Demographic, socioeconomic, dietary and physical activity determinants of obesity in a large nationally representative sample of the Lebanese adult population.

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DEMOGRAPHIC, SOCIOECONOMIC, DIETARY AND PHYSICAL ACTIVITY DETERMINANTS OF OBESITY IN A LARGE NATIONALLY REPRESENTATIVE SAMPLE OF THE LEBANESE ADULT POPULATION

Submitted by

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Demographic, socioeconomic, dietary and physical activity determinants of obesity in a large nationally representative sample of the Lebanese adult population.

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Introduction: The prevalence of obesity within countries varies by gender, age, socioeconomic status, and culture. These determinants appear to predict obesity differently in different countries. The objective of this study was to estimate the impact of these determinants on obesity in a representative sample of the Lebanese adult population.

Methods: A cross-sectional survey of 2697 adults aged ≥ 20 years, excluding pregnant and lactating women, was conducted in 2008. Households were selected randomly from all Governates of Lebanon based on a stratified cluster sampling. One randomly-sampled adult was interviewed in each visited household; demographic, socioeconomic and anthropometric data were measured. Dietary intake was obtained using a 24-hour recall instrument. The prevalence of obesity in 2008 was estimated. Logistic regressions analysis was carried out to assess the relationship between energy intake and obesity as well as adjusted relevant variables, excluding data from participants who reported implausible energy intakes.

Results: Currently, approximately one in four Lebanese adults is obese. While men and women showed overall similar prevalence rates of obesity, gender disparities were noted across obesity classes and age groups. In males, the odds of being obese increased among those married, employed, and owning increased household assets; the opposite was the case for women. Obesity in women decreased with increasing household wealth. In women also, there was a positive association between obesity and energy intake, and a negative association between obesity and physical activity. Obese adults reported consuming a higher percentage of their energy intake from fat, and a lower intake from cereals, compared with their non-obese counterparts.

Conclusion: The prevalence of obesity among Lebanese adults is on the rise, with significant demographic and socioeconomic differentials. High energy consumption and inactivity of Lebanese adults, as well as several complex socioeconomic and cultural elements, are contributing factors to the estimated high rates of obesity.

Table of Contents

Appendix

List of Figures

List of Tables

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To my beloved father who was
always proud of me, as I was of
him and would always be.

May His Soul Rest In Peace

Introduction

There is evidence going back a number of decades of an increase in the prevalence of overweight and obesity in higher income[1] countries, to the point that almost half of the adult population is now overweight (BMI ≥ 25-29.9 Kg/m^2) or obese (BMI ≥ 30 Kg/m^2)s. More recently, reports indicate that this scenario is also occurring in some middle income countries (Popkin, 2010; Popkin, 2008), to include a few in Central and South America (Mexico, Peru and Bolivia), the Gulf and Middle East (Egypt, Saudi Arabia), as well as Africa and Asia (Popkin, 2010). This is associated with an increase in the cost of treatment of obesity-related diseases.

In epidemiology, two related but different measures describe the distribution of a disease in a particular population; prevalence and incidence. Prevalence is a measure of the proportion of total population affected by the disease in question at a certain point in time (Breslow & Day, 1980). The incidence of the disease is the number of new cases occurring in a population over a defined time interval (refers to new cases of disease occurring among previously unaffected individuals. Prevalence depends on both the incidence and the duration of the problem (Silva, 1999). A problem with long duration will have a high probability of being encountered at that designated time when prevalence is estimated (Breslow & Day, 1980). The prevalence of obesity in a general population may be growing because of both the higher incidence and the longer survival of subjects with obesity.

The reported continuous occurrence of obesity in all age groups and in many countries of the world is most probably due to the lack of priority intervention strategies to prevent or reverse obesity at the population level, thus causing the upsurge of obesity cases year after year leading with time to increased prevalence.

Complex and interrelated factors are thought to be responsible for the current obesity epidemic, which is hastened by economic growth, modernization, urbanization and globalization of the food market. While the genetic background of populations is comparatively stable, serious societal changes and universal nutrition transitions have paved the way to more diverse diets with higher proportions of fats and sugars, accompanied with a

[1] For operational and analytical purposes, the World Bank's main criterion for classifying economies is gross national income (GNI) per capita. Economies are divided according to 2010 GNI per capita, calculated using the World Bank Atlas method. The groups are: low income, $1,005 or less; lower middle income, $1,006 - $3,975; upper middle income, $3,976 - $12,275; and high income, $12,276 or more (http://data.worldbank.org/about/country-classification, accessed on Jan2012)

decline in physical activity (Seidell & Flegal, 1997; WHO, 2004b; Lissner, 1997; Canoy & Buchan, 2007).

With time, stronger associations have been made between socioeconomic status (SES) and obesity, and inconsistent relationships have been reported between these two factors, depending on the degree of economic development of the country (Yoon et al., 2006). In higher-income countries, SES tends to be inversely related to obesity, particularly among females (Dahly et al., 2009; McLaren, 2007). Conversely, in lower-income countries, obesity was once viewed as a problem only among the prosperous population segments in men, women and children (Dahly et al., 2009; Seubsman, 2009). However, a growing body of literature suggests that the SES-obesity gradient is shifting inversely as the Gross Development Product (GDP) Per Capita increases in a variety of developing countries with low and middle income, occurring in women first (Monteiro et al., 2004a).s

The trend in low and middle income countries is starting to resemble that in their high-income counterparts (Monteiro et al., 2004; Misra & Khurana, 2008; Dahly et al., 2009; Esmaiely et al., 2009s). This change is attributed to several transitions brought about with the increase in the GDP resulting from the country's economic advancement. These transitions are demographic (younger to older population distribution, rural to urban), epidemiological (infectious diseases to non-communicable diseases), technological (low to high automation and motorization), and nutritional (traditional foods to more processed energy-dense alternatives) (Swinburn et al., 2011).

Obesity and overweight constitute a major risk for diet-related chronic non communicable diseases such as diabetes, hypertension, heart disease and certain types of cancer; they significantly reduce an individual's physical function and overall quality of life (Pi-Sunyer, 1991; Must et al., 1999; Ford et al., 2001; WHO, 2004b; Haslam D., 2007).

All diet-related research studies carried out during the past thirty years in Lebanon, conducted on the individual or rather the national levels, have strongly indicated the need for further investigation and evaluation of the socio-cultural, economic and life-style factors associated with weight gain and obesity in the country. Identification of the potential determinants of obesity relevant in Lebanon that might lead to behaviour change is critical for the development of effective culturally- sensitive public health programs which aim to prevent and manage obesity.

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Chapter 1: Overview of the Prevalence and Determinants of Obesity, and Methods Used to Assess Obesity

This Chapter starts with a review of the epidemiology of obesity prevalence, followed by relevant literature on demographic, socioeconomic, dietary, and physical activity determinants. The final section includes a review of methods used for the measurement/estimation of obesity, and focuses on those methods which are suitable at the population level.

The search strategy followed was that for each variable an online database search was conducted using key words in Medline and Scopus. Review as well as research articles were retrieved, and further studies were identified by citations of retrieved papers. The general search structure for electronic databases was (adulthood or synonyms) and (obesity or synonyms), (gender differences) and (obesity). Longitudinal as well as cross sectional studies with participants from countries of varied economic development (developing and industrialized) were considered. Studies that included measurement of a risk factor for obesity in adulthood were included in addition to those that comprised measures of body fatness, body composition, and measures of fat distribution.

For data on the prevalence of obesity, the researcher used the WHO database for information on the prevalence of obesity in the EMRO (Eastern Mediterranean Regional Office) countries, Europe, USA, and Australia. Further papers reporting obesity prevalence in adults and nutrition transition in various countries of the world were also evaluated and cited.

For data on obesity determinants, general key terms/synonyms were used to locate relevant research resources .These include: Socioeconomic status and obesity-education, occupation, income, and obesity - diet and adult obesity- diet and weight gain - food and adiposity - diet composition, energy dense foods and obesity - physical activity and obesity- lifestyle factors and obesity.

1.1 Lebanon's Socio-demographic Profile and Nutrition Transition Stage

Lebanon is a small middle–income Middle Eastern country located on the eastern edge of the Mediterranean Sea; it occupies a total land area of 10,452km^2. It is divided into six administrative districts or Governorate: North Lebanon, Mount Lebanon, South Lebanon, Nabatieh, Bekaa and Beirut. The population of Lebanon, typified by a diversity of ethnic and religious backgrounds (Sibai et al., 2003a), was estimated to be 3,755,033 in 2006 (Ministry of Health, Lebanon.2006), with an average family size of 4 persons per household and an average monthly income of 1,540,000 L.P (Yaacoub & Badre, 2012;

Ministry of social affairs, 2008). Literacy rate among Lebanese adults is estimated at 89.61%: 85.97% among females and 93.38% among males. Educational attainment is comparable in both genders (Ministry of social affiars, 2006), and more males aged 15 years and above are reported to be in the labor force (68.9% males compared to 20.4% females). One of the main demographic trends in Lebanon is the late marriage age for both males and females, with about 20.8% of men and 20.9% of women aged 35-39 years are unmarried (Ministry of social affairs, 2006). Life expectancy at birth for the Lebanese population is approximately 75 years (Ministry of social affairs, 2011).

The country is characterized by high urbanization rate with migration from rural to urban regions reaching 86.9% in the year 2007 (UNDP, United Nations statistics division, 2011). In addition to its high within-country migration rate, Lebanon is the MENA region's (Middle East and North Africa) country with the longest history of emigration to other countries, in response to a variety of factors including religious conflicts, civil war and economic crisis (Di Bartolomeo et al., 2010).

Nonetheless, the country's economy has been growing steadily since the end of the civil war in 1990, particularly due to the development of the service sector (Ministry of Economics & Trade, Lebanon, 2009). In the year 2000, the gross domestic product (GDP) per capita was estimated at 4379$, and almost doubled by the year 2009 reaching a value of 8321$ (The World Bank, 2011).

As is the case for other members of the MENA region, comprising oil-rich countries as well as others with scarce resources, the rate of nutrition transition in Lebanon is outpacing the rate of economic growth (Akala & El Saharty, 2006), and it is reported to be a more advanced problem in urban areas than in rural ones (WHO, 2009). Five patterns of nutrition transition have been identified: 1) healthy high fiber and low fat diets, leanness and physical activity; 2) low calorie diets, famine occurrence; 3) improved calorie consumption (fruits, vegetables and animal protein, inactivity, and diminishing famine); 4) affluence, diets high in fats and refined carbohydrates, sedentary lifestyle and occurrence of non-communicable diseases; and 5) behavioral changes towards balanced diets and regular physical activity, efforts to delay or prevent disease (Misra & Khurana, 2009; WHO, 2009). Of these five patterns, the 4th has been described as the most prevalent in developing countries, contributing to a rise in obesity, the metabolic syndrome, type 2 diabetes, and cardiovascular diseases (Misra & Khurana, 2009; WHO, 2009).

The World Health Organization classified Lebanon among the MENA countries that are in the early stages of nutrition transition, characterized by moderate levels of overweight and obesity, moderate levels of under-nutrition in specific population pockets and age groups, and widespread micronutrient deficiencies. Lebanon falls within the same category as other intermediate per capita income countries such as Egypt, Jordan, Syria, Libya, and Morocco (WHO, 2009).

Within nations, an individual's socio-economic position is known to be a potent predictor of health as it is an indicator of material advantage and disadvantage (Graham, 2007) that might in turn affect behavioral choices. A study conducted on the national level used household consumption as the socio-economic measure to draw a profile of poverty in Lebanon reported that nearly 28% of the Lebanese population can be regarded as poor, and 8% as extremely poor. Particularly, the distribution of expenditure among the Lebanese population is reported to be relatively unequal; within-governorate inequality accounts for most of the inequality in Lebanon (92%) (El Laithy et al., 2008). Of the six Governorates in Lebanon, the bulk of poverty across the whole country is concentrated in the North Governorate (Tripoli city, Akkar/Minieh-Dennieh), in the South Governorate (Jezzine/Saida), and in the Bekaa (Hermel/Baalbek) (The Ministry of Social Affairs, 2011).

In addition to economic and demographic key elements for countries in transition, food consumption and physical activity patterns are also affected by various cultural norms and knowledge factors associated with food and exercise choice, disease patterns, and sociologic considerations/barriers (Popkin, 2006, Sibai et al., 2010; Hajian-Tilaki & Heidari, 2009). The last factor, for the most part in developing countries, has been related to the role of women and the family structure (Popkin, 2006). Whether in developed or developing countries, rural or urban regions, diverse social and economic factors give rise to different situations, varying from increased risk to protection from the development of obesity (Peixoto et al., 2007)

1.2 Obesity Prevalence

According to the most recent International Obesity Taskforce analysis on obesity estimates, approximately 1.0 billion adults are currently overweight (BMI 25-29.9 Kg/m^2), and a further 475 million are obese. When Asian-specific cut-off points for the definition of obesity (body mass index >28 kg/m2) are taken into account, the number of adults considered obese is over 600 million globally (International Obesity Taskforce, 2010).

In 2007, the WHO investigated the extent of change in the prevalence of obesity in adults in the WHO European region (Branca et al., 2007a). In general, and in countries of both measured and self-reported weight and height, the prevalence of obesity was higher in women; it ranged from 5.4% to 22.8% among men and from 7.1% to 35.6% among women, and the prevalence of overweight was higher among men in all countries (Branca et al., 2007a).

More recently, Low & colleagues (2009) published a literature review on the epidemic of obesity based on 3 previous reviews that examined the prevalence levels and the trends of overweight and obesity in the USA (Wang & Beydoun, 2007), China (Wang et al., 2007), and worldwide (Wang & Lobstein, 2006). The researchers covered all age groups of interest in the population: adults, children and adolescents (Low et al., 2009).

The review by Wang and Beydoun on obesity in the USA used WHO cut-off points of 25 kg/m^2 and 30 kg/m^2 for identifying overweight and obese respectively in adults (Wang & Beydoun, 2007). Wang et al. added to their review Chinese standards of being overweight (24 kg/m^2) and obese (28 kg/ m^2) (Wang et al., 2007). The review by Wang and Lobstein used the international obesity task force (IOTF) cut-off points based on BMI centile curves that passed through the adult cut-off points of BMI 25 kg/m^2 and 30 kg/m^2 for being overweight and obese respectively (Wang & Lobstein, 2006).

The compiled data reported the prevalence of overweight and obesity among adults in low, middle, and high income countries, and noted considerable differences within the three categories. The prevalence of overweight for both genders ranged from 23.2% in Japan to 66.3% in the USA and 72.5% in Saudi Arabia in high income countries, and from 13.4% in Indonesia to 59.7% in Chile in low to middle income countries (Low et al., 2009). The prevalence of obesity was generally higher among females compared to males mainly in low-middle income countries, with an increasing trend with age. The highest obesity prevalence was reached at around the age of 50 to 60 years in most high income countries, and earlier at around 40 to 50 years of age in many low to middle income countries. Among the older age groups, a drop in prevalence was noted (Low et al., 2009).

All in all, an increase in the average annual change in obesity occurrence was observed, ranging from 0.2% to 18.5% in high income countries and from 0.1% to 35.3% in low to middle income countries (WHO Global Database, 2006; Low et al., 2009). However, few studies have reported no significant change or rather a decrease in the trend of prevalence of obesity (Ogden et al., 2008; Branca et al., 2007a). The report from the National Center for Health Statistics in the USA noted that the prevalence of obesity showed no significant change in adults in the USA between 2003-2004 and between 2005- 2006, and a leveling off in the years 2007-2008 (Ogden et al., 2008; Flegal et al., 2010).

Compiling data from the WHO Global database on Body Mass Index that uses WHO recommended BMI cut-off points to produce internationally comparable results (World Health Organization, 2012), **Figures 2.1** and **2.2** provide the most recent available data on adult obesity prevalence in males and females, respectively, in selected low to upper middle income countries, as well as in high income countries in the MENA region (World Health Organization, 2012).

Figure 1.1 shows highest prevalence rates of obesity among males in high income countries as compared to the lower income ones. Of the affluent MENA region countries, the highest prevalence rate was reported in Kuwait comparable to the European country Ireland, and higher than that of Canada and Australia. Of the lower income countries, only Iraq showed a high prevalence rate that is comparable to those of high income ones. Among females (**Figure 1.2**), higher prevalence rates were reported compared to males in all countries except for Ireland. The highest rate among the high income countries was noted in Saudi Arabia and Kuwait, probably related to cultural preferences of plumpness among females, followed by Egypt and Iraq of lower economic standing. Although India, a lower middle income country, exhibited considerably lowest prevalence obesity rates in both genders as compared to its counterpart countries, prevalence rate among females is almost 2 fold higher than that of males, highlighting again the more complex gender variation in obesity prevalence and its contributing factors.

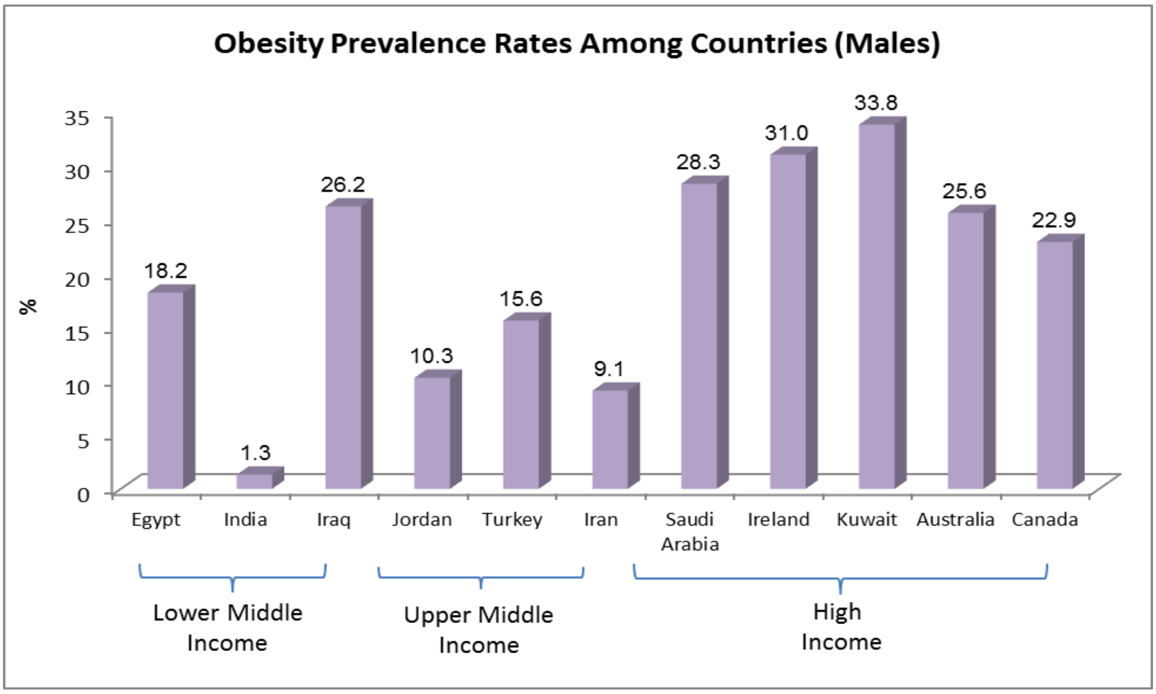


Figure 1.1 Obesity Prevalence rates among adult males in lower middle income countries, upper middle income countries, and high income countries
Compiled from the World Health Organization (2012). *Global Database on Body Mass Index.* Retrieved on February 2012 from http://apps.who.int/bmi/index.jsp
(Survey year: Egypt, 2008; India, 2006; Iraq, 2006; Jordan, 2006; Turkey, 2007, Iran, 2005; Saudi Arabia, 2005; Ireland, 2007; Kuwait, 2009; Australia, 2008; Canada, 2004)

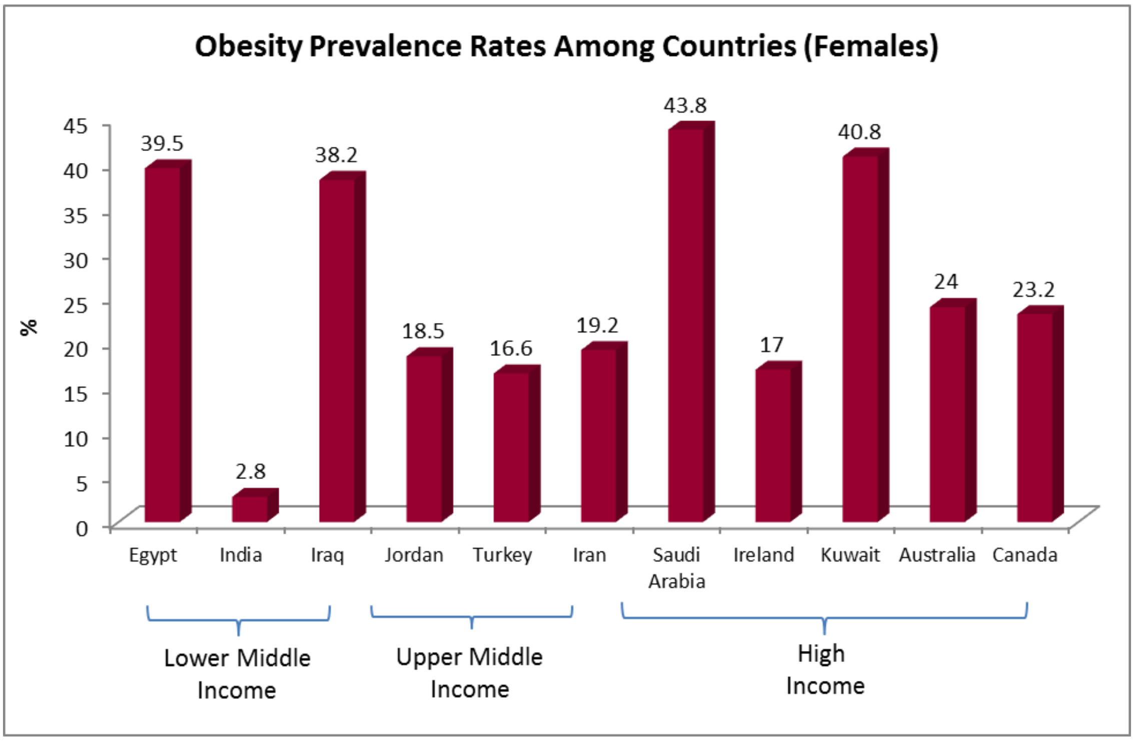


Figure 1.2 Obesity Prevalence rates among adult females in lower middle income countries, upper middle income countries, and high income countries
Compiled from the World Health Organization (2012). *Global Database on Body Mass Index.* Retrieved on February 2012 from http://apps.who.int/bmi/index.jsp

Certainly, nutrition transition has been noted among both men and women in Middle Eastern countries, especially high income ones such as Arab Gulf Countries, in addition to most middle income countries of the region such as Egypt and Jordan. Specifically, nutrition transition was more prevalent in urban areas, and in some high socioeconomic sectors of the low income countries where high prevalence rates of obesity similar to those in high income countries were reported (Musaiger, 2011). Researchers still report that the burden of overweight is greater among the wealthier population of the low to middle income countries; a cross section analysis using a nationally-representative data collected at 2 time points in 37 of these countries showed that in only 6 of these countries, accelerated weight gain was observed in the poorer segments of the community compared with their wealthier counterparts (Neuman et al., 2011).

