fat BMI
21 Body Fat BMI2	22 Body Fat 4 skinfolds (Siri)	23 Body Fat 7 skinfolds (Siri)	24 Body Fat USM (Siri)	25 Lean Body Mass R
26 Lean Body Mass	27 Lean Mass Index	28 Lean Body Weight	29 Basal Metabolic Rate (BMR)	30 BMR(Harris Benedict)
31 BMR (Schofield)	32 Basal Energy Expenditure	33 Resting Metabolic Rate	34 Resting Metabolic Effort	

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Mean		16	59.235	162.41	22.315	21.471	13.803	57.074	58.637	59.065	59.483	61.750	NAN				
	11.652	14.929	20.301	6.9055	20.753	13.207	16.419	83.572	47.657	17.931	45.137	1532.4	1570.4	1.1845	1693.4	1527.2	1527.2
Variance		1.75															
	76.435	134.58	119.21	77.469	55.616	68.850	127.92	127.97	142.52	12.788	135.47	63722.	97308.	0.0682	103944	62702.	62702.
St Dev		1.3228	21.264	12.176	7.4228	1.4442	4.7499	12.135	12.942	11.030	9.1069	6.7579	0				
	8.7427	11.600	10.918	8.8016	7.4576	8.2976	11.310	11.312	11.938	3.5760	11.639	252.43	311.94	0.2611	322.40	250.40	250.40
Skewness		0.3671	0.7022	-0.254	0.8388	-1.246	1.0452	-0.587	-0.254	-0.254	-0.254	-0.254	0				
	0.9827	0.4740	0.7136	0.7912	-0.118	0.8654	0.3656	-0.365	0.1055	0.2107	0.3902	0.3868	0.5220	0.7020	0.5041	0.3825	0.3825
Kurtosis		-0.683	0.2230	-1.027	0.1399	0.4179	0.8153	-0.975	-1.027	-1.027	-1.027	-1.028	-0.5				
	0.1017	-0.855	-0.191	0.0055	-0.861	-0.245	-1.082	-1.083	0.0833	-0.654	0.1693	0.2487	0.2440	0.2230	0.2926	0.2493	0.2493
St Dev p		1.2833	20.629	11.812	7.2012	1.4011	4.6081	11.773	12.556	10.701	8.8349	6.5561	NAN				
	8.4816	11.254	10.592	8.5388	7.2349	8.0498	10.972	10.974	11.582	3.4693	11.291	244.89	302.62	0.2533	312.77	242.92	242.92
Skewness		0.3339	0.6386	-0.231	0.7629	-1.133	0.9506	-0.534	-0.231	-0.231	-0.231	-0.231	NAN				
	0.8938	0.4311	0.6490	0.7196	-0.107	0.7871	0.3325	-0.332	0.0960	0.1916	0.3549	0.3518	0.4747	0.6385	0.4585	0.3479	0.3479
Kurtosis		2.1683	2.8293	1.9176	2.7687	2.9713	3.2612	1.9551	1.9174	1.9173	1.9176	1.9170	NAN				
	2.7408	2.0425	2.5270	2.6706	2.0381	2.4873	1.8771	1.8768	2.7274	2.1895	2.7901	2.8480	2.8445	2.8292	2.8800	2.8484	2.8484

Figure 2-a: Statistical variables of the children’s health factors.

	1 18	2 19	3 20	4 21	5 22	6 23	7 24	8 25	9 26	10 27	11 28	12 29	13 30	14 31	15 32	16 33	17 34
S1C01	B 9.835	14 19.53	54 22.38	154 7.903	22.76 23.05	20.95 12.91	14.78 22.29	49.03 77.70	49.70 41.95	51.44 17.69	53.19 41.28	57.08 1437.5	0.00 1471.3	1.046 1.1203	1.069 1579.4	1.048 1433.	20.32 1433.
S1C02	B 10.31	16 12.17	64 22.53	164 8.674	23.79 21.91	22.43 11.88	14.50 11.89	60.33 86.10	60.33 55.10	60.50 20.48	60.67 48.22	62.63 1590	0.00 1641.9	1.048 1.2411	1.071 1756.9	1.067 1584.	20.52 1584.
S1C03	B 11.42	18 13.77	46 16.87	150 4.193	20.44 17.09	20.19 11.41	13.62 13.76	44.43 86.23	45.44 39.67	47.82 17.63	50.28 36.51	54.86 1312.5	0.00 1322.2	1.059 1.0228	1.072 1449.4	1.067 1309.	17.10 1309.
S1C04	B 19.96	15 25.67	95 31.57	180 15.53	29.32 31.82	22.07 22.04	16.28 27.61	71.73 72.38	77.33 68.77	75.00 21.22	72.64 66.60	71.51 2005	0.00 2139.7	1.027 1.6238	1.048 2273.2	1.016 1996.	29.99 1996.
S1C05	B 0.441	15 6.008	28 7.134	146 -3.88	13.13 8.501	19.32 2.994	8.997 8.424	39.81 91.57	41.19 25.64	44.20 12.02	47.21 25.97	52.64 1122.5	0.00 1078.9	1.079 0.8009	1.092 1181.9	1.079 1120.	6.087 1120.
S1C06	B 29.37	18 34.72	106 43.28	166 25.82	38.46 28.77	22.56 29.37	23.17 34.71	62.27 65.28	62.45 69.20	62.32 25.11	62.17 67.43	63.74 2012.5	0.00 2202.8	1.033 1.7589	1.032 2354.4	1.021 2003.	28.77 2003.
S1C07	B 4.364	16 3.301	41 9.340	165 -1.80	15.05 14.98	22.55 6.010	9.127 4.964	61.45 95.03	61.39 38.96	61.41 14.31	61.42 36.31	63.19 1366.2	0.00 1338.6	1.064 0.9606	1.085 1455.7	1.087 1361.	13.48 1361.
S1C08	B 14.98	15 24.69	82 27.73	175 12.48	26.77 27.65	22.44 17.17	15.30 25.65	69.02 73.34	72.02 60.14	70.47 19.63	68.90 59.33	68.74 1843.7	0.00 1941.5	1.036 1.4642	1.059 2059.5	1.038 1836.	25.72 1836.
S1C09	B 8.392	15 21.73	57 16.05	177 3.204	19.04 21.29	22.52 10.75	11.00 23.77	67.68 76.22	69.89 43.45	68.66 14.51	67.40 46.51	67.63 1581.2	0.00 1597.0	1.050 1.1571	1.074 1715.7	1.044 1576.	15.20 1576.
S1C10	B 4.539	14 2.659	30 10.78	141 -1.31	15.08 18.12	18.04 7.788	10.70 5.968	34.02 91.03	35.88 28.20	39.67 14.18	43.47 26.48	49.87 1116.2	0.00 1087.4	1.057 0.8255	1.081 1184.1	1.085 1114.	15.22 1114.
S1C11	B 5.950	16 1.906	51 10.36	180 -0.99	15.74 15.96	22.07 7.570	8.744 3.592	71.73 96.40	77.33 49.16	75.00 15.17	72.64 44.54	71.51 1560	0.00 1544.5	1.062 1.0834	1.081 1668.2	1.091 1556.	14.48 1556.
S1C12	B 21.45	16 20.08	67 25.14	162 10.75	25.52 30.46	22.17 22.82	15.75 22.26	58.10 77.73	58.20 52.08	58.69 19.84	59.18 49.21	61.52 1607.5	0.00 1677.5	1.030 1.2799	1.046 1798.2	1.048 1602.	29.22 1602.
S1C13	B 29.37	18 37.14	77 39.74	146 23.00	36.12 30.52	19.32 29.37	24.74 37.14	39.81 62.85	41.19 48.39	44.20 22.70	47.21 49.97	52.64 1597.5	0.00 1718.3	1.030 1.4027	1.032 1855.6	1.016 1591.	30.53 1591.
S1C14	B 3.557	16 3.301	47 12.66	165 0.836	17.26 13.92	22.55 5.218	10.46 4.964	61.45 95.03	61.39 44.66	61.41 16.40	61.42 39.67	63.19 1426.2	0.00 1419.0	1.066 1.0343	1.087 1538.2	1.087 1422.	12.41 1422.
S1C15	B 7.038	16 5.958	59 18.16	168 5.205	20.90 17.72	22.55 8.640	12.44 7.578	63.84 92.42	64.58 54.52	64.13 19.32	63.66 46.56	64.85 1565	0.00 1591.1	1.058 1.1817	1.079 1718.2	1.081 1560.	16.27 1560.
S1C16	B 4.348	18 1.444	43 6.894	173 -3.09	14.36 7.723	22.52 4.331	8.304 1.427	67.68 98.57	69.89 42.38	68.66 14.16	67.40 38.75	67.63 1426.2	0.00 1392.4	1.081 0.9852	1.089 1523.2	1.096 1423.	7.738 1423.
S1C17	B 12.75	16 18.73	60 25.30	153 10.87	25.63 23.32	20.77 14.26	16.75 20.14	47.89 79.85	48.63 47.91	50.54 20.46	52.41 43.98	56.53 1481.2	0.00 1535.5	1.045 1.194	1.066 1656.9	1.052 1476.	21.97 1476.