1.3 Obesity Determinants

It has been well reported that obesity is culturally rooted, and that approaches to deal with obesity should begin with understanding how obesity is internalized by individuals, communities and societies (Ulijaszek & Lofink, 2006). While in Europe social pressure to pursue thinness is described to be high (Mclaren, 2007), there is widespread culturally-related tolerance to fatness in some Arab countries such as Kuwait, Qatar, and Morocco (Al-Isa, 1999; Musaiger, 2004; Rguibi & Belhasen, 2004; Musaiger, 2011). Moreover, there is a reduced emphasis on body size and shape among men and women in the Arab Gulf States, Sudan, and North African Countries.

1.3.1 Demographics

1.3.1.1 Age, Gender, Ethnicity and Marriage

Age

Genetic and environmental factors are known to be proximate determinants of body weight; however, social characteristics are also gaining attention as elements of influence on diet and physical activity practices (Tzotzas et al., 2010). Although only few of these characteristics are modifiable, they may offer ways to target weight management (Tzotzas et al., 2010; Sobal et al., 2009).

Age has frequently been reported as a prognostic factor contributing to the development of obesity in both genders (Hou et al., 2008). Several community-based cross sectional studies reported significant association of age with body mass index and higher prevalence of obesity with increasing age (Sidik & Rampal, 2009). Age effects on body weight are attributed to physiological changes that occur with ageing such as decreased energy requirements at rest (Nooyens et al., 2008). However, even without body weight changes, age-related alterations in body composition occur where fat- free mass progressively decreases after reaching its maximum level at the age 20, and fat mass increases reaching its maximum level at the age of 60-70 years (Zamboni et al., 2005). A greater proportion of this body fat is intra-hepatic, intramuscular, and intra-abdominal (Chapman, 2008). Longitudinal studies have shown that waist circumference increases with age, and that even older adults (>=65 years) continue to have progressive increases in waist circumference (Chapman, 2008). Thus the age –related decline of energy requirements at rest, or in other words the decline in basal metabolic rate (BMR), is mainly attributed to the reduction in fat-free mass quantity (Lazzer et al., 2010); however, one should not forget the various behavioral exposures that occur to individuals with time (Nooyens et al., 2008).

Gender

There is an observed gender difference in risk patterns to obesity development reflecting the distinctive effects of health, cultural beliefs and body weight perceptions on body weight status. Women could have different attitudes toward body weight status than men, and may give more value to practices such as mostly diet, food choices and exercise to control body weight and have better health outcomes (Yoon et al., 2006; Borders et al., 2006; Wardle et al., 2004; Giskes et al., 2007). Thus, women are more likely than men to use their resources, whether economic, cultural or social in nature, to shift their diet and activity patterns in pursue of a healthier body weight, whereas men's increased earnings and purchasing power may not lead to a healthier lifestyle (Zhang & Wang, 2004).

An international study carried out to measure perceived overweight among adults in 22 countries that were grouped into 5 geopolitical/economic regions: North Western Europe and the USA, Central and Eastern Europe, the Mediterranean, Pacific Asia, and South America, showed the international consistency in perceptions of overweight in educated adults across diverse regions of the world. The study confirmed the patterning of women's overestimation and men's underestimation of weight (Wardle et al., 2005). The study reported that perceptions of overweight and attempts to lose weight were lowest in women from Mediterranean countries and highest in those from the Asian countries where body weights are generally low. This indicates that local cultural factors may moderate attitudes towards weight (Wardle et al., 2005). The Mediterranean culture might confer not only the beneficial effects of the local diet (Trichopoulou et al., 2003; Wardle et al., 2005) but also a more relaxed relationship with eating and weight (Wardle et al., 2005).

Very few studies have been carried out in Lebanon on methods of pursuing healthy weight; however, a study among university students, assuming that behaviors formed in the second decade of life have lasting individual implications, showed that in Lebanon, and similar to developed countries, attempting to lose weight is a phenomenon most common among females (Tamim et al., 2004). The proportion of students trying to lose weight was significantly higher among female students registered in private universities (Tamim et al., 2004). This reflects these students' higher socioeconomic status; they all work and study at the same time and are characterized by a high sense of self accomplishment (Tamim et al., 2004).

Ethnicity

Ethnicity-specific norms about body image may lead to ethnic differences in body weight, body perception and –accordingly weight-management behavior._Weight patterns are conditional upon gender for some ethnic groups as is the case among black Americans (Sobal et al., 2009), and among populations of certain countries of the MENA region such as Morocco where women are rather preferred to be of heavier weight than men (Musaiger et al., 2011). Also within the same gender, obesity prevalence may vary as higher rates were reported among ethnic minority populations such as black women compared to white women (Sidik & Rampal, 2009).

Studies in the Western literature on the relationship between ethnicity and body weight perceptions and approaches based the definitions of ethnicity on ancestry origin and heritage (such as Hispanic/Spanish or Asians); however, studies conducted in Lebanon based their measurement of ethnicity on religious affiliation and different religious sects, generally grouped under the two broad categories Moslems vs. Christians (Sibai et al., 2010) as the definitions in Western literature do not apply. The two groups have distinctive social and cultural preferences that are passed on from one generation to another, all of which translate into very different experiences in health behaviors, attitudes and disease risks (Sibai et al., 2010). A multidimensional study on behavioral risk factors examined weight loss differentials in a sample of school adolescents in an urban area in Lebanon, who were mostly girls, , representing an ethnic population in the Middle Eastern culture. The study found that in general, Christians were more concerned about their body weight than Moslems, and were more likely to perceive themselves as being overweight as well as to attempt weight loss across all levels of BMI. This indicates less societal pressures towards "thinness" among the Moslems (Sibai et al., 2003). Furthermore, it is possible that the type of dress (the *Jelbab* or Abaya: a long loose dress which covers all the body and its associated *Hijab* which covers the hair) that is frequently worn among young Moslem females in Arab countries including Lebanon as a sign of adherence to religious rules, creates an environment less apprehensive of body image, thus contributing to the rise in obesity (Sibai et al., 2003, Al Tawil et al., 2007). In Iraq for example, it was observed that women who wear trousers and skirts would be more conscious of any changes in their body weight than women who wear the loose grown or *abaya* (Al Tawil et al., 2007).

In the Arab culture, ethnic and religious differentials in weight management behavior have not been investigated earlier; however, the traditional Arab culture values "plumpness" as an "attractive physique" for the opposite sex; this has been suggested as an underlying factor for the alarming high prevalence of obesity in most countries of the region (Sibai et al., 2003). Negative psychosocial attitude toward obesity is not realized in many developing countries, and this may be a major social factor contributing to higher levels of body satisfaction and acceptance of obesity by the individual and community (Misra & Khurana, 2008; Littlewood, 2004).

Among populations, perceptions of weight status also vary according to socioeconomic status, besides race/ethnicity and gender (Ball & Crawford, 2005). Women, whites, and persons of higher socioeconomic status have been found to be more sensitive to self-perceived overweight than men, minorities, and lower-SES groups (Paeratakul et al., 2002). Some evidence shows that men are less likely to report body dissatisfaction than women (Gorgan, 1999; Ball & Crawford, 2009). This may well act as a mediating factor in the relationship between ethnicity, gender and weight approaches (Sibai et al., 2003) and consequently the attainment of healthy body weight status.

Marriage

A significant social characteristic that is reported to exhibit gender and ethnic differential to weight status is marriage. Many cross sectional studies have observed higher prevalence of overweight and obesity among married people than those living alone, however with existing variations according to gender and ethnicity (Tzotzas et al., 2010; Sobal et al., 2009). The positive relationship between marital status and weight has been explained in many hypotheses including social obligations leading to increased food consumption and decreased time for physical activity, and less focus on body image related to the lack of concerns to attract a potential marital partner (Janghorbani et al., 2008; Tzotzas et al., 2010).

In a cross sectional study based on data drawn from the National Health and Nutrition Examination Survey (NHANES), white divorced men were less likely to be overweight than white married men, whereas among women, weight status did not differ with marital status implying a consistency of weight norms among white women. On the other hand, black women had higher prevalence of overweight than white women, and those who were separated had higher odds to be overweight than those who were married, a phenomenon that might be related to cultural expectations whereby thinness is not a significant aspect for potential relationships and marriage (Sobal et al., 2009). In general, longitudinal studies suggested that marriage may be associated with weight gain, whereas separation or divorce may be related to weight loss (Janghorbani et al., 2008).

Studies on the association between marriage and obesity in Lebanon are missing; however, one study relating physical activity, marriage and weight was carried out on a non-random quota-based convenience sample of Lebanese adults drawn from four Governates of Lebanon (Al-Tannir et al., 2009). This study showed that being single was found to increase participation in structured physical activity or exercise, thus contributing to a better weight status. This was attributed to the fact that single adults have more leisure time and less life stressors than married ones (Al-Tannir et al., 2009).

1.3.1.2 Smoking and Alcohol Consumption

Smoking

It is generally known that cigarette smokers have lower body weights than non-smokers (Lissner, 1997), as smoking tends to reduce appetite and to elevate metabolic rate by its thermogenic effects (Lean, 2000). Smoking thus has been associated with thinness, and smokers, even pregnant women, have expressed concern that smoking cessation might lead to increased food intake, decreased energy expenditure, and thus eventually overweight and obesity (Lissner, 1997; Santos & Barros, 2003).

However, having a lower BMI than ex-smokers and non-smokers does not mean that smokers are not prone to increased visceral fat as shown in a study carried out by Esther and colleagues (Esther et al., 2009). The authors reported a higher visceral fat in smokers. Considered as an approach for weight control, smoking has also become common among overweight and obese individuals (Lean, 2000), a phenomenon that makes it more difficult to understand the relationship between smoking and obesity in today’s world.

Increased tobacco consumption in developing countries experiencing demographic transition (rural to urban) has been observed, and a large magnitude of health problems associated with smoking has been reported (Baddoura & Chidiac, 2001). All countries of the Eastern Mediterranean Region report a higher prevalence of male smokers than female smokers. Alarmingly high smoking rates in males were reported in Lebanon (46%), Jordan (48%) and Syria (51%). For females, the highest smoking rates were found in Lebanon (35%) (WHO, 2003). Despite various efforts by different governmental and non-governmental organizations, anti-smoking legislation is effectively nonexistent in Lebanon.

Alcohol

Another socially and somewhat sensitive element that might exhibit associations with BMI is alcohol consumption. Alcohol is a source of dietary energy providing 28.8 KJ/g (Rumplet et al., 1996), and its constituent ethanol is the least satiating dietary macronutrient (Yeomans et al., 2003; Almiron-Roig et al., 2003). Physiologically, alcohol may be a contributor to excess body weight by providing an extra energy source and by acting as a catalyst to increased food intake by stimulating appetite (Yeomans et al., 2003; Caton et al., 2004; Breslow & Smothers, 2005). On the other hand, the relationship between alcohol intake and BMI involves lifestyle and social factors that make this relationship complex, and therefore a direct cause / effect association cannot be assumed (Almiron-Roig et al., 2003; de Castro, 2000).

Lebanon is a country that is at a crossroad between the eastern and the western cultures. It is home to three major religions (Christianity, Islam, and Druze) with different religious doctrines regarding alcohol use, ranging from the most proscriptive Muslim religion that prohibits the use of alcohol, to the more moderate Druze faith that neither prohibits alcohol nor tolerates it, to the least proscriptive Christian religion. In Lebanon, alcohol is not prohibited by law as is the case in some other Arab Countries. Lower prevalence of alcohol use and alcohol use disorders was reported especially among the Muslim population, and this lower prevalence has been significantly linked to religiosity (Ghandour et al., 2009).

Studies on alcohol consumption prevalence and its association with body weight are rare in the MENA region. Alcohol consumption prevalence rates of 69 % and 45.8% have been reported in Lebanese males and females> 15 years, respectively (WHO, 2003). A recent study on alcohol use among Lebanese university students, lifetime alcohol use was reported in 71% of the students, significantly more in males (Ghandour, 2009).

1.3.2 Culture: Food Intake and Physical Activity Practices

Food Intake

Food intake behavior plays a major part in the construction of the individual, social and cultural identity (Mouawad, 2004). In Lebanon, the consumption of traditional foods accompanies all social occasions (marriage, baptism, and funeral), and is a weekly feast component of the Sunday family gatherings. The traditional Lebanese diet acquired its healthy Mediterranean characteristics from its diverse culinary history reflecting Lebanon's unique interaction with various populations throughout the centuries: Babylonians, Phoenicians, Egyptians, Greeks, Romans, Persians, Byzantines and Turks (Hwalla & Dit El Khoury, 2008). It traditionally includes olive oil, plant foods, fresh fruits, minimally consumed red meats, and moderately consumed red wine (Hwalla & Dit El Khoury, 2008).

However, it has been observed that food habits have markedly changed in all the Eastern Mediterranean countries during the past four decades (Musaiger, 2011); a key feature of this remarkable period of urbanization in Lebanon has been the change in the nature of the Lebanese diet (Mouawad, 2004).

Nevertheless, comparing the traditional Lebanese dietary habits with the recent ones reveals a preservation of traditional foods with added modern ingredients accompanied by an increase in fat, milk and meat consumption, and a decrease in the intake of non-refined carbohydrates (Hwalla & Dit El Khoury, 2008). It has been noted that neither tradition nor modernity is the exclusive choice of cities or villages, and the tendencies towards modernity or tradition are present in both societies (Mouawad, 2004).

Consequences of modernity on food practices among countries in transition were reported as follows: disintegration of meals, increased nibbling, eating at working places, less time allocated for home cooking, and increased tendency towards convenience fast foods (Chonchol, 1987; Delisle, 1989). Modernization also brought with it more industrialized energy-dense food products, meat-based products, more sugar, and availability of all foods during all seasons (Chonchol, 1987; Delisle, 1989). Despite being influenced by the western diet, the Lebanese diet still holds some of its healthy traditional Mediterranean characteristics, and it has high popularity among the local population as well as the neighbouring countries.

Most developing countries in Asia, Latin America, Northern Africa, the Middle East, and the urban areas of sub-Saharan Africa have been experiencing a shift in the dietary patterns over the last few decades. Major dietary changes include a large increase in the consumption of fats, particularly animal fat and added sugar, and a decrease in cereal and fibre intake (Misra & Khurana, 2008; Sibai et al., 2010; Popkin, 2006). Notably, availability of edible vegetable oils for consumption has nearly tripled throughout the developing world (FAO, 2004). In Lebanon, the scenario is similar; several studies on food consumption patterns in Lebanon carried out during the years between 1964 and 1998 reported a change towards increased intake of fat, milk, and animal protein, and a decreased intake of complex carbohydrates (mainly bread and cereals) in both rural and urban areas. The contribution of fat to daily energy intake has increased from 24% to 34.4%, and that of carbohydrates has decreased from 58% to 36% within the same period (Cowan et al., 1964; Cowan, 1965; Baba, 1992; Baba et al., 1998b). Such trends persisted throughout the period between 1990 and 2000, where further studies showed a continuous rise in the contribution of fat to daily energy intake peaking at 38.9% in the year 2000. This exceeds the cut-off values of total fat intake recommended by both the World Health Organization and the National Academy of Science to avoid associated diseases (Sibai et al., 2003; Nasreddine et al., 2005). Table 1.1 is a summary of the few dietary surveys carried out in Lebanon, participants' characteristics, dietary intake method undertaken and study outcome.

The supply of many food groups including starchy foods, meat and offal, sweeteners, pulses, nuts, oil crops, and vegetable oils has increased gradually during the last 4 decades in Lebanon. The Dietary Energy supply (DES) has also increased steadily since the 70's, due to a greater availability of food, and has been since reported to be far exceeding the energy requirements of a healthy population with an active lifestyle: 13240 KJ/d as opposed to 8874 KJ/day, according to an assessment carried out in the year 2002 (Lebanese Republic Nutrition Profile-FAO, 2007).

Although energy supply does not directly translate into intake, nevertheless the high energy supply observed in the country could be one of the main reasons for the increasing prevalence of overweight and obesity observed among the Lebanese population as a result of nutrition transition (FAO, 2007).

Table 1.1 Dietary Surveys in Lebanon

Author, Year	Study Year	Subjects & Dietary Assessment Method	Response Rate	Study Results
Cowan J.W., 1964	1962	-22 households in rural areas, with women of child bearing age who were pregnant, lactating or had preschool children (n=305) -2 seven-day Food Consumption survey according to the method of Reh* within a 12 month period.	NA	-Actual caloric intake was higher than the calculated allowance. -Cereals and starchy foods constituted over half of the total daily caloric intake.
Cowan J.W., 1965	NA	-25 households in rural areas chosen on basis of school age children(n=165) -3 seven-day food consumption surveys within a 12 month period.	NA	-Cereals were the major source of calories. -Low consumption of animal products.
Baba N. et al., 1994	1993	-Children aged 6-10 years from the Bedouin population of Lebanon and Syria (n=296) -Single 24 hour recall + interview. Respondents were mothers and children agreed on intake reported by the interviewee.	100%	-Reduced body weight among the study population. -Energy consumption was low as compared to calculated allowance.
Shediac-Rizkallah et al.,2001	1998	-Newly entering Students at the American University of Beirut (n=1065) -Questionnaire on Nutritional behaviour including consumption of foods	90%	-Unhealthy dietary pattern away from the traditional plant-based pattern, and lack of exercise were reported among the major health risk behaviours identified in the study.
Sibai AM.et al., 2003	1997	-National survey of 2104 males and females ≥ 3 years of age recruited from the six administrative governorates of Lebanon. - Single 24 hour recall from adults and by proxy, mostly from mothers, for children< 10 years of age.	90%	-Obesity prevalence rates of 17% in adults ≥ 20 years and 4.8% in children and adolescents 3-19 years were reported. -Obesity was found to be associated with age, low education, non-smoking and family history.

*Reh, E: Manual on Household Food Consumption Surveys. FAO Nutritional Studies No.18, 1962

Table 1.1(Cont'd): Dietary Surveys in Lebanon

Author, Year	Study Year	Subjects & Dietary Assessment Method	Response Rate	Results
Nasreddine L., 2005	2001	-Adult population aged 25-54 years living in the capital Beirut and its suburbs (n=590). - Quantitative food frequency questionnaire consisting of 112 food items and designed to estimate food intake over the past year.	75%	-The study reported high contribution of fat (38.9%) to daily energy intake (2523±763Cal/d). - Low intake of fish, fruits and vegetables were noted among the study population.
Yahia N.et al.,2008	2006	-Students aged 20 ± 1.9 years randomly chosen from the Lebanese American University.(n=220) - Self-reported questionnaire that included information on eating and drinking habits; regularity of meals, snacking, fruits and vegetables consumption, fried food consumption and alcohol intake.	NA	-Obesity prevalence was higher among male students (13.6%) compared to females (3.2%). -Female students showed healthier eating habits in terms of daily breakfast consumption and meal frequency.
Nabhani-Zeidan M. et al., 2011	NA	-Adults 17-19 years recruited from 2 universities in Beirut representing 2 contrasting socioeconomic groups.(n=209) - Self-administered questionnaire + three non-consecutive 24 hour recalls	NA	-Nutritional knowledge was found to be high in both groups. -The intake of macronutrients differed significantly, with lower consumption of carbohydrates but higher of proteins and fats among participants of high SES.

Physical Activity

Concerning leisure or structured physical activity in some regions of the Middle East and North Africa (MENA), many sociocultural barriers generally challenge women more than men. In general, men have more freedom, sport facilities and other recreational activities. In an exploratory study on sports and culture carried out in Iran, women perceived that culture-based constraints and traditions delimited their freedom, including participating in sports activities (Arab-Moghaddam et al., 2007). Women reported that they were to get permission from family members to participate in leisure activities, and were not allowed to engage in gender integrated activities (Arab-Moghaddam et al., 2007). Furthermore, sports was purely perceived as leisure for men, and only reading, watching TV and family gatherings were perceived as types of leisure for women (Arab-Moghaddam et al., 2007).

Another qualitative study among Turkish women also showed the importance of family and kinship relations which play a particularly critical role when it comes to women's involvement in leisure physical activities. Turkish women reported being confronted most of the time with negative attitudes by family and relatives towards their practicing exercise (Koca et al., 2009; Musaiger, 2011). The most commonly reported family-related constraint was the "husband's jealousy". Even those who migrated from rural areas to cities were still confronted with the traditional values of rural life (Koca et al., 2009). It had been generally observed that ethics of care and family responsibilities were the most reported constraints to physical activity among Middle Eastern women, followed by economics which was more evident among women from the lower class (Arab-Moghaddam et al., 2007; Koca et al., 2009; Musaiger, 2011).

Physical activity determinants and their interactions with cultural backgrounds are very rare in Lebanon. A cross sectional study among young University students coming from various socioeconomic backgrounds indicated that both genders were interested in physical activity as a means for controlling body weight. Males exercised for body build up and better physique, and females for thinness. However, females who lived outside Lebanon and were exposed to the upper-middle and high income countries reported higher participation in leisure time physical activity than their counterparts living in Lebanon (Musharrafieh et al., 2008), a factor that may also be related to higher socioeconomic background.

The new access to technology throughout countries in transition has led to a decrease in occupational physical activity; it seems that options to increase energy expenditure through structured/ leisure physical activity may be limited in low to middle income countries (Popkin et al., 2012).

In a more recent cross sectional study carried out among Lebanese adults, walking was reported as the most favourable choice of physical activity among both men and women, probably related to the achievement of physical activity at a free cost (Al-Tannir et al., 2009). An interesting suggestion by Al-Tannir and colleagues (2009) was that higher BMI was not a stimulating factor for physical activity among the study participants; on the contrary, physically active Lebanese adults were more likely to be less obese than physically inactive ones. The study also reported less desire for sports and decreased physical activity among obese adults, smokers, and those who were greater or equal to 45 years of age (Al-Tannir et al., 2009).

To summarize the impact of cultural preferences that in turn influence food intake and physical activity, an study conducted among a group of Arab students in the American University in Cairo found that female students reported their ideal weight to be significantly lower than their current one (Ford et al., 1990); this finding indicates the beginning of change in cultural perspectives on body weight in the developing countries of the MENA region. More recently, and in some Arab countries in the region, it has been proposed that western standards of beauty have contributed to the preoccupation with thinness and body dissatisfaction in women. Arab females therefore might be experiencing a growing conflict between Western values and Arab Tradition (Mousa et al., 2009). Generally, with the global marketing of thinness as the standard of beauty among women, accompanied with rapid social change in cultures in which plumpness was traditionally a sign of beauty, the pursuit of thinness as an aesthetic ideal may well become an upper-class aspiration in the developing world (Mclaren, 2007). Although high cultural valuation of body fatness may contribute to the emergence of obesity in certain cultures of the MENA region, it may possibly cease to be an important contributor in the subsequent generations (Ulijaszek & Lofink, 2006).

1.3.3 Socio-economic Determinants of Obesity

While numerous studies support the inverse relationship between SES and obesity in high income countries such as the USA, Australia, France, Great Britain and Spain (Albright et al., 2005; Mauro et al., 2008; Proper et al., 2007; Lioret et al., 2007; Brodersen et al., 2007; Randall et al., 2009), the association between SES and obesity in middle and low income countries is less clear (WHO, 2000). In general, obesity has been associated with high socioeconomic status in middle and low income countries, including those in transition (Neuman et al., 2011).

A review on findings from studies published between 1989 and 2003 on socioeconomic status and obesity in adult populations of middle and low income countries was carried out by Monteiro et al. (Monteiro et al., 2004c). These studies included countries from Central Eastern Europe, Latin America and the Caribbean, Middle-East and North Africa, South

Asia, and sub-Saharan Africa. The authors reported a greater increase in the levels of obesity in persons with low SES as a country's annual gross national product increases, a trend occurring at the early stages of economic development (a period called transition) and more among women than men (Monteiro et al., 2004c).

Several adulthood socio-economic circumstances are related to healthy food habits (Lalluka et al., 2007), and socio-economic inequalities in health are well established (Giskes et al., 2006; Lahelma et al., 2005). In research, socioeconomic status is most often measured via one or more of the following markers: income, occupational status, and educational achievement (Wardle et al., 2002; Canoy & Buchan, 2007; Dugravot et al., 2010). Research on obesity should not overlook the fact that the social and cultural adjustment of food regulation has been slow as compared to the changing patterns of food security and the appropriate body size for health and beauty, all of which have contributed to the emergence of obesity in various societies (Ulijaszek & Lofink, 2006).

Education

Education, a commonly used indicator of socioeconomic status, is associated with the attainment of knowledge and attitude that enables people to integrate healthy behaviours into their lifestyle (Monteiro et al., 2004a). The associations between an individual's education and healthy food habits are well documented in the literature; many studies found that education is coupled with increased awareness of healthy dietary intake (Groth et al., 2001; Grabauskas et al., 2004), and to some extent with added resistance to obesogenic environments (Bordieu, 1986) that are known to promote excessive food consumption and discourage physical activity (Swinburn et al., 1999; Poston & Foreyt, 1999).

A clear inverse relationship between the level of education and the prevalence of obesity has been reported in most societies (James et al., 2001; Marmot & Wilkinson, 2005). Data from the Health Survey for England, carried out between 2004 and 2008, indicated that men and women who left school at an early age were more likely to be obese than were those with more education, independent of age, ethnicity, and marital status (National Obesity Observatory, 2010). Studies conducted in other developed countries such as the United States, Sweden, and Finland showed similar relations between education and obesity (Wardle et al., 2002; Mclaren, 2007). A few cross sectional studies in developing countries have reported that the level of education was found to be inversely associated with obesity in both sexes in Iran (Hajian Takiri et al., 2010) and in females only in Turkey (Tanyolac et al., 2008) and Greece (Tzozas et al., 2010).

Education has also been identified as the SES variable most strongly associated with body dissatisfaction (Maclaren & Kuh, 2004); however, this attitude varies considerably among different social and cultural groups. In some developing countries, obesity is still a symbol of riches and beauty and thus desirable (Sibai et al., 2003; Olalekan & Uthman, 2009), whereas in the US and Western Europe, it is usually rejected as a symbol of social standing (Grundy, 1998; Maclaren & Kuh., 2004; Maclaren, 2007).

Income

Income is another socio-economic indicator associated with obesity prevalence, particularly when coupled with lower levels of education and health-related knowledge (Groth et al., 2001). Higher consumption of less expensive and more energy-dense foods can be expected from individuals with lower income or frequent economic difficulties accompanied by an inclination towards less leisure-time and fewer chances for recreational exercise (Sobal & Stunkard, 1989; Power, 2005; Travers et al., 1997; Drewnowski & Specter, 2004; Drewnowski et al., 2004).

A study carried out in Australia reported that food purchasing behaviours among the socio-economically disadvantaged were least in agreement with the national dietary recommendations (Turrell et al., 2003). Similarly, in France, energy-dense diets high in fat and sugar continue to be a much cheaper choice than the more nutrient-dense foods (Drewnowski et al., 2004; Andrieu et al., 2006). Researchers reported gender differences in the effect of income on healthy habits and weight. In men, education and occupation play a more important role than income in determining healthy food habits and thus weight (Lalluka et al., 2007). On the other hand, women with a higher income were more likely to follow a healthy diet (Lalluka et al., 2007; Santos & Barros, 2003). Moreover, home ownership as a surrogate of wealth has been found to have a more direct health-promoting effect in men (Krieger et al., 1997) than in women (Macintyre et al., 1998). In accordance with previous findings, the Health Survey for England 2004-2008, showed that obesity prevalence rises steadily with falling household income predominantly in women, whereas in men, the variation in obesity prevalence between the highest and lowest income is small (National Obesity Observatory, 2010). Several studies have also reported positive associations between SES and body size, most commonly among women in middle and low income countries (Ball & Crawford., 2005; Mclaren & Kuh, 2004). On the other hand, a positive association between income and body weight was evident in men from all the three levels of low (Zambia), medium (Brazil), and high (United Kingdom) income countries (Mclaren L, 2007).

Notably, several cross sectional studies have shown a relationship between household food insecurity and adult obesity (Townsend et al., 2001; Adams et al., 2003; Martin & Drewnoski, 2004; Ferris, 2007). Food insecurity is defined as not having access at all times to sufficient food for an active healthy lifestyle, because nutritious food products are either not consistently available or households are not consistently able to afford such food products (Martin & Ferris, 2007). The economics of food choice behaviour suggests that the low cost of cheap high energy dense foods may be a more powerful predictor of weight gain than any one food or beverage (Chou et al., 2004; Lakdawalla & Philipson, 2002; Darmon et al., 2003; Darmon & Ferguson, 2002; World Health Organization, 2004). Hence, one of the major possible explanations for the link between food insecurity and adult obesity include the fact that high fat high calorie food products cost less than healthful food (Drewnosky & Specter, 2004). In addition, food insecure households may experience disrupted eating patterns, varying between feast and famine that can have metabolic consequences (Martin & Ferris, 2007).

For food insecure adults, strategies that merely increase nutrition awareness may not be adequate to combat obesity (Drewnoski, 2004; Martin &Ferris, 2007). Weight loss or weight gain prevention recommendations to eat less and exercise more prove more challenging for food insecure adults who have less access to reasonably priced healthful food (fruits, vegetables, whole grains, and lean meats), but easy access to cheap energy dense food, not to overlook less access to safe affordable outlets for physical activity (Martin & Ferris, 2007).

Gender differences also exist in the association between adult obesity and food security. Investigators have reported that women with low food security were more likely to be obese. With time, increasingly severe food insecurity may cause deteriorating diet quality and poor food management rather than reduced energy intake, until a very low level of food security is reached (Frongillo, 2003; Hanson et al., 2007). On the other hand, compared with fully-secured men, women with low food security exhibited a lighter body weight; this is associated with energy intake reduction (Hanson et al., 2007). This gender difference is attributed to the variation in coping strategies exhibited by men versus women; men more often isolate themselves from others and take individual action probably leading to reduced food intake, whereas women more often involve their social network in coping with stress and channel their efforts toward the needs of others (Hanson et al., 2007). As their food security declines, women restrict their food intake in time of scarcity and binge when food is abundant, thus resulting in weight gain. Orderly eating may be maintained in both men and women in the context of a reasonable economic and food safety net (Hanson et al., 2007).

Occupation

Several studies investigated the relationship between the occurrence of obesity and occupation-based social class in men and women. These studies mostly reported an overall pattern in both genders, where the obesity prevalence in unskilled or lower classification occupations was higher than that in professional occupations; however, the differences were less significant for men (National Obesity observatory-UK, 2010; Wardle et al., 2002). On the other hand, among women, increases in obesity prevalence occurred in all classes except the professional ones (Bartley et al., 2002).

Occupational status is also indicative of social status and may be a marker of shared beliefs regarding the acceptability of obesity (Wardle & Griffith, 2001). Low-status jobs are associated with lack of independence and less free leisure time, which might make it more difficult for one to incorporate recreational physical activity into a day to day routine (Estabrooks et al., 2003; Gordon-Larson et al., 2005). Men and women with higher status jobs reported more preventive dietary practices and more vigorous physical activity (Wardle & Griffith, 2001).

On the other hand, low-status occupations are likely to involve more physical activity than do high-status occupations particularly in the case of men (Wardle et al., 2002). In women, the effect of occupational class on healthy food habits was also partly mediated through income (Lalluka et al., 2007; Lahelma et al., 2005). Studies which investigated the socioeconomic patterning of weight in Canadian men observed an inverse association with education (Cairney & Ostby, 1999; Mclaren & Godley, 2009), as opposed to a rather positive relation for income and occupation (Tjepkema & Shields, 2003; Mclaren & Godley, 2009). For men in a higher ranking occupation, particularly those involving management or supervisory responsibilities, a larger body size could be valued as a symbol of authority (Bourdieu, 1984; Bourdieu, 1998; Mclaren & Godley, 2009). It is important to mention here that in Lebanon, the expression “self-employed” might have different meanings. It could refer to working in construction (house painting, building, etc...) and agriculture (farmer), or taxi driving, rather than a owning a business. As discussed in the previous section, the category of non-salaried employees has the highest risk of poverty and one that applies in all governorates of Lebanon, particularly in the Bekaa and North. For instance in the North, one out of 4 workers in agriculture and one out of five in construction are likely to be poor. Those non-salaried employees paid on a weekly, hourly or piece-rate basis comprise more than one third of the working poor, and the other third of the working poor are the self-employed (El Laithy et al., 2008).

The literature provides evidence that gender differences are apparent in the association between the many indicators of socioeconomic status and obesity. This relation was found to be stronger for women than men, who exhibit smaller variations in the prevalence of obesity (Mclaren, 2007). Up-to-date, individual-level information on SES markers such as income, educational achievement, or occupation chosen with care, offers the most accurate way of highlighting adult men and women at high risk of obesity (National Health Survey Information Centre, 2010; Dugravot et al., 2010).

1.3.4 Energy Balance: Energy Consumption and Energy Expenditure

Obesity has been described as an inevitable human biological outcome of abundant, cheap, and aggressively marketed global food supply, joined with technological developments leading to a decline of daily physical activity levels (Drewnowski & Darmon, 2005; Ulijaszek & Lofink, 2006).

However, there still remains a research question: to what degree do variations in physical activity versus increases in energy intake bring about a rise in body weight (Finucane et al., 2011)? Some researchers still blame this rise on increased physical inactivity and others on energy overconsumption, both of which are associated with technological innovations; they also blame it on changing socio-demographic factors (Bleich et al., 2008). In their study, using a series of cross-sectional observations in a multi-country analysis, Bleich and colleagues (2008) recognized prompts of overconsumption associated with energy imbalance to certain characteristics of development such as lower prices of processed foods, increased urbanization linked to more sedentary lifestyles, and increased country gross development product among developed countries as well as developing ones (Bleich et al., 2008).

In addition to overconsumption, the prevalence of physical inactivity among most MENA countries is high, as reported by the STEPwise surveys supervised by WHO/EMRO (WHO, 2009). Demographic data for countries of the Eastern Mediterranean region showed that with urbanization, occupations requiring physical activity have declined to more sedentary ones (Musaiger, 2011). Explicitly, energy expenditure is made up of three dominant components: basal metabolism, thermogenesis, and physical activity; only the latter has a substantial voluntary control element (Prentice & Jebb, 2004). Energy intake on the other hand is entirely voluntary except in clinical conditions. Thus, only two variables of the energy balance equation are modifiable: physical activity and food intake; each is a complex bio-behavioural phenomenon subject to genetic, physiologic and demographic influences (Prentice & Jebb, 2004). It is illustrated that low levels of physical activity or high inactivity are important drivers of positive energy balance, yet do not single-handedly cause obesity. Weight gain only occurs when energy intake is not regulated to match the low energy expenditure (Prentice & Jebb, 2004). However, this is a far too simple equation to reflect the more complex nature of obesity that involves interactions between multiple biologic, behavioural and environmental factors that in turn have an impact on energy balance (Catenacci et al., 2009; Fontaine et al., 2003; Odgen et al., 2007). Under such conditions, successful energy balance to avoid weight gain can only be reached with conscious efforts towards better food choices and moderate intake, or towards an increase in physical activity whether in leisure time or through occupational and household activities (Kruger et al., 2007).

In countries in transition, persons may experience a change in labour practices that could result in up to 50% reduction in physical activity and thus in total energy expenditure. If not accompanied by a reduction in energy consumption, this may result in weight gain and potential obesity (Hoffman, 2001).

Dietary Energy Constituents: The Macronutrients

Energy density has been highly correlated with a food’s fat content; in other words, foods that are high in fat are generally of high energy density (Skidmore, 2007). In fact, fat is the most energy-dense macronutrient, containing 37.7 kJ per gram (Lunn & Theobald, 2006), and traditionally, low-fat diets are recommended for weight loss as well as for reduction of cardiovascular risk factors such as elevated blood pressure, blood cholesterol and glucose (Avenell et al., 2004). Results from several studies also indicate that low-fat diets were more effective for weight loss than either low-carbohydrate or low-protein diets (Skidmore, 2007).

On the other hand, many cohort studies have shown inconsistent results regarding the association of fat intake with excess weight gain or obesity (Summerbell et al., 2009). A few have revealed that not everyone with a high fat intake will become overweight or obese (Pavlou et al., 1989; Wadden et al., 1989; Blundell et al., 2005), and this could be attributed to factors other than nutrient intake such as an individual’s susceptibility and rare genetic factors (Farooqi et al., 1999). Some of these factors were investigated in men who routinely consumed a high-fat diet. The authors reported that those with a higher BMI experienced lower levels of satiety, increased desire for food and pleasure from eating, and behavioural variations such as a tendency to consume larger meals and more energy dense palatable meals, as well as snacking more frequently (Blundell et al., 2005). This is in accordance with previous studies that explained the physiological mechanisms by which fat consumption could lead to greater body fat, mediated by its weak satiating power, and weaker physiological regulation of fat intake compared with carbohydrate intake (Stubbs & Whybrow, 2004; Drewnowski, 1998). For example, one study showed that in women, but not in men, high-fat food groups were a significant predictor of weight gain (Schlutz et al.,2002), whereas an epidemiologic follow-up survey indicated that fat intake as a percentage of energy did not have a significant effect on weight change in both men and women (Kant et al.,1995).

Although many authors are hesitant in inferring associations between dietary fat and body weight due to limitations and biased underreporting in epidemiological studies (Willet, 1998; Bray & Popkin, 1998; Seidell, 1998), several long term studies have reported that low fat dietary interventions showed modest to significant weight loss. The success of these low fat diets has been attributed to the fact that they result in a decrease in total energy intake of the diet (Astrup et al., 2008; Howard et al., 2006).

In the person's diet, the percentage of carbohydrate tends to be inversely proportional to fat intake, considering that protein ingestion is usually small and has been shown to be relatively consistent (Astrup & Raben, 1995; Benton, 2005). The effects of carbohydrate on weight control and appetite differ with the type of carbohydrate ingested, which is simple versus complex, or liquid versus solid (Colditz et al., 1990; Ludwig, 1999; Saris et al., 2000; Di Meglio & Mattes, 2000). Many studies have shown an inverse association between the intake of high fibre complex carbohydrates and body weight and/or body fat (Howarth et al., 2001; Slavin, 2005). Intervention studies also showed that a high fibre diet that includes whole grain cereals, fruits, and vegetables may assist in losing weight (Howarth et al., 2001; Liu et al., 2003). These beneficial effects of complex carbohydrates could be due to many factors, most importantly their ability to increase satiety and thus reduce the intake of foods that are energy-dense and high in fat (Skidmore, 2007). This effect may be related to the incomplete digestion and absorption of energy from this type of carbohydrate (Pareira & Ludwig, 2001). In addition, complex carbohydrates were found to reduce postprandial glucose and insulin responses and affect cholecystokinin, the gut hormone involved in appetite regulation (Frost et al., 2003). On the other hand, scientists have suggested that the ingestion of refined carbohydrates may have an effect on serotonin metabolism and stimulate craving, low mood, and overeating (Wurtman & Wurtman, 1984).

The most satiating of all the macronutrients is protein, and when preloads of protein are ingested, both appetite and successive energy intake are equally reduced (Lejeune et al., 2005; Bowen et al., 2006). However, cohort studies showed no significant associations between protein intake and subsequent weight change in adults (Branca et al., 2007b). There are no available data on the relative impact of consuming protein from either animal or vegetable origin on body weight (Branca et al., 2007b).

Energy dense foods: fats, oils and sugars

Nutrient intake is manipulated by choice of foods, and in recent years, researchers' interest has shifted to the energy density of the diet, i.e., the energy content per unit weight of foods. Short-term experimental studies have consistently shown that covert increases in the energy density of the diet lead to increases in spontaneous and passive energy intake (Stubbs et al., 2000; Bell & Rolls, 2001; Skidmore, 2007). Physiological studies have shown that individuals are unable to recognize foods that are energy-dense, and thus are incapable of balancing them off over the short-term. Thus, regular ingestion of large amounts of these foods would pave the way to the accumulation of adipose tissue over time (Prentice & Jebb 2003; Stubbs et al., 1995a, 1995b).