Figure 2-a: Children’s health factors.

4. Physical activity levels

Physical activity levels are measured using intensity cut-point systems validated in research studies per epoch (generally 1 second), age group, and accelerometer attachment position on the child's body. In the research study carried out in your child's school, we have extended the measurement to 6 different epochs (1, 5, 10, 15, 30 and 60 seconds) and included all the intensity cut-point systems available in the literature (Shafer, Hildebrand, Duncan and Philips) with wrist attachment. In this first step, the focus is on better understanding the impact of different epochs and cut-point systems chosen epoch on the different physical activity levels as illustrated below in Figure 3. The cut-point systems' references are below listed.

- Phillips 1993: https://www.jsams.org/article/S1440-2440(12)00112-0/fulltext
- Schaefer 2014: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3960318/
- Hildebrand 2014: https://journals.lww.com/acsm-msse/Fulltext/2014/09000/Age_Group_Comparability_of_Raw_Accelerometer.17.aspx
- Hildebrand 2016: https://doi.org/10.1111/sms.12795
- Duncan 2016: https://pubmed.ncbi.nlm.nih.gov/27785561/

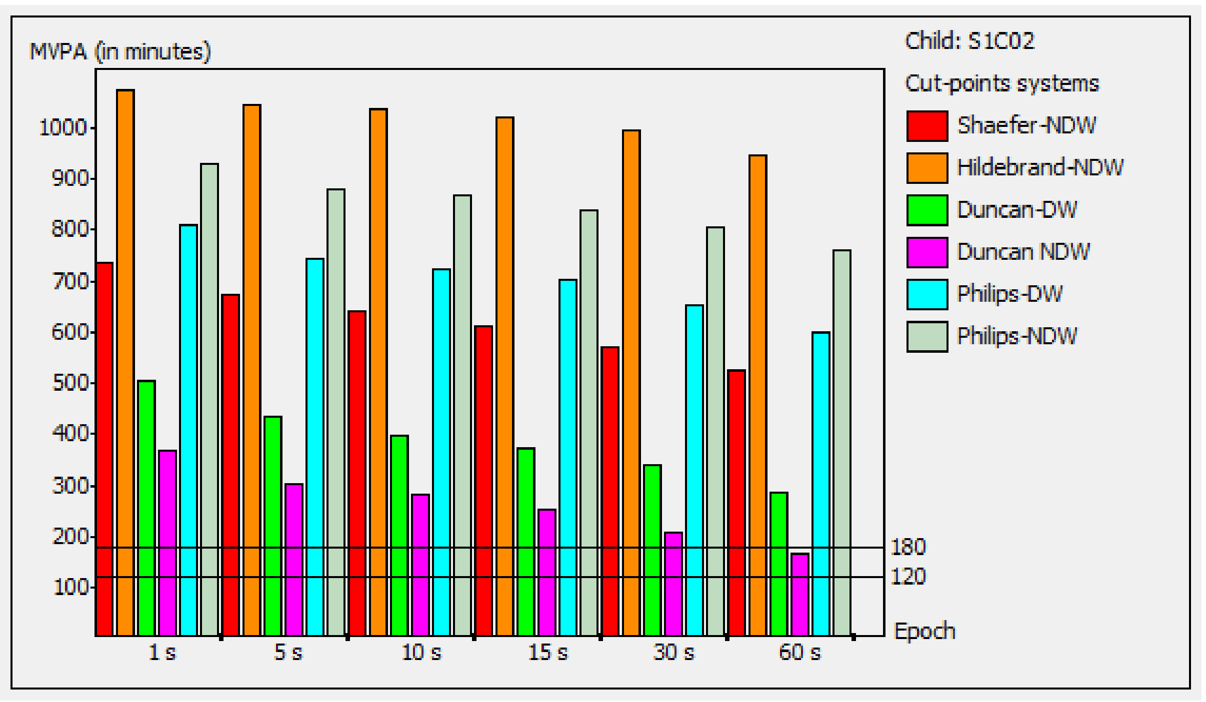

Figure 3: MVPA times per child for the different intensity cau-point systems and epochs.

It is essential to note that among all this intensity cut-point systems shown in Figure 3 and used in Figure 3, only the Philips system (Dominant Wrist and Non-Dominant Wrist) is appropriate for use for the PA classification in this research. However, it covers only the 8-14 years age group whereas the research study sample includes participants aged from 13 to 21 years old and the age group 15-21 years is not covered by the existing intensity cut-points system. This aspect is an important knowledge gap considered in this research. The introduction in this research of the measurement of a set of 10 semi-structured activities being considered plausible activities performed in free-living conditions aimed at validating intensity cut-point thresholds for this age group. Additionally, reducing and extending the Philips intensity cut-point thresholds by 20 % is considered as explained in section 4.4.

The PA levels shown in Figure 3, have been computed using the following intensity cut-point thresholds.

Study	Philips et al (2013) 8 – 14 years old		Shaefer et al (2014) 6 – 11 y old	Hildebrand et al (2014) 7 – 11 y. old	Duncan et al (2019) 8 – 11 years old		Intensity of Exercises (in METs)
Accelero. Attach. Position	Right Wrist	Left Wrist	Non-Dominant Wrist	Non-Dominant Wrist	Dominant Wrist	Non-Dominant Wrist	Up to 1.5
Sedentary	< 6	< 7	< 14.25	< 13.17	< 11.6	< 9	>1.5 & <3.0
Light	6 - 21	7 - 19	14.25 – 23.39	13.17 – 17.99	11.6 – 29.5	9 – 34.6	3.0 – 6.0
Moderate	22 - 56	20 - 60	23.4 – 84.75	18 - 36	> 29.5	> 34.7	> 6.0
Vigorous	> 56	> 60	> 84.75	> 36	n. a.	n. a.	

Figure 4: Intensity cut-point thresholds used in this research.

4.1. Sedentary, sleep, and light activity levels

Below is the school summary of sedentary, sleep, and light activity levels measured using the intensity cut-point system (at a 60-second epoch) by Philips et al (1993). The graph shown in Figure 5, is based on the new sleep times computed using the arm elevation angle formula detailed in the third-year review report.

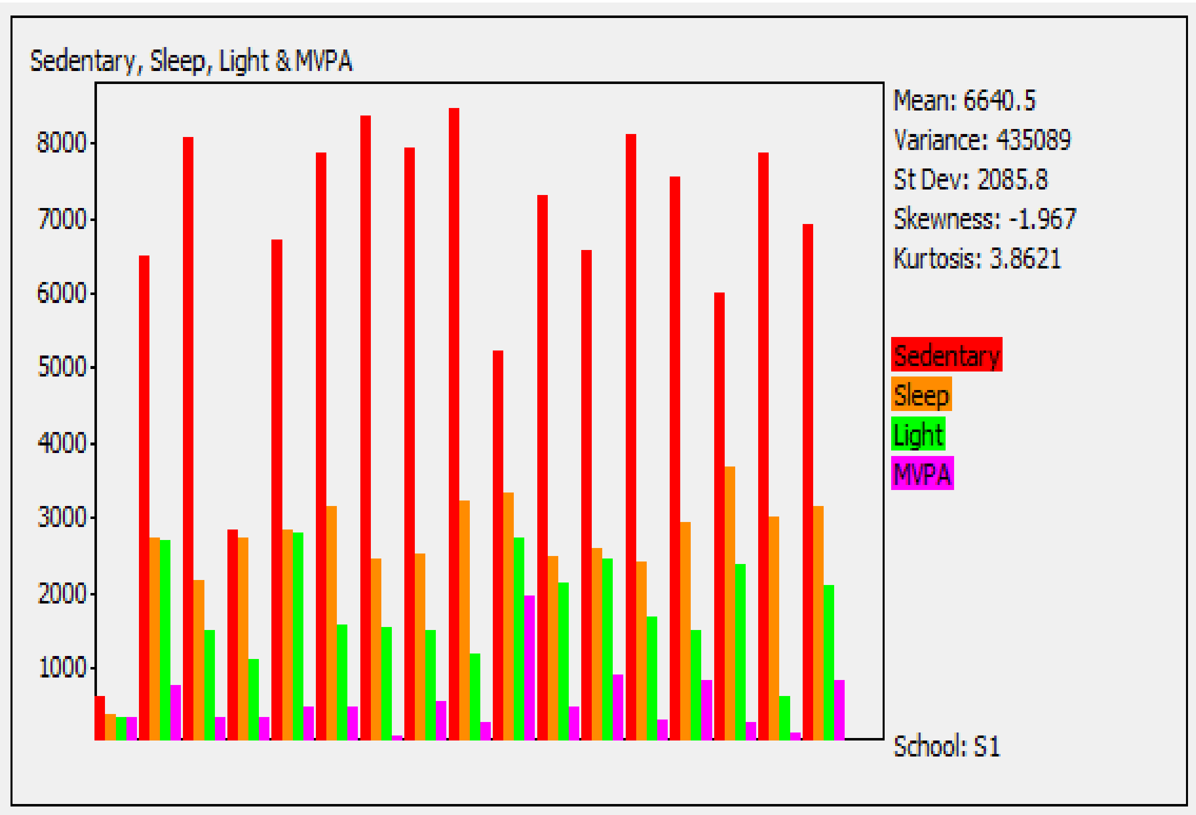

Figure 5: Sedentary, sleep, and light activity levels (Epoch 60-second, Philips et al, 1993).

4.2. Moderate and vigorous activity levels

Below is the school (S1) summary of moderate and vigorous activity levels measured using the intensity cut-point system (at a 60-second epoch) by Philips et al (1993).