In a nutrition transition, the consumption of foods high in fats and sugars is increasing throughout the developing world. The diet is becoming increasingly energy-dense and sweeter, and high fibre foods are being replaced by processed versions (Popkin, 2006; Sibai et al., 2010).

This shift could be attributed to the nutrition transition bringing along cheap processed foods (Drewnowski, 2003; Misra & Khurana, 2009). Studies carried out to examine the relationship between energy density and the cost of diets reported that more energy-dense diets were associated with higher consumption of refined grains, fats, sugars and sweets, i.e. food items that cost less per unit energy in most countries, and with lower consumption of fruit and vegetables, i.e. food items that tend to cost more per unit energy in most countries (Drewnowski & Darmon, 2005; Darmon et al., 2004; Drewnowski & Darmon, 2005; Drewnowski, 2003).

Of main concern in the nutrition transition is the intake of sugar-sweetened drinks whereby evidence from cross-sectional and cohort studies (Malik et al., 2006) suggests a significant positive relationship with overweight and obesity in children, adolescents and adults (Vartanian et al., 2007; Malik et al., 2009; Hu & Malik, 2010). Indeed, intervention studies have shown that a reduction in the intake of these drinks in children and adolescents has led to weight loss (Malik et al., 2006).

Interestingly, a recent longitudinal study has shown that even beverages that are 100 percent fruit juice are as high in sugar and calories as sugary sodas and soft drinks. Among male and female participants who were tracked for up to 20 years, those who increased their intake of fruit juice gained more weight over time than those who did not (Mozaffarian et al., 2011).

In the US population, the consumption of sugar-sweetened soft drinks has increased in parallel with the obesity epidemic, and Europe is known to represent 31% of the total world soft drink consumption (Bes-Rastrollo et al., 2006). In Lebanon, research on consumption of sugar sweetened drinks including soft drinks is very rare, if not negligible. Nevertheless, one global school based student health survey carried out by the ministry of health reported that 33% of students in grades 7-9 drink carbonated soft drinks two or more times per day (Abi Haidar et al, 2011).

In general, food consumption surveys showed an increasing trend in energy consumption from fats, particularly oils, in several MENA countries such as Saudi Arabia (38%) and Egypt (>30%) (Hassan et al, 2006). Similarly, high sugar intakes were also noted in Lebanon, Jordan, Egypt , and Iraq, accounting for up to 14% of total energy, a value exceeding the 10% intake recommended by the World Health organization (Nasreddine et al., 2006; FAO, 2003; WHO, 2003).

Physical Activity

As a major component of total energy expenditure, daily physical activity levels have a direct impact on energy balance, and consequently on both body weight and body composition (Miles, 2007; World Health Organization, 2007c). Researchers support the hypothesis that, in view of the reported decrease in energy intake that has taken place in certain populations at the same time as an increase in the prevalence of obesity, increased levels of sedentary behaviour and decreased levels of physical activity are the primary cause of obesity (Foster & Lunn, 2007; Miles, 2007).

The amount of physical activity required to prevent weight gain is likely to differ between populations, and also between life stages of individuals (Saris et al., 2003). In western populations, it has been estimated that on average, an extra 418.4 kJ per day must be expended to reinstate energy balance and diminish weight gain (Hill et al., 2003). The American College of Sports Medicine states in its position stand paper that moderate intensity physical activity of 150-250 min/week with an energy expenditure of approximately 5016 to 8360 kJ/week seems enough to prevent weight gain greater than 3% in most adults (Donnelly et al., 2009).

Nonetheless, it is evident that physical activity at its various levels, and in any population, has benefits throughout the life course, from childhood when it is the time to encourage healthy habits that would prevent weight gain and diminish later risks of chronic diseases (Brage et al., 2004; Ekelund et al., 2006; Andersen et al., 2006), to adulthood when the gradual loss in muscle mass and strength that normally occurs with ageing could be fairly counteracted, thus improving functional activity all the way into the elderly years (Hardman & Stensel, 2009; Wilkes & Rennie, 2009). Thus, benefits of physical activity are apparent even for men and women who had years of sedentary lifestyle at early adulthood but became physically active as older adults (Blair et al., 1995; Blair, 2007).

The major role of physical activity extends beyond maintaining a healthy weight; it improves social, cognitive, and emotional well-being among all age groups (Department of Health-UK, 2004; World Health Organization, 2004), and enhances physical function and health in older adults (Taylor et al., 2004). Consequently, and due to its major public health impact, physical activity should be initiated in childhood, continued through early adulthood and maintained into old age for as long as possible. The Global Strategy on Diet, Physical Activity and Health (World Health Organization, 2004) states that individuals should engage in different levels of physical activity throughout their life; different types and amounts are required for different health outcomes.

The UK department of health (Miles, 2007), the US health organizations (Haskell et al., 2007) and the World Health Organization (World Health Organization, 2004) advocate 45–

60 minutes of moderate intensity physical activity a day to prevent obesity, and at least 30 minutes of moderate-intensity physical activity on most days of the week to reduce the risk of cardiovascular diseases, diabetes, breast cancer and colon cancer.

Numerous studies have also examined and demonstrated the relation between lifestyle factors including dietary quality, physical activity, smoking, and alcohol consumption on body composition and central obesity (Samaras et al., 1999; Shimokata et al., 1989; Fogli-Cawley et al., 2006). Findings from a large population based cohort of women and men free of cardiovascular disease showed that a diet consistent with recommended dietary guidelines and enhanced physical activity was associated with lower volumes of subcutaneous and visceral adipose tissue in both sexes (Molenaar et al., 2009). These findings are comparable to those from other large and cross-sectional studies that demonstrated a considerable decrease in waist circumference occurring with changes in a combination of lifestyle factors (Koh-Banerjee et al., 2003; Samaras et al., 1999). Researchers have also shown that Cardio-respiratory fitness (CRF) accomplished through regular exercise is associated with a reduction in abdominal obesity, in particular visceral fat, independent of any change in BMI in both men and women (Mourier et al., 1997; Ross et al., 2000; Ross & Katzmarzyk, 2003; Irwin et al., 2003).

Physical activity, whether in lifestyle forms or structured programs, is affected by many determinants including household, demographic and socioeconomic factors (Fogelholm et al., 2000; Fogelholm & Kukkonen-Harhula, 2000). Studies reported that young adults in home environments with sedentary recreational activities such as television viewing are more prone to overweight and obesity, particularly if TV viewing is for 3 or more hours per day (Giles-Corti et al., 2003). Television watching is reported to be the social activity of the less educated and the poor as it requires minimal monetary resources and originality (Catenacci et al., 2009).

Similarly, studies reported that subjects spending more than 35 hours a week of their leisure time sitting down were one and a half times more likely to be obese than those who spent less than 15 hours per week sitting down (Martínez-González et al., 1999). Those in deskbound occupations with an inactive work environment and who also have a sedentary lifestyle are at particular risk of becoming overweight or obese (Giles-Corti et al., 2003).

1.4 Obesity Indicators

1.4.1 Body Mass Index (BMI)

Obesity is a concept that refers to excessive fatness, a systemic process of fat accumulation and abundance of adipose tissue (Bjorntorp, 2002; Bray et al., 1998). The current view of fatness in the medical literature is that fat collectively constitutes an endocrine organ that secretes leptin which damages the cardiovascular system, and resistin which causes insulin resistance and Type 2 diabetes (Trayhurn and Beattie, 2001). Obesity is now recognized as a chronic disease which brings a multitude of symptoms with physical, psychological, social and medical consequences (Lean, 2000); its International Classification of Disease code is E66 (Bray et al., 1998).

To date, fatness has almost universally been measured in population groups using body mass index (BMI), originating from Quetelet's 'average man' (Garrow & Webster, 1985), which is calculated using weight in kilograms divided by height in meters squared (kg/m^2) (National Institutes of Health & National Heart, Lung, and Blood Institute, 2000). BMI is used in epidemiologic surveys to track change in the overall incidence and prevalence of obesity, by identifying the proportion of people who have an excess storage of body fat. It classifies adults into underweight, overweight and obese according to sex and age independent of cut-off points (WHO, 1995). Current clinical guidelines recommend BMI cut-off points of 25 kg/m^2 and 30 kg/m^2 to define overweight and obesity respectively. Obesity can further be subdivided based on subclasses of BMI (Table 1.2), and extreme obesity is defined as a BMI greater than 40 kg/m^2 (WHO, 2006; WHO, 2004).

Table 1.2 The International Classification of adult underweight, overweight and obesity according to BMI

Classification	BMI(kg/m^2)	
	Principal cut-off points	**Additional cut-off points**
Underweight	**<18.50**	**<18.50**
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
Ideal range	**18.50 - 24.99**	**18.50 - 22.99**
		23.00 - 24.99
Overweight	**≥25.00**	**≥25.00**
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99
Obese	**≥30.00**	**≥30.00**
Obese class I	30.00 - 34-99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

Source: Adapted from the World Health Organization (WHO, 2004)

Since BMI does not measure body fat directly but is rather calculated from an individual's weight that includes both muscle and fat, it may not correspond to the same degree of fatness in different populations. However, research has shown that it effectively captures adiposity in the general population, and correlates fairly strongly with body fatness (Mei et al., 2002; Garrow and Webster, 1985) even though this correlation might vary by gender, ethnicity, and age (Gallagher et al., 1996).

For instance, the correlation between BMI and body fatness is stronger in young and middle aged adults than it is in older adults (Willet et al., 1999; Villareal et al., 2005). At the same BMI, women tend to have more body fat than men; on the other hand, both athletic men and women may have an excess body weight due to increased muscle mass rather than fat mass, a body form known as hypermuscular obesity (Centres for Disease Control and Prevention, 2011).

Non Caucasians populations tend to have a different correlation between BMI and body fat compared with Caucasian populations (Jackson et al., 2002; He et al., 2001), as for a similar BMI, visceral fat mass is higher for Asians (Raji et al., 2001; Banerji et al., 1997) and lower for African-Americans compared with Caucasians (Conway et al., 1995; Hoffman DJ et al., 2005). Based on body fat equivalence and comorbid disease risk, BMI cut-off points of 23Kg/m^2 and 27.5Kg/m^2 for overweight and obesity respectively have been recommended for public health action among the Asian population (WHO Expert Consultation, 2004).

Despite these variations, international health organizations agree that BMI is a simple and inexpensive tool that provides a reasonable approximation of adiposity at the population level, and estimation of the relative risk of disease in most people (Glasgow, 1995). The World Health Organization uses the principal BMI cut-off points for surveillance purposes, and has developed further additional cut-off points for reporting purposes to facilitate international comparisons between countries (Table 1.2 - WHO expert consultation, 2004). The BMI ranges are based on the relationship between body weight, morbidity, and mortality (World Health Organization, 1995).

1.4.2 Body Composition

Waist circumference

In epidemiological studies, age, sex, and ethnic background all have to be taken into consideration, particularly when determining the health risk caused by the amount of body fat (Kok et al., 2004). Obesity is a heterogeneous condition with individual differences in the pattern of adipose tissue deposition (Goodpaster, 2005) and regional body fat distribution (Prentice & Jebb, 2001). Abdominal obesity is a known determinant, independent of total body fat, of metabolic abnormalities (Walton et al, 1995). Intra-abdominal obesity or visceral fat has been strongly associated with insulin resistance (Reaven, 1988; Pouliet, 1994; Wannamethee et al., 2005) and numerous studies have shown that the risk of various metabolic disorders, as well as death, is increased in people with abdominal obesity, even when BMI is not markedly increased (National Institutes of Health & National Heart, Lung, and Blood Institute, 2000).

As shown in Table 1.3, disease risk is increased at the increased waist circumference cut-off point of 102 cm and 88 cm for at a normal BMI of 18.5-24.9, and at the substantially increased metabolic complications cut-off of 94 cm and 80 cm at a BMI of 25-29.9, for men and women respectively.

Total abdominal fat has been described as the sum of the fat or adipose tissue present in three compartments of the body's abdominal region: subcutaneous, visceral and retroperitoneal. It is most accurately measured by magnetic resonance imaging or computed tomography (CT), methods that are rather expensive and inaccessible for large epidemiological studies and routine clinical use (Onat et al., 2004). Alternatively, adult sex specific cut-off points for waist circumference and waist to hip ratio have been suggested as easier to perform anthropometric indices which can be used as indicators of abdominal obesity and predictors of metabolic disturbances and disease risk (Folsom et al., 2000; Snijder et al., 2006). A waist to hip ratio (WHR) of 0.95 or greater in men or 0.8 or greater in women is indicative of android obesity and increased risk for obesity-related diseases (National Institutes of Health & National Heart, Lung, and Blood Institute, 2000). Concerning waist circumference, for both men and women respectively, levels greater or equal to 94 cm and greater or equal to 80 cm indicate increased risk or alerting zone, and levels at 102 cm and 88 cm indicate greatly increased risk or action zone, (World Health Organization, 2000; Lean et al., 1995).

These cut-off values for waist circumference were initially based on replacing the classification of overweight (BMI >= 25Kg/m^2) in combination with WHR>=0.95 in men and >=0.80 in women for increased risk, and on classification of obesity (BMI >=30 in combination with high WHR for greatly increased risk (National Institute for Clinical Excellence, 2006). More recently, the International Diabetes Federation (IDF) further suggested that ethnic-specific cut-off points for waist circumference as certain disease risks, mainly associated with the metabolic syndrome, are evident at different levels of adiposity in different ethnic groups (Deurenberg et al., 2003). The suggested values for eastern Mediterranean and Middle East populations are the same as those for Europoids: WC >=94cm in men and >= 80 cm in women (Zimmet et al., 2005). However, since South Asian and Chinese males are at higher risk for metabolic diseases at a lower level of waist circumference, their cut-off point was set at 90 cm, whereas Japanese women have a higher waist circumference threshold value of 90cm compared with their counterparts of a different race (Zimmet et al., 2005).

Many studies have shown that waist circumference is a better predictor of total abdominal fat than the Waist to Hip Ratio (WHR) (Wang et al., 2005) since it was found to be more strongly correlated with visceral fat (Onat et al., 2004). Nevertheless, several scientists report that different indices may be appropriate in different circumstances. For example, waist-to-hip ratio may be the most accurate predictor of risk of myocardial infarction, and waist circumference may be the most accurate predictor of risk of type 2 diabetes (Yusuf et al., 2005).

Table 1.3 Combining body mass index (BMI) and waist measurement to classify disease risks

			Waist circumference (cm)	
Classification	**BMI (kg/m^2)**			
		Men	94-102	≥ 102
		Women	80-88	≥ 88
Underweight	< 18.5		–	
Healthy weight	18.5–24.9		–	Increased
Overweight	25–29.9		Increased	High
Obesity	≥ 30		High	Very high

Source: Adapted from the National Institute of Health and Clinical Excellence (NICE), Nov2007

Percent Body Fat

The total amount of body fat, and its distribution and location in the body, can have adverse effects on health. There is a consensus in the medical literature that excess body fat causes morbidity and mortality (Pi-Sunyer et al., 2007); both total body fat (TBF) and percent body fat (PBF) are used as measures of obesity and related metabolic disturbances. Body fat is defined as the percentage of total body mass or percent body fat (PBF), and a variety of methods exist for its assessment, cadaver studies being the only direct method (Lee & Neiman, 2007). In epidemiological studies, only a few procedures are appropriate and these include bioelectrical impedance technique (Lukaski, 1987; Segal et al*.,* 1988), anthropometry such as skinfold thickness measurements (Durnin & Womersley, 1974; Pollock et al., 1975; Jackson & Pollock, 1978; Slaughter et al*.,* 1988; Deurenberg et al*.,* 1990) or weight-height indices (Womersley, 1977; Norgan & Ferro-Luzzi, 1982; Garrow & Webster, 1985).

The most widely used inexpensive and easy to perform indirect method is measurement of skinfolds, which is the thickness of a double fold of skin and compressed subcutaneous tissue. When carried out correctly by well trained professionals, skinfold measurement can give body composition estimates that correlate well with those derived by other more expensive direct methods such as hydrostatic weighing (Lee & Neiman, 2007).

Cadaver analysis studies on the relationship of external to internal adipose tissue showed that each kilogram of subcutaneous adipose tissue is associated with approximately 200 grams of internal adipose tissue, and that skinfolds are significantly correlated with total adiposity. Due to differences in body composition between males and females, the age-related increase in body fat mass, and the decrease in fat-free mass (Lee & Nieman, 2007; Prentice & Jebb , 2001), the relationship between percent body fat (PBF or %BF) and BMI is sex- and age-dependent (Lee & Nieman, 2007). In adult men with an average weight, the percentage body fat is in the order of 15-20%, whereas in women, this percentage is higher and in the range of 25-30% (Seidell & Flegal, 1997). Reference cut-off points of percent body fat greater or equal to 25% in men and greater or equal to 32% in women are considered unhealthy (Lee & Nieman, 2007).

In practice, people or populations are usually not classified on the basis of their body fat percentage but rather on the basis of their BMI; nevertheless, previous and current research has revealed that metabolically obese normal-weight persons exist (Ruderman et al., 1998; Poirier, 2007). Thus obesity prevention and management interventions should include a variety of anthropometric measurements such as body mass index, as well as total fat and body fat distribution (Poirier, 2008).

1.4.3 Anthropometric considerations in older adults

Ageing is, more frequently than rarely, accompanied by a tendency for gradual weight increase (Zamboni et al., 2008). It is well documented that in modern sedentary populations, there is now a pronounced increase in BMI with age in most individuals (Grundy, 1998**;** Prentice & Jebb, 2001). However, this weight gain is not marked by more muscle mass in most cases. In fact as adults age, fat-free mass decreases, and fat mass increases and is redistributed in the abdominal area (Pavlou et al., 1985; Whately et al., 1994; Carmelli et al., 1991; Svendsen et al., 1995). This change in body composition is accentuated after middle age in both genders and more so during menopause in women (Prentice & Jebb, 2001). Consequently, BMI has its limitations as it may fail to detect the transformation of lean mass to fat tissue, prompting several suppositions for the interpretation of anthropometric data where fat distribution may be more important than total body fat in assessing disease risk particularly in older adults (Zamboni et al., 2005).

Losses in height of approximately 3 cm in men and 5 cm in women between the ages of 30 and 70 years occur as the result of vertebral compression (Sorkin et al., 1999). This combination of excess body fat and reduced skeletal muscle mass and/or strength has been recently termed sarcopenic obesity (Gallagher et al., 2000; Doherty, 2001; Zamboni et al., 2008; Baumgartner, 2000). Sarcopenia occurs in both men and women; however, the rate of decline in muscle mass and strength is greater among men (Thomas, 2007). Data from the Rosetta Study show that older adults have on average more fat than younger adults at any given BMI (Gallagher et al., 1996). When young adults gain weight, extra muscle mass may develop to support the increased adipose tissue weight (Forbes, 1991), but because aging itself is usually accompanied by loss of muscle mass, body fat probably accounts for most of the weight gained with aging (Grundy, 1998). Also, a similar skinfold thickness in young and older persons represents a higher percentage of body fat in older persons (Deurenberg et al., 1989).

As previously mentioned, the relationship between BMI and percentage of body fat has been shown to be dependent on age (Jackson et al., 2002);therefore, prediction equations to estimate body composition from the sex and age independent BMI cut-off points will generally underestimate the amount of body fat in the elderly (Deurenberg et al., 1989). This has led researchers to recommend the use of age-specific prediction equations to estimate body fatness in older adults (Visser et al., 1994; Stanforth et al., 2004).

The international guidelines for identification and treatment of obesity have not given any specific guidance about how to apply anthropometric or imaging data thresholds to define obesity in the elderly (National Institutes of Health & National Heart, Lung, and Blood Institute, 2000; World Health Organization, 2011b).

Current guidelines suggest using BMI at all ages to define obesity, and recommend the same cut-off values of BMI in the elderly as in younger adults (National Institutes of Health & National Heart, Lung, and Blood Institute, 2000; World Health Organization, 2011b). Although BMI has been reported to be strongly associated with cardiovascular disease risk factors in men aged 60-79 years (Wannamethee et al., 2004), other studies argue that measures of body fat such as waist circumference and percent body fat may potentially be more sensitive indicators of disease risk in older adults (Pouliet, 1994; Reaven, 1988).

Waist circumference has been shown in the elderly to be practical to assess and strongly related to both visceral and total fat, as evaluated by Computed tomography (Woo et al., 2002). In older persons, excess adipose tissue, whether central or total, is more strongly associated with physical dysfunction than low muscle mass (Visser et al., 1998; Zoico et al., 2004). Moreover, it is reported that body fat percentage is generally more closely correlated with both BMI or waist circumference than any other common obesity diagnostic tests in the elderly (Cockcroft, 1994);therefore, elevated waist circumference alone, or together with BMI, may be used to better describe obesity as a determinant of related health risk in the elderly (National Institutes of Health & National Heart, Lung, and Blood Institute, 2000; World Health Organization, 2011b) as presented in Table 2.2

In summary, and based on the research findings presented in this chapter, it appears that the pattern of how the prevalence of obesity has increased over the last few decades differs between countries and among population subgroups within these countries (Rokholm et al., 2010). This variability is greatest in developing countries experiencing the nutrition transition and is a result, in part, of rapid urbanization, modernization and affluence, which impact on food availability, dietary habits and lifestyles (Popkin, 2010; Popkin et al., 2011).

In addition to genetic and environmental factors that are known to be proximate determinants of body weight, social characteristics are gaining attention as elements of influence on diet and physical activity practices (Bleich et al., 2008; Tzotzas et al., 2010). Although only a few of these characteristics are modifiable, they may offer ways to direct public health resources towards the promotion of effective obesity prevention strategies in specific population groups (Tzotzas et al., 2010; Sobal et al., 2009).

Prevalence rates of obesity in the Lebanese adult population were previously estimated in a national survey (Sibai et al., 2003), and several socio-demographic and dietary factors associated with obesity were examined and reported in the study. However, obesity prevalence rates and associated factors not only vary by country, but also within a country, changing with time through dynamic changes in the society and behavioural patterns of the community. The aim of this thesis is threefold; primarily to identify the current prevalence and potential determinants of obesity in an adult population living in Lebanon (a country in transition), and to report whether, and how, they are different than those recognized in other countries. This thesis rationale, framework and objectives are described in the next chapter.

Chapter 2: Study Rationale and Objectives

2.1 Study Rationale

Preliminary research looking into the prevalence of obesity and its determinants in Lebanon first commenced with small scale surveys conducted on selected small samples of population groups and restricted to specific regions (Baba, 1992). The first attempt to relate lifestyle to the incidence of obesity was carried out on a sample of adult men and women from both rural and urban areas (Baba, 1994), whereby 42% of urban women were found to be obese, and relatively lower obesity rates among both urban and rural men (9% and 8% respectively) were reported. It was also observed that 42% of rural women were overweight but none were obese (Baba, 1994).

The first national study to estimate the occurrence of obesity in children, adolescents and adults in Lebanon was carried out in 1997 (Sibai et al., 2003). Findings showed high prevalence rates in the adult population in both men and women (14% and 19% respectively) with age, low education, non-smoking and family history shown to be significantly associated with obesity. In spite of these results, obesity related advocacy projects focusing on nutrition and physical activity remain scarce in Lebanon and lack the essential support of governmental policies. Like in many parts of the world, the accelerated nutrition transition in the country, characterized by a shift to the intake of energy dense foods and physical inactivity, may be endorsing a rise in obesity and other non-communicable diseases.

Indeed, elevated levels of metabolic syndrome and abdominal obesity were indicated among underprivileged adults of the Lebanese population (Sibai et al., 2007).

Within this context, another nation-wide study was planned in response to the growing need for country-level trends on a variety of health measures, notably obesity, chronic medical conditions, and behavioural risk factors.

2.2 Thesis Framework

This thesis is the integral nutrition component of a national cross-sectional household survey entitled “Comparison of estimates based on cell phone interviews with face to face interviews” that aimed to determine the prevalence of non-communicable diseases, including hypertension, cardiovascular diseases, diabetes and obesity, and their risk factors in Lebanon, as well as to compare outcomes of cell phone interviews with face-to face interviews.

For the purpose of this thesis, the national cross-sectional study (including its nutrition component) will be referred to as the general study, and its nutrition component, i.e. the research outcomes that are presented in this thesis, as the nutrition project. Further details on the development of the national study, its nutrition component, and the degree of participation of the investigator of this thesis in its development and implementation are described in Appendix A.

The general study followed the WHO STEP-wise approach to surveillance of non-communicable disease risk factors. It is a simple, standardized method for collecting, analysing and disseminating data for chronic disease risk factors in WHO member countries. It is satisfactorily flexible to allow each country to expand on the core variables and risk factors, and to incorporate optional modules related to local or regional interest. Core topics covered by most surveys are demographics, health status, and health behaviour (WHO, 2005) providing data on socioeconomic risk factors as well as nutritional, lifestyle, and metabolic elements.

The WHO-STEPS is a sequential process, starting with gathering information on key risk factors by using a questionnaire (Step 1), then moving to physical measurements (Step 2) and only then recommending the collection of blood samples for biochemical assessment (WHO, 2005).

The general study consisted of recruiting two age groups: children and adolescents aged 5- 17 years and adults aged 18 years and older, from randomly selected households in the different Governates of Lebanon, excluding pregnant and lactating women as well as subjects with mental disabilities and learning difficulties. Information was obtained through face to face interviews with participating subjects and by proxy (as applicable) from children 5-12 years, about socio-demographic characteristics, tobacco and alcohol use, eating habits, reported diseases, general health status and health seeking behaviour. A 24 hour recall was collected from participating subjects and physical activity patterns were assessed using the short form of the “International Physical Activity Questionnaire” **(IPAQ**) in subjects of 15 years of age and above. Physical activity in children less than 15 years of age was assessed through questions on engagement of physical activity at school and at home. Blood pressure and anthropometric measurements (weight, height, waist circumference, and skinfold thickness) were obtained for all participants, whereas blood pressure was measured only in adults. During the face to face interview, cell phone or land line numbers were recorded for participants aged 18 years and older, and a random sample of 500 individuals were dialled from the various Governates for a later stage of collecting blood samples. The overall conduct of the general study as well as that of this nutrition project is summarized in Figure 2.1.

For this thesis, the nutrition project, the researcher opted to zoom into the adult population so as to provide an in depth examination of obesity and its determinants, and consequently present outcomes and recommendations that are specific to this segment of the Lebanese population. Whereas the general study recruited adults that are greater or equal to 18 years of age, only adults who are greater or equal to twenty years of age were included in the data analysis for this thesis nutrition project. The rationale behind this decision is described in section 3.2 (Thesis Study Population). Furthermore, and as shown in **Figure 2.1**, blood pressure measurements as well as biochemical measurements were not included as analysis parameters.

2.3 Thesis Objectives

This thesis reports on the prevalence of obesity among Lebanese adults ≥ 20 years, and examines factors associated with adult obesity in Lebanon. Its specific objectives were to:

1. Estimate the current prevalence of adult obesity in Lebanon and, compared with published data, assess a) whether the prevalence has changed over the last two decades in Lebanon, and b) if and how the current prevalence of adult obesity in Lebanon compares with that in other countries.

2. Identify the most important demographic, socioeconomic, dietary, and physical activity associates of adult obesity in Lebanon.

3. Provide recommendations to help inform the development of future research and effective culturally sensitive public health programs which aim to prevent and manage obesity in Lebanon.

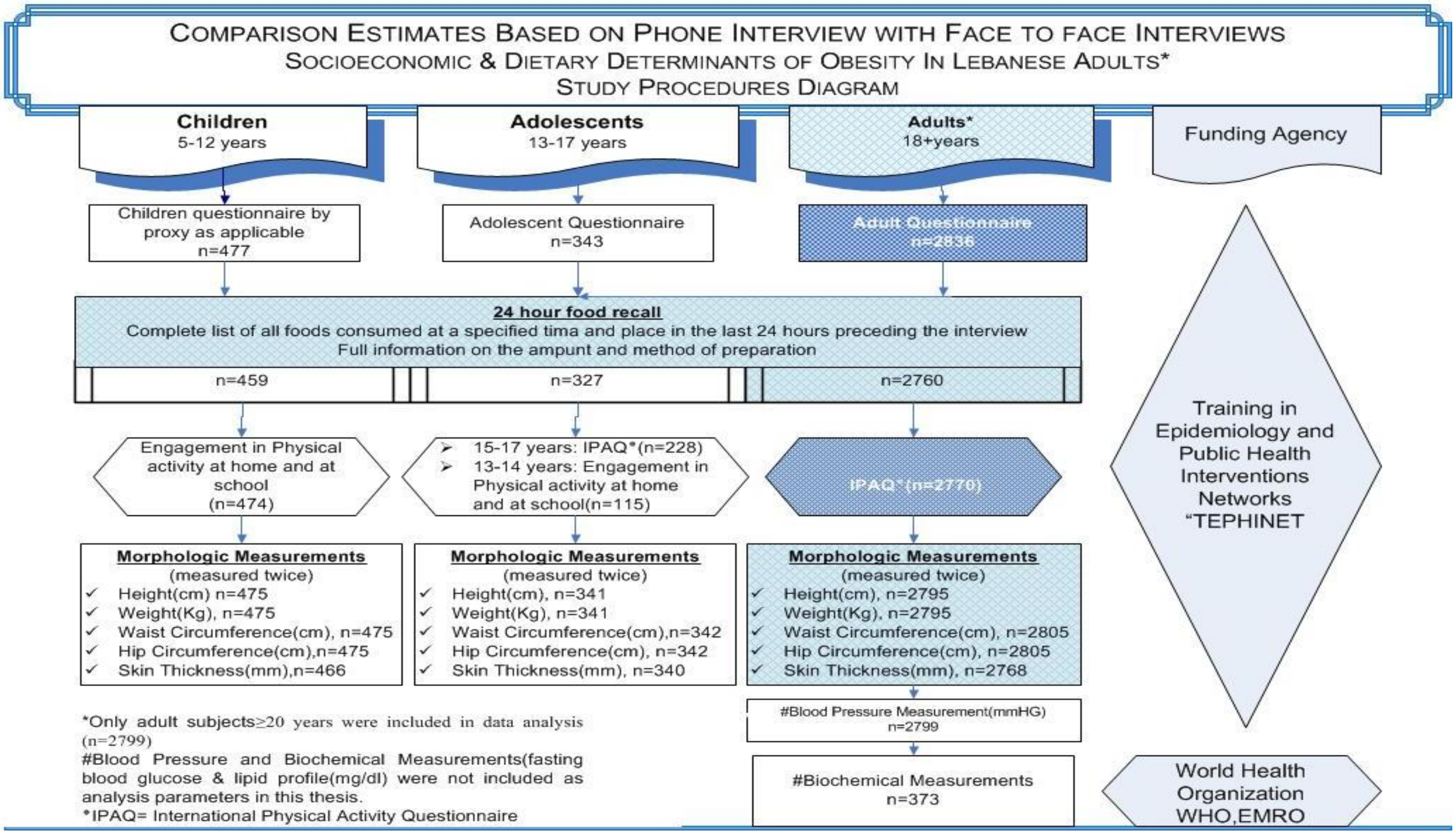


Figure 2.1 Study Procedures

Chapter 3: Methods

3.1 Study Design

This study is a cross-sectional investigation of the prevalence of obesity in Lebanese adults and the related demographic, socioeconomic, and lifestyle factors. The study uses the Body Mass Index (BMI) as the main outcome variable, and overweight and obesity are defined according to the World Health Organization's standardized criteria. What follows is a detailed description of the study's participants and data collection.

3.1.1 Ethics, Approval and Funding

The general study protocol, including its integrated nutrition component, has been approved by the Institutional Review Board (IRB) of the American University of Beirut (AUB). (Appendix B is a copy of the approval letter).

The study was funded by the World Health Organization, EMRO as well as "Training in Epidemiology and Public Health Interventions Networks (TEPHINET)", a non-profit organization that aims at strengthening international public health capacity. The Centre for Disease Control and Prevention (CDC), Atlanta provided logistic support throughout the project.

3.1.2 Recruitment of Data Collectors / Interviewers

The recruitment process of interviewers for the face-to-face data collection started as soon as the IRB approval was obtained and funding was received for the general study and its integral nutrition component. Several interviews were conducted with potential candidates before the final selection of the team members. The researcher opted to recruit graduates either with a bachelor's or a master's degree in nutrition, dietetics and related sciences for two reasons. The first is that these interviewers will be completing the general study interview questionnaires in which the nutrition project-related modules are embedded; the second and more specific reason is that the questionnaires contained a 24-hour recall for dietary assessment. The interviewing process took almost one month, and the recruitment of 8 interviewers was finalized by end of March 2008. Three of them hold master's degrees in nutrition.

3.1.3 Data Collection

The survey involved household visits and face-to-face interviews; calling households and inviting potential participants to take part in the study is an approach that ought to be handled in a well-structured and culturally-acceptable manner. For this purpose, local authorities, mainly municipalities and /or stakeholders in the regions where the study was conducted were contacted prior to the scheduled house visit by the interviewer in order to facilitate the field work. A monthly calendar was created with the dates of the visits scheduled for each region, districts and areas to be visited, and a list of the municipalities' phone numbers and names of the current person in charge of the city or village municipality (obtained from the Ministry of Interior Affairs and Municipalities on: www.moim.gov.lb). The initiation process involved calling the head of the municipality to explain the content and the scope of the study, and the need for household visits and face-to-face interviews. The heads of the municipalities were provided with clarifications concerning some of their worries and concerns regarding the types of questions and measurements involved in the survey. Furthermore, those who requested received copies of the questionnaires and the informed consent forms via fax. After obtaining the approval for the visits, the final dates were set, and the team of interviewers proceeded to the designated areas for the household visits.

The team, which consisted of 8 interviewers in addition to the researcher, headed to one region in Lebanon at a time to conduct the interviews. The goal was to maintain close monitoring of field work as well as to acquire the best possible coverage of the target population and high response rates (Koch et al., 2009). Since the interviewer has a great potential to affect data quality (Koch et al., 2009), standardization of approach across all interviewers was ensured through intensive training on both the conduct of the questionnaire and anthropometric measurements procedures as described in sections 3.5, 3.5.1, and 3.5.2.

The first stop upon arrival was usually at the municipality, where interviewers introduced themselves, and the researcher, in addition to the appointed field supervisor, requested more details about the geographical and residential distribution of the area. The team inquired about any possible difficulties that might be encountered. Using a map whenever available, pairs of interviewers decided on a trajectory and followed it in order to conduct the face-to-face interviews. The direction was initially random, and then each pair would move on to the next nearest household within the sample cluster. The same process was repeated until all the households in the cluster were covered. In each household they visited, interviewers presented a letter from the researcher indicating their names and role in the survey; this was done for identification, trust, and security purposes (Appendix C is a translated copy of the letter). In certain villages where inhabitants were hesitant to participate in this survey, a member of the municipality police or a local community organization accompanied the pairs of interviewers and introduced them to these selected households.

The identification of participants was carried out using the Kish-Method (WHO, 2005) which allows the interviewers to randomly select participants from the household. The process was conducted in each household according to the following three steps:

1. A roster was prepared with the name, gender, age, educational background, occupation, and marital status of each member in each household. (Appendix D).

2. A pre-assigned table of random numbers was used to select the members to be interviewed. The process, described in the questionnaire (Appendix D), was carried out by referring to the household ID number and the number of eligible members in each household.

3. The selected person was then invited to participate in the study.

One adult ≥18 years was selected in every household, and an informed consent was obtained from all adult participants (appendix E) before the interview was conducted.

Two interviewers were present in each selected household, and the duration of each interview did not exceed one hour. All interviewers were trained to conduct the questionnaire and to carry out anthropometric measurements. To ensure consistency, one member of each pair of interviewers always carried out the measurements throughout the study.

3.2 Thesis Study Population

This PhD thesis, a nutritional integral sub-part of the national study, focuses on demographic, socioeconomic, dietary, and physical activity predictors of obesity in the Lebanese adult population, using body mass index (BMI Kg/m^2) as the primary dependent variable.

The adult population of the general study included participants aged 18 years and older; however, subjects aged 18 to19 years were later excluded, mainly because this thesis examines the prevalence of obesity among Lebanese adults using the WHO cut–off points for the classification of body mass index (BMI Kg/m^2). The recently established WHO child growth standards, based on sex and age specific Z scores, incorporate the 18-19 year old populace within the children and adolescents 5-19 years old category (De Onis et al., 2007). Consequently, to maintain homogeneity of outcome measurement throughout data analysis as well as for comparison purposes with other national studies carried out in Lebanon on adult obesity (Sibai et al., 2003), only participants who are greater or equal to 20 years of age were included for estimating obesity prevalence and its determinants among Lebanese adults.

3.2.1 Sample Size Determination

The present study focuses on obesity measured by body mass index (BMI Kg/m^2) as the main dependent variable. One of the main objectives of this nutrition project was to assess the proportion of the Lebanese adult population who is obese (BMI>= 30 Kg/m2), and to identify the magnitude of change in obesity prevalence that occurred over the last decade. Therefore, the sample size was based on the aforementioned objective and on a previously estimated adult obesity prevalence of 17% (Sibai et al., 2003). Considering a power of 0.8, a confidence interval of 95%, and an error margin of ±1.5, the sample size was determined using the following formula: $\mathbf{n= (Z_{1-}\, \alpha/2)^2\ P\ (1-P)/E^2}$ (Sharon L., 1999), as presented below:

Sample size (n)

$$n = \frac{(1.96)^2\,(0.17)\,(0.83)}{(0.15)^2}$$

$$\mathbf{n=} \frac{(3.8416)\,(0.1411)}{2.25^{-4}}$$

n= 2409

Accounting for a 25 % non-response rate, the final sample size was set at approximately 3011 sampling units randomly selected from the 6 Governates of Lebanon. This large sample size would provide further support to this nutrition project, given that randomization requires a sufficiently large number of sampling units to yield unbiased estimates (Magnani, 1997).

Households constituted the primary sampling units selected randomly based on stratified cluster sampling. The strata are the six Governates in Lebanon, and clusters were selected further at the level of districts, urban and rural areas. Housing units were selected randomly and proportionally according to the size of units in each district or area. Sampling of regions was performed after acquiring the maps (if available) and the number of population in all the regions using electoral lists obtained from the Ministry of Interior Affairs and Municipalities (www.moim.gov.lb).

3.2.2 Thesis Sample: a Nationally Representative Sample of Adults ≥ 20 Years of Age

As previously mentioned, only participants ≥ 20 years of age (n=2697) were included for estimating obesity prevalence and its determinants among Lebanese adults. The total sample recruited showed an age and gender distribution proportionate to that of the baseline population, obtained from the national survey of household living conditions (The National Survey of Household Living Conditions-2004, Lebanese Republic Ministry of Social Affairs, Central Administration for Statistics and United Nations Development Program; 2006- Tables (Appendix F), and as presented in Table 3.1 and Table 3.2.) The final sample size is presented in Table 3.3, distributed according to 10-year age groups and gender.

Table 3.1 Age distribution of the study adult sample (≥20 years) compared with the baseline population (≥20 years)

	*Population Lebanon	% population	Study Sample	% sample	Ratio (%Study sample/ %population)
Age					
20-24	372745	15.8	420	15.6	0.99
25-29	298373	12.6	370	13.7	1.08
30-34	275922	11.7	337	12.5	1.07
35-39	256711	10.9	308	11.4	1.05
40-44	249793	10.6	267	9.9	0.93
45-49	193968	8.2	239	8.9	1.08
50-54	165746	7.0	175	6.5	0.93
55-59	137583	5.8	140	5.2	0.89
60-64	126052	5.3	146	5.4	1.01
65-69	112915	4.8	93	3.4	0.71
70-74	83809	3.6	100	3.7	1.04
75-79	49365	2.1	61	2.3	1.10
80-84	26818	1.1	31	1.1	0.97
85+	9342	0.4	10	0.4	1.01
Total	2359142	100	2697	100	

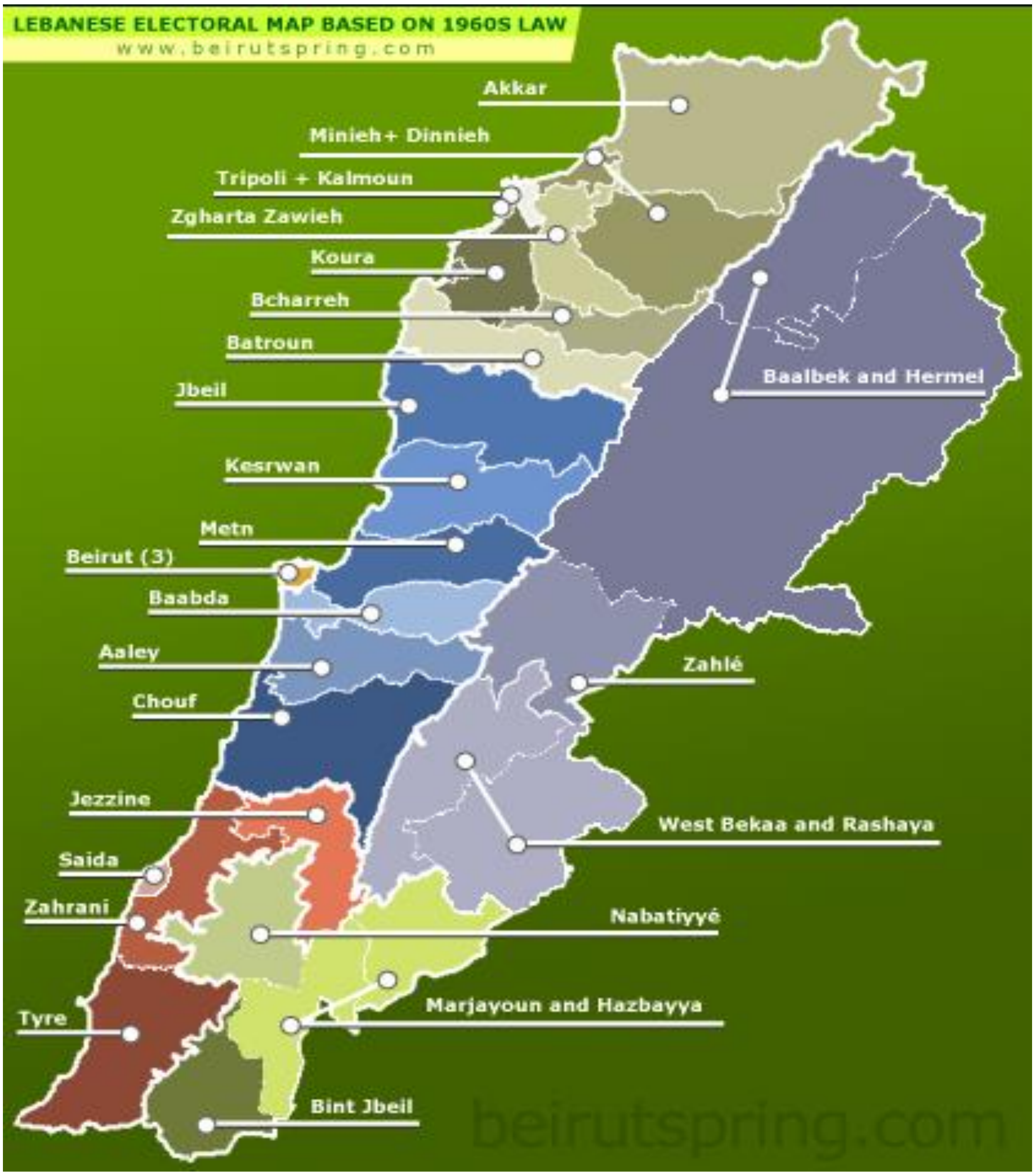
Table 3.2 Distribution of the study adult sample (≥20 years) by gender compared with the baseline population (≥20 years)

	%Population	
Gender	*Baseline (≥20 years)	Study Sample (≥20 years)
Females	51.5	53.7
Males	48.5	46.3
Ratio Females/Males	1.0	1.1

***Data Source:** The National Survey of Household Living Conditions-2004, Lebanese Republic Ministry of Social Affairs, Central Administration for Statistics and United Nations Development Program; 2006.