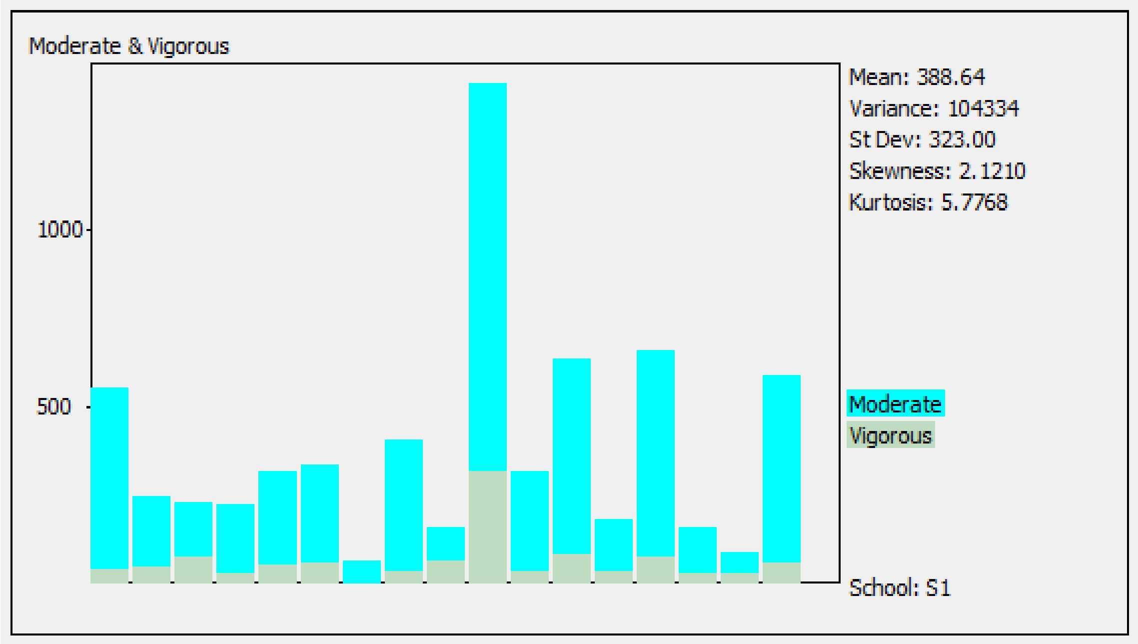

Figure 6: Moderate and vigorous activity levels (Epoch 1second, Philips et al, 1993).

As can be seen from the above figure, the moderate and vigorous activity levels of child number 10 are much higher than others due to a higher number of SVM high values which may correspond to the accelerometer misreadings during the activity monitoring.

4.3. Moderate and vigorous physical activity (MVPA) levels

The MVPA levels are the accumulation of the moderate and vigorous levels shown above.

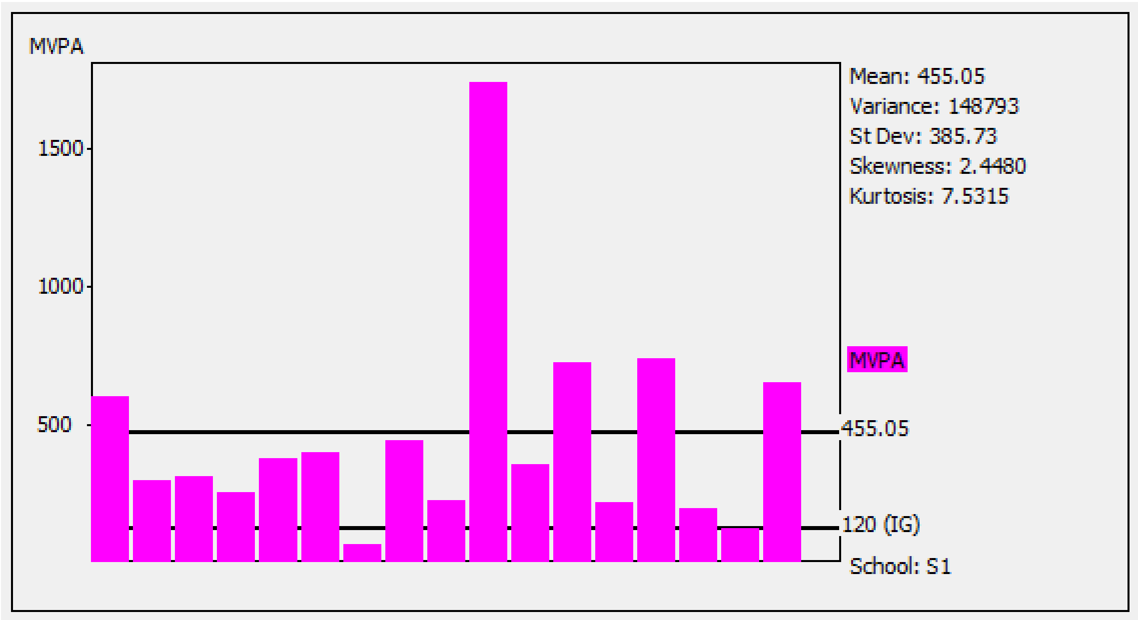

Figure 7: Moderate and vigorous activity levels (Epoch 1second, Philips et al, 1993).

As can be seen from the above figure, apart from the 7th child, all the school children meet the weekly moderate and vigorous physical activity guidelines requirements of 120 minutes. The different times are based on a 60-second epoch, dominant wrist, and Philips et al (1993) intensity cut-point system.

MVPA Meeting Guildelines (School :S1)

	120-180 mi	7x20 min	3x40 min	Total	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	School	SSA Days	Weekend
Mean	0.9411	0.3529	0.7647	455.05	54.411	70.882	86								
Variance	0.0588	0.2426	0.1911	148703	7833.2	3906.1	3023.5	5142.6	6707.8	3762.1	2224.6	44.264	88734.	14515.	9911.6
St Dev	0.2425	0.4925	0.4372	385.62	88.505	62.498	54.986	71.711	81.901	61.336	47.166	6.6531	297.88	120.47	99.557
Skewness	-4.123	0.6766	-1.372	2.4439	2.3421	2.7347	1.2896	0.5183	2.4076	1.4564	1.5405	0.8346	2.5567	0.7914	1.3854
Kurtosis	16.999	-1.766	-0.149	7.5110	4.5172	9.1509	4.1285	-0.907	6.7347	1.5579	1.8219	-0.696	8.2384	0.7818	2.1496
S1C01	Yes	No	No	299	283	16	0	0	0	0	0	0	299	0	0
S1C02	Yes	Yes	Yes	603	31	64	107	205	59	88	44	5	471	312	132
S1C03	Yes	No	Yes	313	54	55	95	70	15	9	11	4	293	165	20
S1C04	Yes	No	Yes	254	51	60	80	63	0	0	0	0	254	143	0
S1C05	Yes	Yes	Yes	380	35	40	60	107	27	58	50	3	272	167	108
S1C06	Yes	No	Yes	399	9	103	115	119	19	20	5	9	374	234	25
S1C07	No	No	No	69	0	6	5	20	1	9	25	3	35	25	34
S1C08	Yes	No	Yes	443	0	25	40	55	136	171	15	1	257	95	186
S1C09	Yes	No	Yes	229	7	45	68	65	8	11	10	15	208	133	21
S1C10	Yes	Yes	Yes	1731	283	285	247	228	320	205	159	4	1367	475	364
S1C11	Yes	No	Yes	360	11	57	86	75	26	55	47	3	258	161	102
S1C12	Yes	Yes	Yes	727	26	83	133	171	101	64	129	20	534	304	193
S1C13	Yes	No	Yes	219	9	53	86	50	1	0	3	17	216	136	3
S1C14	Yes	Yes	Yes	738	45	127	114	184	119	56	81	12	601	298	137
S1C15	Yes	No	No	196	11	60	67	27	8	19	4	0	173	94	23
S1C16	Yes	No	No	123	2	53	63	2	0	2	1	0	120	65	3
S1C17	Yes	Yes	Yes	653	68	73	96	155	77	107	63	14	483	251	170

Figure 8: MVPA times and meeting guidelines variables.