Table 3.3 Sample size of study population by 10 year age groups and gender (n=2697).

Age group	**Men**	**Women†** **n (%)**	**Total**
20-29	367 (29.5)	423 (29.1)	790 (29.3)
30-39	282 (22.7)	362 (24.9)	644 (23.9)
40-49	218 (17.5)	289 (19.9)	507 (18.8)
50-59	155 (12.5)	160 (11.0)	315 (11.7)
60-69	109 (08.8)	130 (08.9)	239 (08.9)
70+	113 (09.1)	89 (06.1)	202 (07.5)
Total	1244(100)	1453 (100)	2697(100)



The Map of Lebanon

3.3 The Thesis Interview Questionnaire

A comprehensive questionnaire composed in Arabic, the mother tongue language in Lebanon, was used for the adult participants. It is referred to as the "Adult Questionnaire", and it includes questions that were validated and extensively used in many health studies in Lebanon (Sibai et al., 2003), Jordan (Zindah et al., 2008), and Syria (Nasreddine et al., 2009). The Questionnaires used in the general survey are found in **Figure 3.1,** and only those that are shaded in blue were used for the objectives of this thesis.

The "Adult Questionnaire" was based on the "Behavioural Risk Factor Surveillance System" (BRFSS) instrument, a WHO Steps based questionnaire, designed for chronic disease risk factor surveillance activities. The questionnaire was previously used in Jordan in similar studies in the years 2004 and 2007. The BRFSS was initiated in 1984 by the Centres for Disease Control and Prevention to collect state-based prevalence data on risk behaviours and preventive health practices that affect health status (Zindah et al., 2008).

The "Adult Questionnaire" included modules on demographics, household characteristics, smoking, dietary intake, physical activity, and reported diseases. However, modifications were made in the nutrition and physical activity sections, where the nutrition section was changed to include a 24-hour recall and few questions on eating habits, and the Global Physical Activity Questionnaire (GPAQ) was replaced by the short form-International Physical Activity Questionnaire (IPAQ). The rationale which backs up these alterations is presented in sections 3.3.1.1& 3.3.2.1.

Also, the roster used for subject selection within the household as well as the module on household characteristics were adopted from a household questionnaire that was designed collaboratively by the "Centre for population & Health Studies" at the American University of Beirut and the Ministry of Social Affairs in the year 2004 for use in national studies.

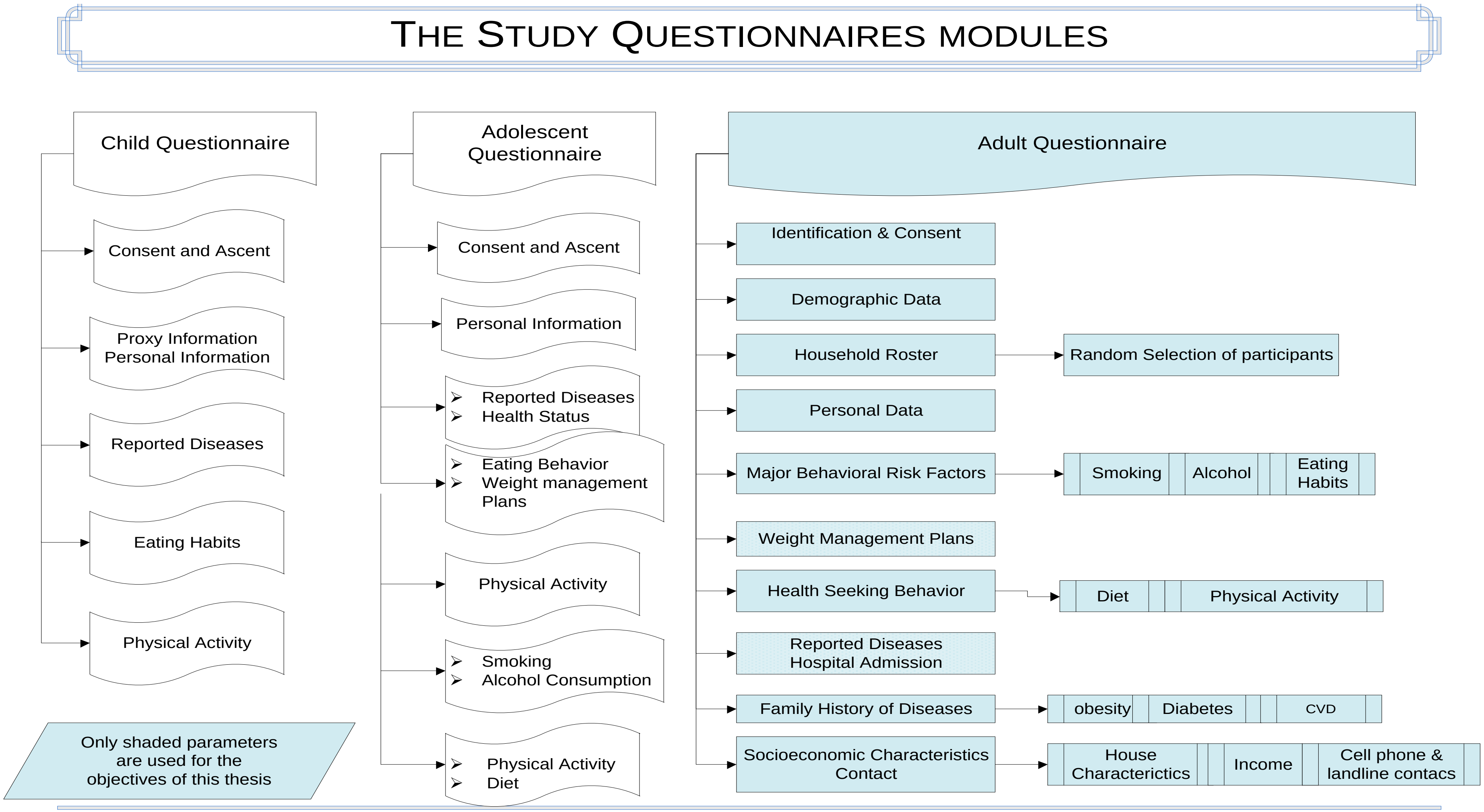


Figure 3.1 The Study Questionnaires Modules

3.3.1 Dietary Intake Assessment Tools

Several dietary assessment techniques have been used to estimate usual food intake. These were categorized into “meal based” daily consumption methods, such as the 24 hour recall and food records, or “list based” recalled average food consumption methods such as the food frequency questionnaires and diet history (Murphy, 2003; Thompson & Subar, 2008).

Each method contains an inherent amount of error, some considerably more than others (Kipins et al., 2003). Yet, they all share a major source of error identified as misreporting, including both under- and over- reporting of food consumed, related to an array of biological and psychosocial factors.

Investigators exploring associations between diet and obesity have revealed a widespread misreporting of energy intake regardless of the dietary assessment method used (Livingstone & Black, 2003; Subar et al., 2003; Fernanda et al., 2006; Mendez et al., 2011); the issue appears to be more challenging in data collected from large nutrition surveys (Garriguet, 2008a; McCrory et al., 2002). Although over-reporting is not as prevalent as underreporting, that is known to possibly occur at a quite higher magnitude; both types of inaccurate reporting should be taken into account when identifying inaccurate energy intake reports (Mendez et al., 2011; McCrory et al., 2002). Research indicates that energy intakes of plausible reporters have stronger associations with the degree of obesity as well as other health problems compared with the energy intake of all reporters (Bailey et al., 2006; Ferrari et al., 2004; Rosell et al., 2003; Garriguet, 2008). In addition, several other studies have found stronger diet-obesity relations, where factors such as fat, sugar, and fibre consumption were highlighted (Mendez et al., 2004; Howarth et al., 2005).

It is noteworthy that both implausible categories were found to be related to individual characteristics (Mendez et al., 2011). Overweight individuals as well as those practicing dietary restraints tend to underreport dietary intake (McCrory et al., 2002; Ferrari et al., 2004; Rennie et al., 2007). Gender differences were also noted where underreporting was more prevalent in women than men (Mendez et al., 2011; Mirmiran et al., 2006; Scagliusi et al., 2006)

Depending on the population studied and dietary assessment method used, underreporting of energy intake would range from 10-88 % (Black et al., 1991). Underreporting was examined in many cross-sectional studies investigating dietary intake. In studies carried out in Iran, Jamaica, and South Africa, underreporting of energy intake was found to range between 30% - 40% in adults of both sexes

(Mirmiran et al., 2006; Mendez et al, 2004); MacIntrye et al., 2001). In developed countries such as Canada and Greece, under-reporting was found to be at the lower range of 10 -12% (Garriguet, 2008; Yannakoulia, 2007).

Proper probing and use of aids during collection of dietary data can improve recall of food intake as well as of eating time and estimation of portion size of the food consumed (Polusna et al., 2009). It is worth noting that the choice of dietary assessment tool to be used for the quantification of food intake in a sample population should be properly considered as it may influence research results (Asbeck et al., 2002). For the current study, two tools were considered for evaluating the mean energy and macronutrient intake of the Lebanese adult population: the 24 hour recall and the semi-quantitative food frequency questionnaire.

The 24 hour Recall

Several researchers consider the 24-hour recall instrument as more objective than both the food frequency questionnaire and food records because its administration does not change usual food intake (Lee & Nieman, 2007; Thompson et al., 2010). Although 24 hour recalls focus on a short period of intake (the preceding 24 hours), they still provide richer details about types of foods and amounts consumed. However, a single 24-hour recall, or even averaging intakes over a period of a few days (by additional days of data collection) to account for day-to-day variability in food intake of free living individuals, does not adequately reflect most frequently eaten foods (Murphy et al., 2003; Dodd et al., 2006). All the same, researchers have proven that a sufficiently large number of 24-hour recalls does provide a valid estimate of the mean energy and nutrient intake when applied to a group of 50 individuals and more (Kipnis et al., 2009; Lee & Nieman, 2007; Magarey, 2003).

In practice, the 24-hour recall method imposes little burden on the respondent in terms of time and literacy required on his/her behalf during the data collection (Lee & Nieman, 2007; Thompson & Subar, 2008); an observable fact that is further reduced when the instrument is implemented by a well-trained interviewer (Thompson et al., 2010) is that a complete recall of a day's food intake can be achieved within a maximum time of 20-30 minutes (Lee & Nieman, 2007).

The Food Frequency Questionnaire

The Food Frequency instrument, designed to assess energy and/or nutrient intake, generally list more than 100-150 individual line items. Respondents are asked to report their usual frequency of consumption of each type of food on the list for a specific period of time: weeks, months or years, depending on the objective of the study (Lee &

Nieman, 2007; Thompson & Subar, 2008). Most commonly used FFQ's are quantitative, and the respondents are additionally asked to specify the habitual serving size of the food item listed as consumed; however, minimal detail is obtained on other characteristics of the foods such as the methods of cooking or the combinations of foods in meals (Thompson & Subar, 2008).

Generally, inaccuracies in the FFQ may result from an inadequate listing of all potential foods, as it is crucial that the foods listed in the instrument be representative of the most common foods consumed by the respondents in the sample (Lee & Nieman, 2007). Inaccuracies may also occur because of errors in reporting frequency of intake, where acquiring true information about foods eaten both as single items and in mixtures is particularly tricky. Habitual portion size estimations of the food consumed can also be inaccurate, mainly because estimation can be difficult for respondents across all assessment methods. However, the cognitive burden is higher in the FFQ where the respondent is asked to estimate an average of probably highly inconsistent portion sizes over a range of eating occasions (Thompson & Subar, 2008).

Moreover, the interview time required to complete the long FFQ list can go up to 60 minutes; this raises concerns about the length of the instrument and its effect on response rate as well as the truthfulness of information reported by the respondent (Thompson & Subar, 2008).

3.3.1.1 Rationale for Use of the 24-hour Recall Instrument for this Study

Considering both the advantages and the disadvantages of the 24-hour recall instrument and the food frequency questionnaire, the researcher decided to use the single interview-administered 24-hour recall method for collecting dietary data for the nutrition project. The following notes support this decision.

1. The single 24-hour recall method is an inexpensive instrument that is often used in epidemiological studies and was consistently implemented over the years in national dietary surveillance.

2. The study is a national cross-sectional one aiming at a large sample size, thus a single 24-hour recall per subject would yield reliable estimates of population groups' mean energy and nutrient intakes.

3. The quality of dietary data collected by the 24-hour recall can be improved by following a standardized procedure.

4. Logistic support for training, assessment, and re-training of interviewers on procedures of the 24-hour recall as well as for quality control of data collected throughout the study was available.

5. Less time is required to possibly attain accurate dietary information with less complex cognitive processes and lower burden on the respondent as compared with the FFQ instrument.

3.3.1.2 Weekdays and Time Sampling for the 24-hour Recall Data Collection

Efforts were made in this study to include weekdays and weekends in the participants' collected 24-hour recalls, and visits were planned to take place Mondays to Saturdays and thus include Sundays as representative days of the weekend. However at times, the assigned days for visiting a cluster were disrupted thus causing an imbalance of the days of the week for dietary data collection. The reasons for this were unexpected circumstances such as delay in receiving approval to visit a certain cluster, the need to carry out a refreshing training session on measurement tools, or the need to calibrate equipment. Furthermore, the design of the study itself, a national cross-sectional study targeting a large sample size, made it not practical to assign specific days of the week for the visits (24-hour recalls collected for balanced weekdays and weekends) due to time constraints.

A central feature of the dietary intake of free- living individuals is variation from day to day overlaid by a basic habitual pattern. Day of the week or season of the year may present contributing factors to daily variation in dietary intake regulated by cultural and environmental factors. For instance in Lebanon, Sunday is the week end day on which all public and private sectors are officially closed; it is time for outings and family gatherings. However, in public sectors Friday is only half a day of work. Also, in certain areas where the majority of the inhabitants are Muslims, Friday is a holiday and family gatherings also take place, which may also affect eating patterns.

Dietary surveys have reported -on average- higher intakes among individuals on weekends than during the week, and thus it was recommended that at least one weekend day should be included in the study in order to reduce error in energy intake (Yunsheng et al., 2009). In many dietary studies, investigators purposefully sample on weekdays and weekends assuming that this division of days represents a valid categorization of behavioural effects (Buzzard, 1998).

This study has been carried out during the months of May 2008 till April 2009, thus allowing the researcher to trace monthly variation in dietary intake and to look at average intakes. On the other hand, days of the week effects on dietary intake could not be completely accounted for in the study due to disproportionate representations of all days of the week in interviews across the sampling units.

3.3.1.3 Implementation of the 24-hour Recall

The 24-hour recall includes a complete list of all foods consumed at a specified time and place, as well as full information on the amount, method of preparation, and amount of oil and fat used for preparation. Therefore, the nutrition module in the source questionnaire which consisted of frequency of intake of fruits and vegetables as well as amount and type of oil added during food preparation was replaced by the 24-hour recall list. At the end of the 24-hour recall list, a question was added as to whether or not the day's intake is typical of the respondent's habitual food consumption. Respondents were asked to indicate the reasons if the answer was no.

A section on eating habits was added to supplement the data. This section included questions on regular intake of meals, snacking, eating out as well as eating while watching TV. These questions were used in a previous survey carried out in Syria in the year 2007 (Nasreddine et al., 2009), and were retested again for this study. Minor modification was done whereby respondents perceived the same denotation for the words "rarely" and "sometimes", and therefore the word "sometimes" was used to indicate either event.

The 24-hour recall instrument for dietary data collection was executed using the "USDA 5 step multiple pass method" as the implementation frame **(Figure 3.2)**, and following standardized detailed interviewing procedures adopted from "Procedures for collecting 24-hour recalls", "A method for training EFNEP Staff and volunteers on collecting 24 hour recalls" downloaded from www.csrees.usda.gov on March, 2008 (Appendix G). A food recall kit (Section. 3.3.1.4-portion size estimation) was used to assist the subjects interviewed in the food intake estimation process. The USDA's Multiple-Pass Method for collecting 24-hour dietary recall was developed in 1999 through research carried out by the US Department of Agriculture (USDA)-Agricultural Research Service (ARS), to enhance and improve the 24-hour recall method (Moshfegh et al., 2008). It is a 5-step dietary interview, as summarized in **Figure 3.2**, and includes multiple passes through the 24-hours of the previous day, during which respondents receive prompts to help them remember and describe foods they consumed (Raper et al., 2004; Moshfegh et al., 2001). An automated version called "What We Eat in America", put in use since January 2002, has been used jointly by the USDA Food Surveys Research Group and the Department of Health and Human Services (DHHS), National Centre for Health Statistics for dietary data collection as part of the continuing National Health and Nutrition Examination Survey (NHANES) (Conway et al., 2004).

Step	Purpose
Quick List	Collect a list of foods and beverages consumed the previous day.
Forgotten Foods	Probe for foods forgotten during the Quick List.
Time & Occasion	Collect time and eating occasion for each food.
Detail Cycle	For each food, collect detailed description, amount, and additions. Review 24-hour day.
Final Probe	Final probe for anything else consumed

Figure 3.2 The 5-Step Multiple-Pass Approach for collecting 24 hour recalls*
*Downloaded from www.ars.usda.gov/Services/docs.htm?docid=7711

In this study, the 24-hour recall was executed following the standardized procedure of the "5 steps Multiple Pass Method" with particular consideration given to factors that might affect the quality of reporting as described in the next section.

3.3.1.4 Special Focus in Implementing the 24-hour Recall

Respondent Reactivity

Respondents reporting their 24-hour recalls might be faced with the challenge of differentiating between what they usually consume and what they ate the previous day, thus reporting foods that were not actually eaten, or on the other hand, omitting foods that they consumed the day before but they do not usually consume (Thompson & Subar, 2008).

Another challenge occurs when the subject interviewed is on a special diet. This is mostly observed in the elderly whereby due to chronic illnesses, special diets might be recommended thus affecting actual dietary intake. It could also create bias in reporting, as individuals may report what they should eat rather than what they do eat. Alternatively, respondents on special diets may be more aware of their diets and may more accurately report their food intake (Thompson & Subar, 2008).

Probing

Collecting dietary information depends on the subjects' own retrieved memory of their diet (Thompson & Subar, 2008) and is always affected by the context in which the instrument is administered. Therefore, appropriate, neutral, and non-directive probing or questioning by the interviewer accompanied by use of memory cues is essential to avoid leading the respondent to specific answers when the respondent does not actually discern or remember what he/she ate (Thompson & Subar, 2008; Moshfegh et al., 2008). The interviewer should be aware that the way in which questions are asked can affect responses, and that certain characteristics of the interviewing situation may impact the social desirability of particular responses for some foods and drinks. For example, the presence of other family members during the dietary interview may enhance social desirability bias, especially for certain foods like alcoholic beverages (Thompson & Subar, 2008). More importantly, issues related to dietary self-discipline and socioeconomic status may affect accuracy of self-reporting of food intake (Moshfegh et al., 2008). For example, respondents may refrain from or change information provided on a certain food consumed due to complex psychosocial reasons leading to the desire to impress a health professional by only reporting consumption of foods supposedly healthful (Lee & Neiman, 2007). In general, respondents tend to underreport binge eating, consumption of alcoholic beverages, and consumption of foods perceived as unhealthy (Lee & Neiman, 2007).

Probing was found to be particularly useful in retrieving memory for items not originally reported, in collecting necessary details on food preparation method and common add-ons to foods (e.g., butter, oil, sauces, dressings), and in capturing disregarded eating occasions not formerly reported (e.g., snacks and beverages during a neighbour's visit) (Thompson & Subar, 2008).

Portion Size Estimation

Researchers have acknowledged that under-reporters of energy intake tended to report smaller quantities of foods consumed, fewer numbers of the foods consumed, and smaller portion sizes across a wide range of foods (Krebs-Smith et al., 2000). The last item was reported in one observational study accounting to a great extent for the occurrence of underreporting (Jonnalagadda et al., 2000).

Portion sizes of foods that are commonly bought or consumed in distinct units (e.g., bread by the slice, pieces of fruit, beverages in cans or bottles) may be more easily reported than amorphous foods (e.g., steak, lettuce, pasta) or poured liquids (Thompson & Subar, 2008; Lee & Neiman, 2007). Several approaches are commonly used to help participants estimate portion size, and these include food models or photos, standard measures of cups, bowls, and spoons of various sizes (Lee & Neiman, 2007).

For the purpose of this study, a "food recall kit" was assembled based on the one recommended by the 24-hour recall protocols (procedures of 24-hour recall: www.csrees.usda.gov), with the purpose of assisting both the interviewer and the respondent in the process of estimating the amount of food consumed by the latter.

As the carrying load of the interviewer was already high (weighing scale, questionnaires, and necessary stationeries), the recall kit was made as compact as possible and it included the following:

- One set of standard plastic measuring cups: 1 -8oz cup, ¾ cup, ½ cup, 1/4 cup
- One set of standard plastic measuring spoons: 1 Tablespoon, 1 teaspoon, 1/2 teaspoon, ¼ teaspoon
- Few food photos (downloaded from www.mypyramid.gov) exemplifying the most commonly consumed foods in frequent serving sizes
- A 15 cm plastic ruler to show measure of a food consumed (for example slices of bread, cakes, ice cream cones, etc...)
- A hand-out or "Handy-guide" for estimation of portion size: to help the respondent estimate portion size of a food consumed by comparison to a household element, for instance a light bulb, or a deck of cards, or 4 stacked dices to refer to a half cup of cooked vegetables, 3 oz beef steak, or 1 oz of cheese, respectively (Appendix H).

The 24-hour recall procedures recommend the use of raw rice and dry beans to help respondent indicate how much he/she consumed of a certain comparable food. But due to the previously mentioned heavy carrying of instruments, these were not included in the kit; however, when the interviewer found it feasible, he or she would ask the household head if they have these items at hand to pour in a plate. Also, cooked rice was recommended as an example for measuring dense foods such as mashed potato, and cooked beans for foods that are loosely packed such as cereal or vegetables.

In certain instances, the subject willingly brought leftovers of the foods they consumed and poured what he/she ate on his/her serving container to demonstrate to the team members the amount consumed. This was interestingly more evident in villages.

3.3.2 The Physical Activity Recall Questionnaire

Valid and reliable measures of physical activity are essential in studies designed to document the frequency and distribution of physical activity in defined populations (Al

Hazzaa, 2005), as well as in those intended to determine the dimension of physical activity required to influence a specific health outcome (Wareham, 2007).

Several methods are used to measure physical activity with varying levels of ease of assessment and precision. These include accelerometry, heart rate monitoring, pedometers, and self-report methods (Neilson et al., 2008; De Cocker et al., 2007); the last is the most convenient and cheapest way to collect physical activity data from a large number of people in a relatively short time (Matthews, 2002; Armstrong & Bull, 2006). They provide data on the dimensions of physical activity, i.e. frequency, intensity, duration and type, in the various forms in which physical activity occurs: leisure, occupational, transport, and household/ garden chores (Armstrong et al., 2000). Physical Activity Questionnaires (PAQs) vary greatly in their detail and reference time frame, and thus the choice of the instrument is determined by several factors including the study design, the research question pertaining to the kind of information required, and available resources (Shepard, 2003; Hallal, 2010).

Over the decades, a variety of questionnaires were developed for surveillance purposes, and used to classify people into broad physical activity categories for investigative studies. These questionnaires allowed the quantification of physical activity by several domains using the Compendium of Physical activity (Ainsworth et al., 2000). Examples of these validated instruments include Baecke physical activities questionnaire, Bouchard's 3-day physical Activity record (Sallis et al., 1985; Sallis et al., 1993; Pereira et al.,1997), the European Prospective Investigation into Cancer and Nutrition (EPIC) physical activity questionnaire, EPAQ2 (Wareham et al., 2002; Wareham et al., 2003), the international physical activity questionnaire IPAQ (Craig et al., 1999; Craig et al., 2003), and -more recently- the global physical activity questionnaire (GPAQ) (Armstrong & Bull, 2006). The last two questionnaires were built for surveillance studies, and the GPAQ more exclusively for developing countries (Armstrong & Bull, 2006). The IPAQ was developed with the support of the World Health Organization (WHO) and the US Centres for Disease Control and Prevention (CDC) (Craig et al., 2003), and the GPAQ under the auspices of the World Health Organization (Armstrong & Bull, 2006).

Of the many physical activity questionnaires, both the IPAQ and GPAQ were considered as the two best options to use in this study.

The International Physical Activity Questionnaire (IPAQ)

The IPAQ was developed in response to the call for a homogeneous measure to estimate the usual practice of physical activities of populations from different countries and socio-cultural background (Roper et al., 1992; Ainsworth et al., 2006; Maddison et al., 2007; Hallal et al., 2010). It has been validated for use in subjects 15-65 years of age, through extensive reliability and validity testing undertaken across twelve countries during the year 2000 (Cora et al., 2003). It has been used in several countries such as Norway (Belander et al., 2004), Brazil (Hallal et al., 2003), Belgium (Rzwenicki, 2003), and Saudi Arabia (Al Hazaa, 2006) to assess the population prevalence of physical activity as well as to identify associates of physical activity behaviours (Abu-Omar et al., 2004; DeBourdeaudhuji et al., 2003; Rzwenicki, 2003).

Two-forms of the IPAQ have been developed: a short and a long version both of which involve a 7-day recall of physical activity (Cora et al., 2003) and are available in a number of languages (www.ipaq.ki.se) including Arabic, the mother tongue of the Lebanese population.

The short-form (SF) was designed for use in surveillance studies in which time is limited. It consists of seven items which provides information on time spent in walking, in vigorous and moderate intensity physical activities, and in sedentary activity (Cora et al., 2003). It is a measure of total physical activity in all its settings including transportation, work and leisure time (Ainsworth et al., 2006).

The long form (LF) was designed to provide a comprehensive evaluation of daily physical activities, and assesses the time spent walking, doing moderate-intensity and vigorous-intensity activity within the domains of work, transportation, domestic and gardening (yard), and leisure-related activities (Pedro et al., 2010). It consists of twenty seven items.

The international 12-Country Reliability and Validity study has demonstrated that reliable and valid physical activity data can be collected by the IPAQ instruments in many countries (Cora et al., 2003); several others reported a good one-week test – retest reliability of the short interview-administered IPAQ (Spearman r = 0.70-0.79) as well as an acceptable criterion validity for the IPAQ total minutes per week as measured against accelerometer total counts (Ainsworth et al., 2006). Several studies have also shown that there was no difference between the reliability and validity of the short and long IPAQ forms (Hallal, 2010).

The Global Physical Activity Questionnaire (GPAQ)

The development of GPAQ as an instrument to assess physical activity patterns, especially in developing country contexts, has been undertaken by the WHO as part of the WHO STEPwise approach to chronic disease risk-factor surveillance (WHO, 2005b). In a WHO workshop held in the year 2002 on physical activity measurement and surveillance, pre-existing physical activity questionnaires were reviewed for their usefulness in developing-country settings. Attention was mainly given to the long and short forms of the International Physical Activity Questionnaire as they were the most recently developed forms (Craig et al., 2003) and also due to their resemblance in purpose of employment as instruments fit for international comparisons of physical activity estimates (Armstrong & Bull, 2006). The long form of IPAQ was considered time-consuming and complicated to be used in national health surveys, whereas the short-form IPAQ was limited in terms of distinguishing between data from the various domains in which physical activity can be performed (Armstrong & Bull, 2006). Thus, the GPAQ was developed as a concession between the short-form IPAQ and the long-form IPAQ instruments with the purpose of collecting information on patterns of physical activity in the key areas of life common to people in developing countries (Bull et al., 2004; Armstrong & Bull, 2006).

The GPAQ collects information on participation in physical activity in three domains: activity at work, travel to and from places (walking & cycling), and optional time (leisure and recreation). A single question to assess sedentary behaviour is common with the IPAQ (Armstrong & Bull, 2006). The final version of GPAQ was the GPAQv2 (version 2) consisted of 16 questions. The phrasing of these questions was improved for simplicity purposes and in several cases to resemble the wording of the IPAQ questions (Armstrong & Bull, 2006).The reliability and validity of the GPAQ instrument has been found to be comparable with that of the IPAQ (Armstrong & Bull, 2006).

3.3.2.1 Rationale for Use of the IPAQ Instrument in the Current Study

Both the GPAQ and IPAQ forms were used in surveys carried out in neighbouring countries to Lebanon. The IPAQ was used in a cross-sectional study in Saudi Arabia (Al Hazzaa, 2006), and the GPAQ was used in the behavioural risk surveillance study (BRFSS) in Jordan (Zindah et al., 2008). Although Lebanon is considered a developing country and thus the GPAQ is the primary choice for use to estimate physical activity prevalence and patterns, the researcher opted to employ the short IPAQ form based on the following:

1. Both forms of the IPAQ have been used extensively by public health officials and their reliability and validity have been tested in over a dozen countries (Ainsworth, 2006; Rzewnicki et al., 2002; Craig et al., 2003), while the performance of GPAQ in reporting national-level prevalence estimates has yet to be examined and reported (Armstrong & Bull, 2006).

2. The IPAQ executive committee recommends the use of the short form IPAQ "last 7 days" based on participating country preference for national and regional prevalence and surveillance studies (Cora et al., 2003; Maddison et al., 2007), whereas the long version of IPAQ could be used for research purposes or studies requiring more details on the separate domains or dimensions of physical activity (Cora et al., 2003). Being a cross- sectional surveillance study, and thus following the above mentioned IPAQ executive committee recommendation, the short 7-item IPAQ form was the questionnaire of choice for the general survey rather than the long 27-items form.

3. The “Adult Questionnaire” is a comprehensive one consisting of around 16 modules (excluding the 24-hour recall form and the morphologic measurements data sheet). Hence, the amount of time spent in the household was a major concern. For this reason, the short 7-item IPAQ form was preferred over the longer GPAQ form of 16 items.

   This option was also backed up by the implication that IPAQ and GPAQ are theoretically similar although structurally different (Armstrong & Bull, 2006); both instruments aim to record physical activity undertaken across the same various domains (Armstrong & Bull, 2006), and both provide categorical variables of physical activity (high, moderate and low), as well as a continuous variable of total physical activity (as Median METmin/week) within each domain, thus allowing comparability across different persons and types of activities (Armstrong & Bull, 2006; Cora et al., 2003).

4. The most important rationale is the type of information required for the objectives of this thesis, i.e., a total measure of physical activity in all its settings; in other words, what needs to be surveyed is the energy exerted in all customary activities ranging from exercise to non-exercise rather than detailed information on the separate domains of physical activity; the former measure can be provided by the short 7-day IPAQ form.

5. Drawbacks of the IPAQ have been extensively discussed by several authors in various articles, so the researcher as well as the interviewers involved in this study would be able to note as well as reduce the occurrence of these faults throughout training and field implementation. Rzewnicki and colleagues (2003) concluded from their experiences that only trained interviewers familiar with over-reporting issues of physical activity questionnaires should be employed to administer the IPAQ in order to avoid related setbacks.

Consequently, for the purpose of this study, the short form of IPAQ translated to Arabic, available online (www.ipaq.ki.se.), and used previously in a study carried out in Saudi Arabia (Al Hazzaa M., 2006), was adopted as the foundation questionnaire. Very few studies validated the utilization of IPAQ for elderly men and women; however, the short IPAQ form has been used for elderly subjects greater or equal to 65 years of age in this study, considering that it was recently implemented in similar surveys in neighbouring countries such as the one carried out in Saudi Arabia, with a sample consisting of 1616 Saudis between 15 and 78 years of age (Al Hazzaa, 2007). It was also used in Brazil on elderly men in a validation and reliability study (Benedetti et al., 2007), and in a comparison study between the BRFSS and the IPAQ physical activity questionnaires which included 4258 men and 5687 women ranging in age from 18 to 99 years (Ainsworth et al., 2006).

Prior to testing the adopted IPAQ short form questionnaire, minor modifications were made. As evaluation of intensity of physical activity was perceived differently by different people, and following the GPAQ phrasing used in the behavioural risk factor surveillance study in Jordan (Zindah et al., 2008) -a neighbouring country sharing a common language with Lebanon, “sweating” and “increased heart rate” were added to the merely pre-existing “increased breathing” criterion as descriptive factors for the evaluation of the intensity of physical activity performed.

3.3.2.2 Pilot Testing of the IPAQ- Short Form for the Study

Lessons Learned from Past Experiences

Several studies discussed features of the IPAQ that might increase the chance of over-reporting (Ainsworth et al., 2006; Maddison et al., 2007); others have documented overestimation of physical activity levels using both the IPAQ short and long versions (Hallal et al., 2010; Brown et al., 2004).

Following are few factors that might affect the validity of self-reports attributed to over-reporting and overestimating of physical activity (time and intensity) using the IPAQ instrument; these that were noted in the field during the pilot testing carried out by the researcher.

1. **There are differences in the cognitive understanding of physical activity questionnaires** by various demographic groups (Ainsworth et al., 2006), particularly respondents with low levels of education (Hallal et al., 2010). Therefore, and although the IPAQ instrument used for this study was previously put into practice, it was re-tested with individuals from different socio-economic and educational backgrounds. After the completion of each section, the

respondents were asked if they understood the purpose of the questions and if they have any further queries. Interestingly, most middle-aged and older participants, and mainly those of lower socio-economic backgrounds, perceived the descriptions of physical activity criterions as being ill, fatigued or suffering from blood pressure and blood sugar fluctuations.

Subjects' queries were noted down and documented to be later discussed in the training sessions as described in the next section (Lessons learned from the current study).

2. **There exists diversity in physical activity patterns** among certain demographic groups distributed over the various domains of the IPAQ: leisure/exercise, walking, occupation, housework / gardening, and transportation (Brown et al., 2004; Ainsworth et al., 2006).

   In most rural areas in Lebanon, and among the less educated, occupational and household activities were more dominant; whereas among those in urban areas or higher educational and social classes, leisure time physical activities were more prevalent. Nevertheless, the fact that the respondents had to calculate mean hours per day of physical activity executed over a diversity of domains created grounds for overestimation (Rzewnicki et al., 2002) by all. Therefore, it was essential to probe questions that would give more exact, complete, and detailed reports on physical activity for the last 7 days.

3. **The tendency of providing socially desirable responses** to a popular behaviour (Ainsworth et al., 2006) leads to the over-reporting of the time and intensity in which physical activity is performed (Rzewnicki et al., 2003). Therefore, it is essential during the interview to avoid questions that would lead to or suggest an answer and to use more neutral or open-ended ones.

4. **Misconception of the time criterion of a "minimum of 10 continuous minutes"** of physical activity performed during the last 7 days is common (Rzewnicki et al., 2002).

   The IPAQ protocol requires the respondent to "think only about those physical activities that were performed for at least 10 minutes at a time" (www.ipaq.ki.se.). It may be overestimated due to issues such as social desirability as well as low levels of education, and is mostly apparent in household and occupational activities (Rzewnicki et al., 2002; Hallall et al., 2010). Successful interviewing questions might include asking the respondent about the time of start and finish of a certain activity to account for such misperception.

Moreover, **over-estimation of MEAN or AVERAGE time per day** that the IPAQ protocol asks respondents to report for each activity is common (Rzewnicki et al., 2002; Hallall et al., 2010). For instance, if physical activity is reported for more than a single day, it is likely that subjects will tend to over-report this mean time per day, by reporting the day they executed the activity most (Hallal et al., 2010).

It was thus concluded that lack of implementation of IPAQ-probing skills by the interviewer may lead to inaccurate over-reporting of physical activity by the respondents (Hallall et al., 2010).

Lessons Learned from the Current Study

After pre-testing of the IPAQ instrument by the researcher, the following was documented and later thoroughly discussed during the training sessions:

1. It was important to verbally clarify to the participant at the beginning of the IPAQ that the criterions expressed in the questions are not to identify illnesses but are rather normal by-products of physical activity, and would help the interviewer to categorize the level of physical activity performed.

2. It was important to clearly explain to the participant the purpose of each question, and that each set of questions referred to a specific intensity of physical activity (vigorous, moderate, and walking) in all its domains (work, transport, home, recreation). Pilot testing showed the importance of integrating specific work-related activities examples depending on the person's job, as well as culturally-relevant recreational activities as examples to improve understanding of the question. For instance, a leisure time activity for a young female in a village is walking in the neighbourhood with friends, whereas that of her counterpart in the city is exercising at the gym or going to a dancing class. Examples of household activities including moderate-intensity activities done at home, such as carrying loads (e.g. babies), scrubbing floors, sweeping and vacuuming were also essential to define in terms of intensity and duration.

3. The documented tendency of over-reporting in both occupational and household activities was observed during pilot testing, where especially housewives in rural areas would report that "they have a family to care for and that they are working all the time at home, from morning till bed time". For women who both work and take care of a family, the exaggeration was more evident.

4. Over-reporting of walking was also noted. Reports of walking “to the supermarket”, “to a neighbour for coffee”, “to the village plaza”, “to the church”, “to the mosque”, for example, were often revealed to take less than 10 minutes after probing.

3.3.2.3 Implementation of the IPAQ Short 7-day Instrument

Following the IPAQ protocol, physical activity was assessed using the official Arabic short-version telephone format of IPAQ, which is available at (http://www.ipaq.ki.se), and adopted for this study as an interviewer-administered questionnaire. It consists of seven items which provide information on time spent walking, doing vigorous- and moderate intensity physical activities, and sedentary activity during the prior seven days. Participants were asked to refer to all domains of physical activity including occupational, transport, household, yard/garden and leisure/sports, whereby for each question, participants were given culturally-related examples of moderate, vigorous, and walking activities as well as physiological cues for breathing, heart rate, and degree of sweating. This helped them recall activities with an accurate intensity level. As in other similar research studies, the potential problems faced during pre-testing and those highlighted during training and later during data-collection, were mostly related to perception of duration and intensity of physical activity.

It is important to note that during pilot testing, guiding the participant through the questionnaire in a conversational manner was most effective in facilitating description by the respondents of their daily amount of time spent performing each category of physical activity. For instance, if the participant reported performing several types of physical activity in a day within the last 7 days, the interviewer would reconfirm by asking “Tell me how did you start your day , since the time you woke up till you slept”, probing with closed-ended questions such as “did you sweat a lot?” or “tell me exactly how long did it take you to do this activity, or what time did you sleep?”, or “did you rest or have a nap in the afternoon?”. Not mentioning the afternoon siesta was common especially on typically long summer days. Generally, and as a rule throughout the study, if a respondent reported a typical activity day with a total of less than 6 hours of sleep, then the interviewer should re-probe for more descriptions of the various physical activities performed including duration and intensity.

After instrument testing, minimal rephrasing in the source questionnaire was done in the prologue that is read to the participants about the questions, mainly relating to inclusion of culturally-related physical activity examples that match each type of intensity expressed as MET (metabolic equivalent)-score: walking (3.3 METs), moderate intensity (4 METs), or vigorous (8.0 METs). Examples were derived from the

Compendium of Physical Activities which is used as a reference for researchers, clinicians, and practitioners to identify examples of various intensities of physical activities (Ainsworth et al., 1992; Pate et al., 1995; Ainsworth et al., 2000).

A list of culturally-related activities compiled after pilot testing was developed for use as a guide to interviewers during data collection (Appendix I). Further examples were added to the various types by means of new contact with participants from the various backgrounds and regions of Lebanon throughout the study.

3.4 Anthropometric Measurements

Anthropometric measurements including height, weight, skin thickness, waist and hip circumference were taken based on standardized techniques that the researcher was trained on in a Regional Training Course on “Anthropometry and Stable Isotope Preparation and Administration for Body Composition Assessment” from 1-5 October 2007, Tokyo, Japan (Appendix J). The majority of “measurement protocol” used in this training course was based on the protocol defined by Ross and Marfell-Jones (Ross et al., 1991) and approved by the International Society for the Advancement of Kinanthropometry (ISAK) and the Australian Sports Commission Laboratory Standards Accreditation Scheme, consistent with their manual “International Standards for Anthropometric Assessment” (Marfell-Jones et al., 2006).