4.4. Meeting the international guidelines

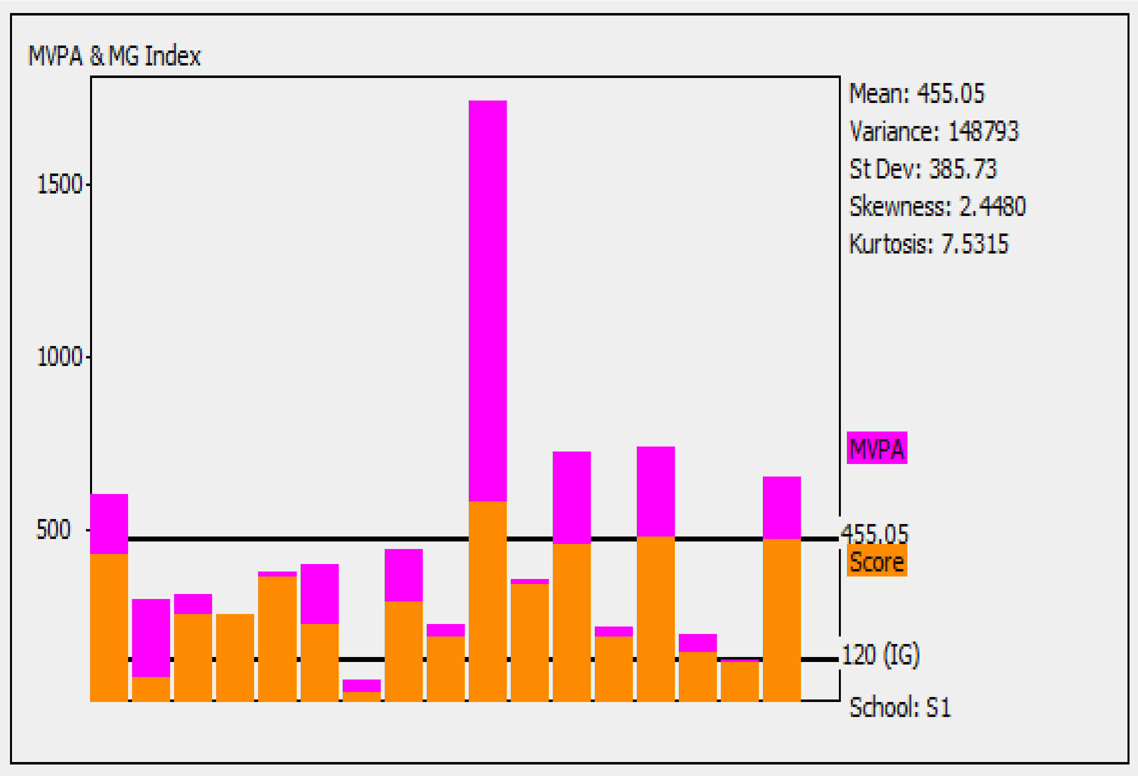

Figure 9: Meeting guideline index (score) compared to MVPA levels.

Among the age groups considered in the first stage, the cut-point system by Philips et al (1993), is the most appropriate as it covers an extended age range from 8 to 14 years old. After processing the children's data, ages above 14 up to 21 were encountered. This posed on one hand the problem of cut-point system appropriateness regarding the age group. On the other hand, the impact of physical activity age decline that starts generally late in adolescence, and reduced physical capabilities among disabled children are the basis for selecting the intensity cut-point system by Philips et al (1993) and developing 2 scenarios of threshold variation (-20% and +20%) to integrate the problems above mentioned.

Detailed daily physical activity levels for any intensity cut-point system and epoch are produced to support the analysis of how these systems differently classify physical activity levels inside and outside schools and activity classification differences will be produced later, in the next research phase. The physical activity classification is expressed in minutes and includes the daily global and hourly activity levels. The hourly levels correspond to the school times and include 9 hours: one hour before and after school, and seven hours inside the school. In this classification, the day is delimited by the monitoring period from 00:00:00:000 to 23:59:59:990. The sleep times are included in the sedentary times and based on the raw signal metric Euclidian Norm (vector magnitude) sleep cut-point selected.

Mean	0.8823	0.2941	0.6470	362.17	45.647	56.823	71.117	79.882	39.647	36	28.941	4.1176	293.23	151	64.941
Variance	0.1102	0.2205	0.2426	117482	6528.2	3185.0	2304.4	3693.3	4879.3	2136.1	1509.3	17.235	72464.	10563.	6421.5
St Dev	0.3321	0.4696	0.4925	342.75	80.797	56.436	48.005	60.773	69.852	46.218	38.849	4.1515	269.19	102.77	80.134
Skewness	-2.609	0.9936	-0.676	2.8149	2.4033	2.8568	1.5666	0.5114	3.0198	2.0328	1.8027	0.7549	2.8262	0.9647	2.0433
Kurtosis	5.4399	-1.165	-1.766	9.3887	4.8023	9.6257	5.0276	-0.675	10.315	5.0641	2.7965	-0.882	9.6145	1.6914	5.2947
S1C01	Yes	No	No	251	242	9	0	0	0	0	0	0	251	0	0
S1C02	Yes	No	Yes	378	15	44	65	146	34	52	21	1	305	211	73
S1C03	Yes	No	Yes	284	51	49	85	64	14	7	11	3	266	149	18
S1C04	Yes	No	Yes	199	38	40	65	56	0	0	0	0	199	121	0
S1C05	Yes	Yes	Yes	327	29	35	50	99	22	50	39	3	238	149	89
S1C06	Yes	No	Yes	328	5	75	103	107	12	16	3	7	309	210	19
S1C07	No	No	No	52	0	3	3	15	0	7	22	2	23	18	29
S1C08	Yes	No	Yes	229	0	14	31	42	52	82	7	1	140	73	89
S1C09	Yes	No	No	189	3	39	61	62	1	5	8	10	176	123	13
S1C10	Yes	Yes	Yes	1544	268	252	217	204	285	179	136	3	1229	421	315
S1C11	Yes	No	Yes	260	5	45	68	61	16	38	25	2	197	129	63
S1C12	Yes	Yes	Yes	560	23	68	110	138	69	42	98	12	420	248	140
S1C13	Yes	No	No	169	5	38	70	42	0	0	3	11	166	112	3
S1C14	Yes	Yes	Yes	624	35	114	90	167	96	43	72	7	509	257	115
S1C15	Yes	No	No	152	6	49	57	22	5	9	4	0	139	79	13
S1C16	No	No	No	99	1	42	54	1	0	0	1	0	98	55	1
S1C17	Yes	Yes	Yes	512	50	50	80	132	68	82	42	8	388	212	124

Mean	0.8823	0.2941	0.6470	362.17	45.647	56.823	71.117	79.882	39.647	36	28.941	4.1176	293.23	151	64.941
Variance	0.1102	0.2205	0.2426	117482	6528.2	3185.0	2304.4	3693.3	4879.3	2136.1	1509.3	17.235	72464.	10563.	6421.5
St Dev	0.3321	0.4696	0.4925	342.75	80.797	56.436	48.005	60.773	69.852	46.218	38.849	4.1515	269.19	102.77	80.134
Skewness	-2.609	0.9936	-0.676	2.8149	2.4033	2.8568	1.5666	0.5114	3.0198	2.0328	1.8027	0.7549	2.8262	0.9647	2.0433
Kurtosis	5.4399	-1.165	-1.766	9.3887	4.8023	9.6257	5.0276	-0.675	10.315	5.0641	2.7965	-0.882	9.6145	1.6914	5.2947
S1C01	Yes	No	No	251	242	9	0	0	0	0	0	0	251	0	0
S1C02	Yes	No	Yes	378	15	44	65	146	34	52	21	1	305	211	73
S1C03	Yes	No	Yes	284	51	49	85	64	14	7	11	3	266	149	18
S1C04	Yes	No	Yes	199	38	40	65	56	0	0	0	0	199	121	0
S1C05	Yes	Yes	Yes	327	29	35	50	99	22	50	39	3	238	149	89
S1C06	Yes	No	Yes	328	5	75	103	107	12	16	3	7	309	210	19
S1C07	No	No	No	52	0	3	3	15	0	7	22	2	23	18	29
S1C08	Yes	No	Yes	229	0	14	31	42	52	82	7	1	140	73	89
S1C09	Yes	No	No	189	3	39	61	62	1	5	8	10	176	123	13
S1C10	Yes	Yes	Yes	1544	268	252	217	204	285	179	136	3	1229	421	315
S1C11	Yes	No	Yes	260	5	45	68	61	16	38	25	2	197	129	63
S1C12	Yes	Yes	Yes	560	23	68	110	138	69	42	98	12	420	248	140
S1C13	Yes	No	No	169	5	38	70	42	0	0	3	11	166	112	3
S1C14	Yes	Yes	Yes	624	35	114	90	167	96	43	72	7	509	257	115
S1C15	Yes	No	No	152	6	49	57	22	5	9	4	0	139	79	13
S1C16	No	No	No	99	1	42	54	1	0	0	1	0	98	55	1
S1C17	Yes	Yes	Yes	512	50	50	80	132	68	82	42	8	388	212	124

Figure 10: Physical activity classification based on Philips extended intensity thresholds.

As can be seen from the above figure, all 17 participant children (except child 7) meet the weekly moderate and vigorous physical activity guidelines requirements of 120 minutes for all three scenarios considered for the age group extension and the integration of physical activity incapacity and age decline.

5. Children's physical activity levels

The children's physical activity levels have been computed using the Philips intensity cut-point system (Phillips et al, 1993) and are shown in Figure 11. The sleep times were produced using the arm elevation angle formula as explained in the third-year review report.

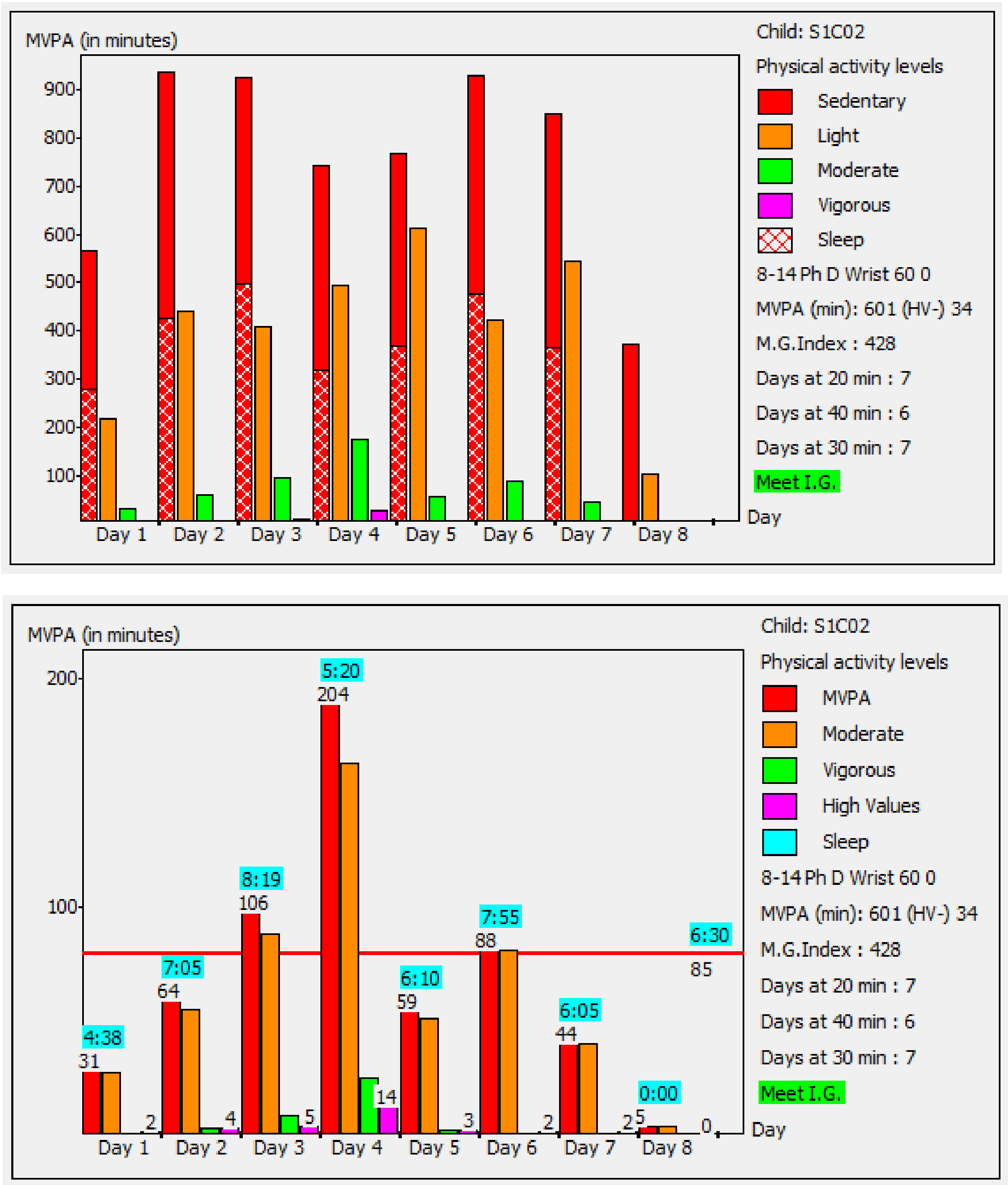

Figure 11: Physical activity levels (child S1C02).

All the computed data are stored in the SACYPPADD database as shown in the user screen view, in Figure 12. They include the sleep and the device non-wear times, the SVM high-values (greater than 100), the cumulated SVM for the 10 semi-structured activities performed in 2 distinct days, the daily PA levels which also indicate the MVPA, light and sedentary times and SVM high values for 9 hours of the day that correspond to the school day starting I hour before and after school times. It is essential to note that the sleep times have been computed using 2 methods (Arm elevation angle and sleep cut-point) as explained in the third-year review report and can be seen in AEA and SCP sleep.

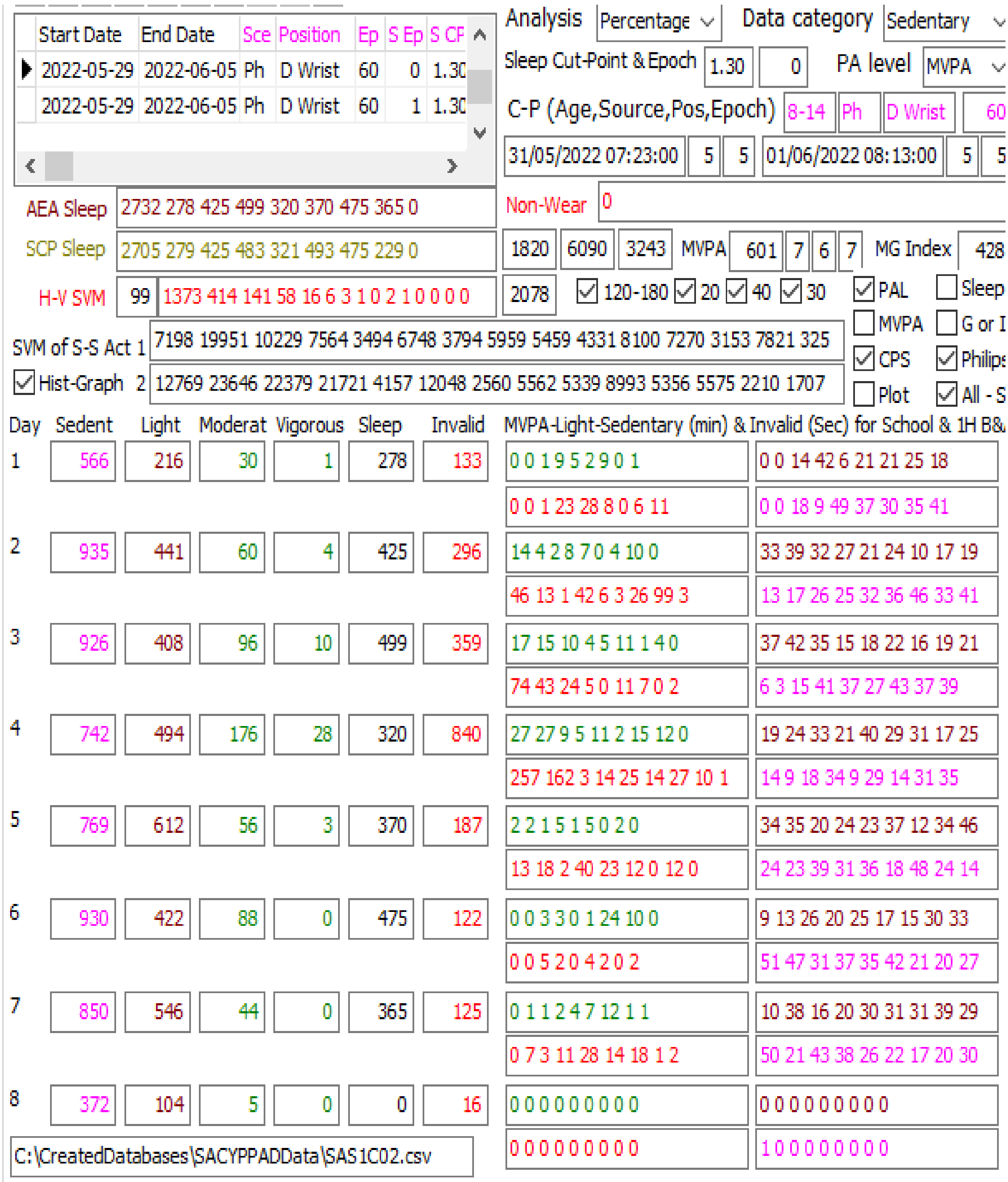

Figure 12: Computed data per child and intensity cut-point system.

PA levels can be analysed inside and outside the school as can be seen from Figure 13. This analysis details the daily global PA levels and indicates the individual PA levels at school and outside. The school PA levels are given for each session and the hour before and after school. This analysis includes the calculation of the impact on the validity of the results of High SVM values (greater than 100 per second) that can be considered accelerometer reading errors.

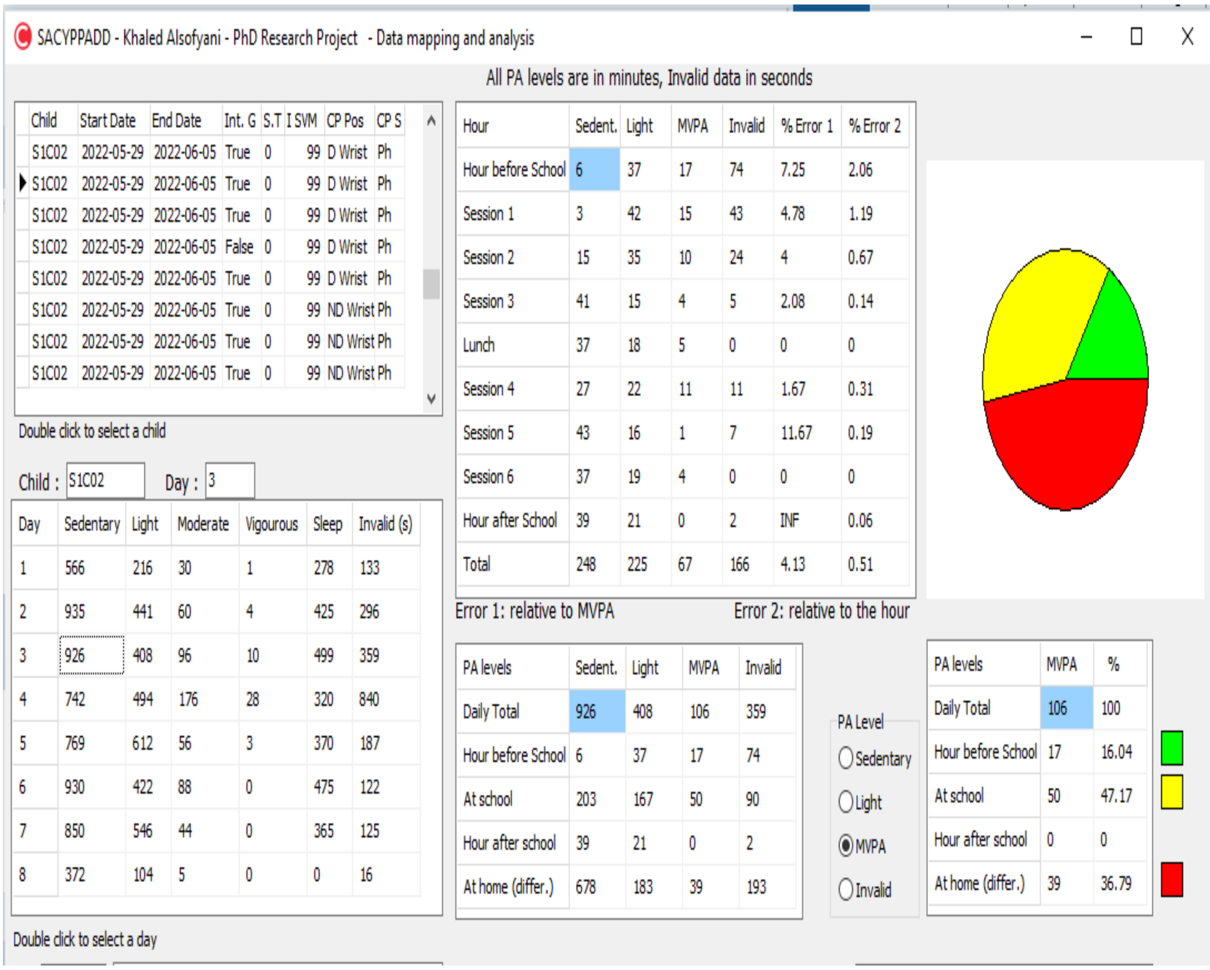

Figure 13: PA levels (inside and outside school) analysis.

6. Semi-structured physical activity

The physical activity monitoring of the two runs of semi-structured activities has been processed individually per child as can be seen in Figure 14. The consolidated analysis towards refining the intensity cut-point systems will be carried out in the theoretical phase of this research study.

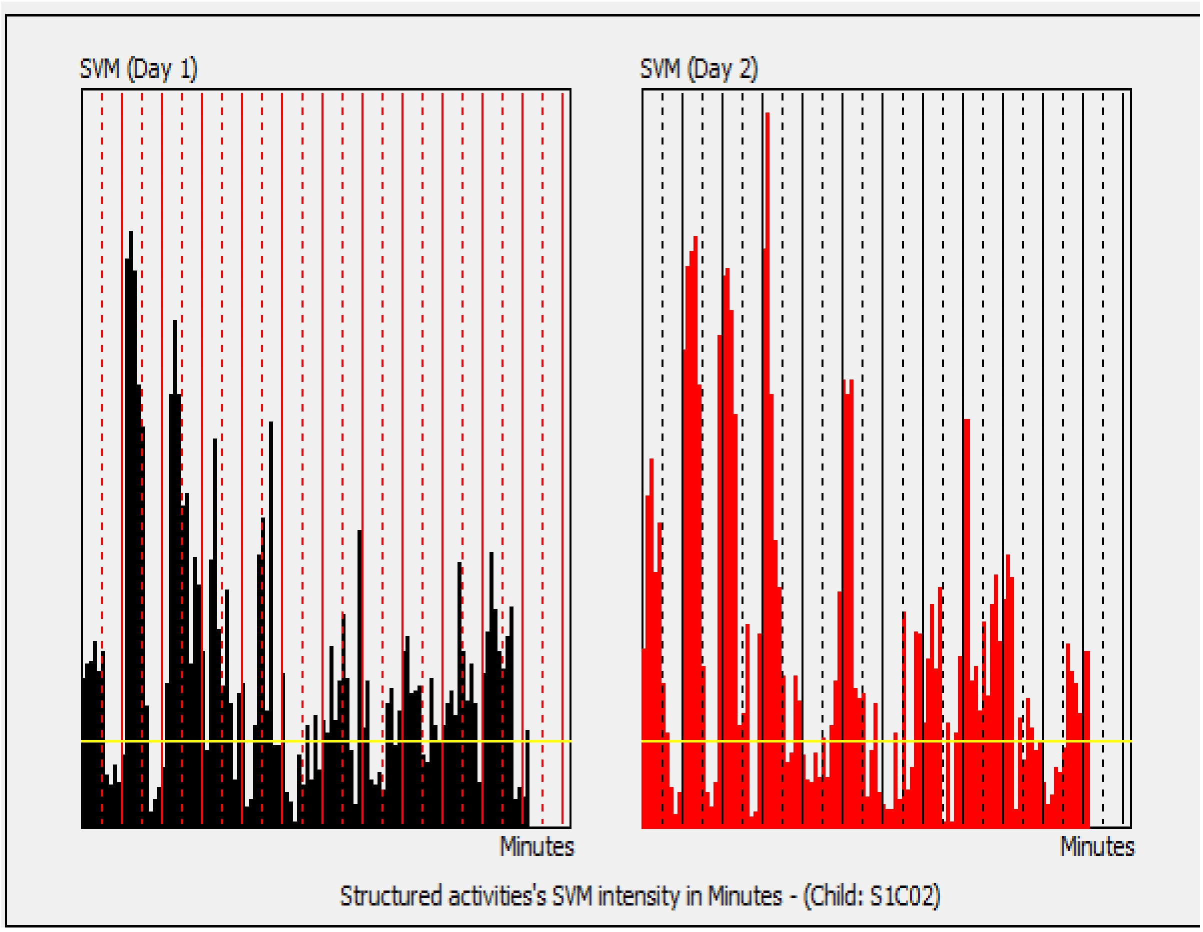

Figure 14: Activity intensity in structured activities.

7. Conclusion

This report contains preliminary results which may be refined later after implementing the research recommendations in terms of the most accurate physical activity classification system. These results are necessary to identify possible trends of variation with the children's s personal and socio-environmental factors and the school support data. The school's participation in the focus group discussion to examine the barriers and facilitators to the children's active participation in physical activity inside and outside the school will be very important.