Calibrated equipment was used, and all measurements were taken twice for all participants; the average was later computed for statistical analysis.

3.4.1 Weight

Subjects were weighed to the nearest 0.1 kg using a calibrated balance (Seca model 11770 Germany) in light indoor clothing and with bare feet or stockings.

3.4.2 Height

The standard method for measuring height or stature is the *stretch stature* technique defined as the maximum distance from the floor to the vertex of the head, the highest point on the skull. Stature is usually recorded using a stadiometer mounted on a wall with a fixed head piece; however, due to impracticality of using such a device in field work consisting of household visits, a triangular head piece and a carpenter’s retractable tape measure with a foot piece were used to measure the length from the floor, with the subject standing erect without shoes, arms to the sides, legs straight, shoulder relaxed, and head in the Frankfort plane achieved when the Orbitale (lower edge of the eye socket) is in the same horizontal plane as the Tragion (the notch superior to the tragus of the ear). Measurements were recorded to the nearest 0.5 cm.

3.4.3 Skinfold Thickness

The training protocols suggested the Harpenden calliper (John Bull, British Indicators England) for use in the measurement of skinfold thickness; however, in this study the LANGE calliper (Beta Technology Incorporated –Cambridge, Maryland), calibrated to 40mm and with a pressure of 10g/mm^2 was used as it was available for research purposes at the department of Nutrition and Food Sciences at the American University of Beirut. Measurements were done on the right side of the body and at four sites (biceps, triceps, subscapular, and suprailiac defined in the protocols as supraspinale) to the nearest 0.1 mm, and following the formerly mentioned standardized procedures in (Appendix J). Soft tip washable pens were used to mark the skinfolds sites, two measurements were carried out at each site, and the average value was later taken as the skinfold score for computation of percent body fat.

3.4.4 Waist and Hip Circumference

Waist and hip circumferences were measured with the use of a plastic measuring tape to the nearest 0.5 cm. Only the waist circumference as indicator of abdominal obesity was later included in this study analysis.

The cross hand technique was used for measuring all girths with the measurer standing to the right hand side of the participant, and the tape measurement was read at eye level to avoid a parallax error.

Waist circumference

Three methods are proposed for the measurement of the waist circumference: **1)** Waist (minimum) which is the perimeter at the level of the estimated minimum waist halfway between the costal border and the iliac crest; **2)** Waist (mid-way) which is the perimeter at the level of the mid-point between the lower costal (10th rib) border and the iliac crest. This can be considered as the same measurement site for the WHO recommendation defined as “The midway between the inferior margin of the last rib and the crest of the ilium in a horizontal plan” (WHO, 1995; Marfell-Jones, 2006); and **3)** the umbilicus, the perimeter at the level of navel (Marfell-Jones, 2006).

Primarily, the option was to measure the waist circumference following WHO recommendation (WHO, 1995; Marfell-Jones, 2006). However, this technique was considered culturally non-receptive especially with overweight and obese subjects as it requires that the measurer palpitates, and more profoundly if the subject is obese, at the inferior border of the chest cage additional to the hip bone, to locate the landmarks; thus, the third measurement technique was implemented throughout the study for all objects whereby the tape was placed at horizontal plane at the level of the umbilicus, with the subject standing erect and following normal expiration (Marfell-Jones et al., 2006).

Waist Circumference as a Proxy Method for Adiposity

The use of waist circumference is highlighted as an anthropometric indicator to complement the measurements of BMI in identifying individuals with increased risk of obesity-related morbidity due to accumulation of abdominal fat (World Health Organization, 2000; World Health Organization, 2011b).

Waist circumference was favoured over other proxy measures (waist to hip ratio and waist to height ratio) used as an alternative to BMI when measuring disease risk (World Health Organization, 2011b). Although BMI and abdominal obesity measures may be highly correlated, the WHO recommends utility of joint use of these two indicators (World Health Organization, 2011b). In this study, elevated waist circumference cut-offs were used to identify the prevalence of increased risk for metabolic disorders among Lebanese adults.

In older adults, waist circumference may be a better predictor of adiposity than BMI since the latter has its limitations in detecting the physiological age-related transformations of lean mass to fat mass(Zamboni et al., 2005).

Hip Circumference

Similarly, hip circumference was measured at maximal girth of hip or buttocks with feet put together and without contracting the gluteal muscles (Marfell-Jones, 2006).

Some difficulties in girth measurements were encountered in the field related to the following issues:

1. Correct positioning (parallel to the floor at the level of measurement) of the tape in obese persons was difficult.

2. The posture of the subject affected the degree of accuracy in the measurement performed: Few subjects were non-cooperative in maintaining the proper position required for accurate measurement of both waist and hip circumferences.

3. The WHO STEPS protocol for waist circumference measurement requires normal expiration at the time of measurement and this was sometimes difficult to achieve in few individuals. There was the tendency of holding breath and sucking in the abdominal wall among many subjects, especially women, thus affecting the

reading. Subjects were continuously asked to relax and breathe normally during the measurement.

4. The most accurate waist circumference measurement is obtained after an overnight fast (FAO, 2011) and this was difficult to accomplish in the survey since visits were done at any time of the day.

3.5 Training

The training sessions were introduced by the principal investigator of the national project “comparison of estimates based on cell-phone interviews with face-to-face interviews” with an overview of the study background and protocol followed by a total of 5 in-depth training sessions on the questionnaires modules (Appendix K). The researcher trained the interviewers and evaluated them on the implementation of the procedures of the nutritional subpart “Demographic, Socioeconomic, Dietary and Physical Activity Determinants of Obesity in Lebanese adults” consisting of key interviewing techniques as well as the implementation of the 24-hr recall, IPAQ short form, and the anthropometric measurements.

The sessions started with the interviewers familiarizing themselves with the questionnaires and practicing by interviewing each other, followed by interviewing invited subjects from different age groups.

The questionnaires were reviewed for completeness and correctness, and the experiment was repeated until the procedures for filling the questionnaires and undergoing anthropometric measurements were mastered:

- For the 24-hour recall, scoring forms were used to assess the interviewer’s ability to elicit complete information about foods eaten by the respondent (Appendix G).

- For the IPAQ, and according to the IPAQ scoring protocols, information on number of days, number of hours (minutes) per day across the various domains of physical activity, as well as on sedentary time collected by the interviewer was summed up and any discrepancies were re-checked and discussed.

- For the anthropometric techniques, the researcher re-performed the measurements on the invited subjects, and values with large discrepancy as compared with those reported by the trainee interviewers were questioned and the technique performed reassessed.

3.5.1 Training Procedures

Interviewing Techniques and Essential Characteristics of the Interviewers

Being an integral element of interview-administered data collection, interviewing skills and their importance to obtain good quality data were discussed at the beginning of the workshop. A summary hand-out of good interviewing techniques was included in the interviewer's folder to be used as a guideline for supportive communication throughout the field work (Appendix L).

This component of the training procedures aimed at instilling and emphasizing the following characteristics in all the study interviewers:

1. Good interpersonal skills, as well as being non-judgmental and non-biased in both verbal and non-verbal cues throughout the face to face interview.

2. Sensible probing, encompassing the ability to conduct the interview with non-leading and non-directive questions.

3. Knowledge of local foods as it is important that the interviewer readily understands the multiple local names of foods, the diverse methods of food preparations, as well as popular and cultural eating occasions.

4. Knowledge of occupation-related physical activities, as well as culturally acceptable leisure time exercise, across the various regions and areas of Lebanon.

Collection of Food Intake Using the 24-hour Recall Instrument

It is well-documented that the preparation of the interviewer for the collection of potentially reliable and valid dietary data is of highest importance, and that a well thought-out interview would help minimize differences among and within interviewers (Dolecek et al., 1997; Willett, 1998; Dennis et al., 2003; Conway et al., 2004; Robertson et al., 2005).

For that reason, a thorough training consisting of two sessions on collection of dietary intake was carried out. The full training was based on the previously mentioned formation, "The USDA 5 step multiple pass method" (**Figure 3.2**), and standardized procedures (www.csrees.usda.gov - Appendix G).

Session1: How Much Do I Know?

At the start of the 24-hour recall workshop, interviewers were paired off taking recalls on each other first, sharing past experiences in the process, exchanging knowledge of foods available in the market, cultural foods, and new recipes. This was done as a

“How Much Do I Know” off-the-record session shared with the researcher, followed by a session on the procedures of the 24-hour recall (Appendix G) and the USDA 5 step model (**Figure 3.2)** summarized as follows:

Step 1: “Setting the stage for the interview” where the interviewer was provided with steps that would elicit true and complete information from the interviewee, by ensuring confidentiality and being non-judgmental and non-directive.

Step 2: “During the food recall” where steps for collecting dietary intake of the subject in a sequential manner were introduced, and these include: 1) complete the listing of all foods eaten with probing on time of eating and activities of the day, 2) complete information about the food already eaten (added fat or sugar, a drink with food, a second helping of the food, etc..), additional descriptions on type of the food consumed such as combination dishes or packages and brand names, and 3) determine amounts of foods using food models, measuring cups and spoons, or a ruler to show size of certain items.

The protocol provides the interviewer with a set of neutral non-leading questions to probe for more complete information (Appendix G: Procedures of 24-hour recall www.usda.gov).

Session 2: Hands-on Training:

Step 1: Life-like food models were set on trays to represent a one-day typical intake of a Lebanese adult. Standard measuring cups and spoons, along with food photos, were provided to help the interviewers through the process. Scoring forms adopted from “Procedures of 24-hour recalls” on www.usda.gov (Appendix G) were used to evaluate the trainees, whereby 1 point was allocated for each of the following:

1. Proper listing of each food item presented on the tray.
2. Well-written description of each food item: type, size, amount, method of preparation.
3. Overall completeness of information drawn out during the 24-hour recall interview.

Step 2: Following step 1, practice interviewing sessions using the 24-hour recall form of the study (attached to the adult questionnaire - Appendix B) have been carried out with volunteers including co-workers, students, and staff acting as respondents.

The process was observed and scored by the researcher and 2 helpers who were graduate students in Nutrition at the American University of Beirut. The trainees were also observed for their communication skills, type of probing questions they used, body language and ability to elicit complete information about foods eaten by the respondent. The 24-hour recalls were then collected and checked for thoroughness and completeness. In addition to the scoring forms (Appendix G) used for evaluating the proper listing and description of the foods, the recalls were checked for proper recording of time and place the food was eaten, as well as good handwriting. The results were then discussed and shared with the team for further accurate and complete collection of data. The workshop lasted for approximately 8 hours to ensure that its goals are accomplished.

3.5.2 Training Highlights

Highlight 1. Procedures of the 24-hour recall (www.usda.gov) ask the respondent to start the recall with the most recent meal or snack that he/she consumed immediately before the recall time and over the previous 24-hours (Appendix G). For this study, a modification was made where the respondent was asked to recall the previous day intake from midnight to midnight of the previous 24-hours (most respondents would start with reporting the first meal they consumed since they woke up the previous day till the time they slept). This decision was backed up by the shared experience of practicing dieticians and nutritionists in Lebanon, the researcher being one as well as the interviewers, acknowledging that the cognitive process of going backward was troublesome for numerous Lebanese individuals regardless of their educational or socioeconomic background. This was also observed in an analysis study carried out by Tapsell et al. (Tapsell et al., 2000) and in the INTERMAP Belfast (Robertson et al., 2005).

Highlight 2. The study team was selected from the various regions of Lebanon and with varied cultural backgrounds in order to facilitate communication of dietary information. Lebanese cuisine does not vary greatly across regions; however, cooking practices among the different regions were noted by the interviewers during the training.

The interviewers exchanged knowledge of names of foods in different areas of Lebanon and consequent distinctive or analogous recipes, as well as occasions of eating certain food items (festivities, baptism, celebrating new-born baby, birthdays, weddings, fasting, etc...). For instance, a popular Lebanese dish known as “stuffed grape leaves” is called “warak arich” in the capital Beirut whereas in Bekaa area it is called “Yabrak”. The popular tabbouli dish is made with bulgur (crushed wheat) in some areas, whereas in certain villages, mainly in the Bekaa area, it is made with red lentils. In food preparation practices, rural community households who raise their own herd use more ghee in their food preparation, or use more dairy products as compared with their counterparts who have to buy such products.

Highlight 3. The 24-hour recall procedures (www.usda.gov) provide an interview structure for trainees in order to elicit as much accurate information as possible from the respondent. Yet, it is not feasible to fully assess the possible bias introduced by inadequate questioning techniques, since for free-living individuals, actual intake is not attainable with 100% validity, i.e. there is no 'gold standard' method (Dennis et al., 2003).

Consequently, interviewers were repeatedly advised on methods to clarify information, and kept practicing articulation of non-leading questions to minimize frequency of error in data collection. Several re-structuring of probing questions was carried out, supplementary in-practice observations were noted, and culture-related components (alcohol, religious foods) were further discussed during the workshop.

Following is an example on how to probe for description of a simple beverage: coffee. 'Did you have black coffee?', for example, could readily lead participants to report simply that they did, when they may actually have added cream and sugar. A non-directive – hence proper – open question would be 'How do you take your coffee?

When inquiring further about type of milk added, a leading question would be: Did you use low fat milk? This will lead the respondent to answer with a yes while he or she might have actually added a sweetened condensed milk. Similarly, when probing about "additions", a question such as "you add milk to your coffee, don't you?" would lead to an answer of "yes" while the respondent may not have actually added any milk.

In questioning amounts of food eaten, "How much of that did you eat?" rather than 'Did you eat all of your stew?' would more probably lead to an unbiased answer.

Measures that can enhance accuracy in collecting dietary data were also discussed and include:

- Identifying linguistic choices possibly associated with inaccurate reporting, for example the use of 'probably', or 'it depends' by the respondent: a conversational analysis study assessed terms like 'it depends,' as indicative of possible fabrication, and 'probably' as a way of guessing (Robertson et al., 2005).

- Dealing carefully with sensitive topics: alcohol, fats, confectionery (Tapsell et al., 2000; Robertson et al., 2005)

- The necessity to involve a household member to indicate the type of food consumed when uncertainty in the recall of food eaten the previous day is observed, particularly among men (Robertson et al., 2005)

It is worth noting that life-like food models were used during the training of interviewers to assess their knowledge of standard food portions from various food groups so that all food items are recorded in proper measures (cups, spoon, slices, and numbers, small, medium, or large) for accurate transformation into weight during data entry and analysis. However, these food models were not assembled in the recall kit used in the field (again due to heavy load the interviewers had to carry).

The IPAQ Short Form

The training on the implementation of the short IPAQ focused on the potential problem of over reporting, with the aim of obtaining accurate reports. During the training, and later during data collection phase, the researcher supervised the teams one at a time, and feedback was given on daily basis at the start of the field work and then on a weekly basis as needed.

During the training sessions, the interviewers were briefed on the IPAQ procedures (www.ipaq.ki.se); they first practiced conducting the questionnaire survey on each other and then on invited participants. The training session lasted for around 6 hours during which the interviewers were evaluated on their introduction of each set of questions, the use of culturally-related activities to clarify type and intensity of a certain activity, the choice of probing questions (open-ended and neutral vs. directive), and the ability to identify over-reporting based on precedent lessons learned by researchers and discussed during the training. The following was basically highlighted:

1. The interviewers should be able to clearly explain the 10-minute concept and to constantly remind interviewees about the 10-minute bouts (Hallal et al., 2010).

2. The interviewers should be able to use culturally-related and job-related examples of activities (Appendix I).

3. The interviewers should be aware of the typical tendency for over-reporting in household activities especially by less educated housewives.

3.6 Field Methodology Testing

A sample of 22 houses was selected from a cluster that was different from the clusters selected for the study. The pilot study was viewed as a simulation of the actual study, and a rehearsal for the interviewers. It was also a chance for the final check on the questionnaire items, the anthropometric procedures, the 24-hour recall data collection, and the time spent within each household. Logistic, geographical, and social issues were noted including time to prepare data collection equipment prior to departure to field work, accessibility to area visited, households approach and response, and -last but not least- social distractions and interferences during the interviews.

The field methodology testing took a period of 4 days during which the researcher supervised each paired team, one at a time, within each household. A 12-point checklist, assembled by Robertson et al. (Robertson et al., 2005) to evaluate interviewer's performance in collecting 24 - dietary recalls was used as a reference to assess the interviewers' competence in the whole interview process, since the competencies listed apply in wide-ranging face-to-face interviews. The interviewers were rated on a scale of 1-4 (1= retrain, 2=needs work, 3=acceptable, 4= excellent) on the following: privacy of interview, general manner of interviewer, introduction by interviewer, use of non-leading questions, pace of interview, manner of questioning, objectivity, probing, use of portion size estimation tools, documentation, use of memory aids, and review of the recalls .

Questionnaires collected during the pilot study were solely used for a final check of the questioning procedure, anthropometric procedures, and field logistics. Respondents were not included in the examination of this thesis outcome variable.

3.7 Field Work Follow-up

The researcher followed up on the progress of the study and data collection with the appointed field supervisor, and directed any logistic or technical problem that the teams have faced during fieldwork. Regular reviews of the data collected were done to maintain quality of data. Meetings with the interviewers were carried out on a weekly basis to identify the need for retraining on any questionnaire section or procedure, and most importantly, to motivate the data collectors throughout the long period of challenging tasks.

3.7.1 Field Work Challenges

The task of data collection for this project has been challenging as well as rewarding. It involved household visits to the various districts of Lebanon, and face-to-face interviews with more than 2697 adults. Many challenges were encountered in the field, varying from simple logistic obstacles to daunting safety situations. At the time during which the field work was planned for the study (2008-2009), the political situation in Lebanon was charged, and at certain points, field work had to be stopped, without certain knowledge of whether or not it was going to be resumed again. Dogmatic conflicts in the country have sometimes led to warlike zones and heavily armed street battles. However, thanks to the commitment of the field-work team and the continuous support of the research investigators, the work was achieved. Following is a brief description of the many obstacles that the field team came across:

1. Getting access to selected clusters (Villages and towns): obstacles varied from physical to safety issues. For example, absence of proper roads or signs indicating the village/ town name has caused tremendous delays in starting the field work on time; this required extra time and imposed stress on the interviewers, especially in far areas. Safety issues were mostly encountered in the South of Lebanon and in certain areas in the North, where at times, the team was denied entry into the area due to militant reasons. Even when approval had been obtained from the corresponding heads of the municipalities, and although interviewers carried official letters of introduction from the research institution, miscommunication with key parties (mainly political and/ or military) regarding arrival of the team on the day of the field work often resulted in postponement of data collection till further contacts were made. To overcome this obstacle, the study coordinator liaised with a local recruit to facilitate the team's entry into the clusters with the approval of the various political parties.

2. Safety of the fieldworkers within the cluster: security was a continuous key concern throughout the data collection phase. At many instances, the team members were regarded with doubt while conducting the interviews. Female team members were sometimes faced with insults, especially if not wearing attire considered culturally-acceptable by the community they were visiting; it is noteworthy to mention here that culturally-acceptable conduct during the interview process was highly stressed in the training sessions. On one occasion, and during the first day of a pre-approved field visit in a cluster, few of the male inhabitants were suspicious of the team members; they detained them and took away their filled questionnaires. Contacts were then made with the municipality police who cleared the situation. However, the field work was discontinued and also considered undone in that cluster due to unreturned filled questionnaires.

3. These incidents have imposed a sampling challenge on the study coordinator where the intended random sampling had to be replaced by convenience

sampling; adjacent clusters with a similar population size had to be selected.

4. Well-being of the field workers: unexpected during the field work was the distressed responses of some fieldworkers to households presenting extreme poverty and deprivation. On the other hand, irritation and frustration towards wealthy settings were expressed by the interviewers often, where they were sometimes faced with carelessness and rudeness. Such incidents bring about the importance of expanding an element within the training program on what might be expected within households of different classes.

5. To alleviate such feelings among the interviewers, the study coordinator provided support during the daily pre-and post-field work short meetings, listened to the field workers' thoughts and emotions, and tried to provide counsel as much as possible.

6. Resignation of a well-trained interviewer during the period of field work: data collection for the study was accomplished in a period of one year, with several interruptions mainly due to security reasons, as well as religious occasions and holidays. During this time, some interviewers were offered jobs abroad, have gotten married, or had to quit for one reason or another. This has necessitated additional hiring and training, which at some points caused fewer interviewers to go into the field, and thus extended the time allocated to completing and finalizing data collection in a selected cluster.

7. Role confusion: At many instances, the field team members were confused with governmental or non-governmental organizations, and participants always expected donations or material gain from the visit. Thus, the study coordinator had to stress during each field day the significance of communicating the objectives of the study and the role of the interviewer through the written consent process.

8. The challenge of completing the face-to-face interview: few participants showed boredom or sarcasm during the interview, many refused to provide information related to income and very few of the selected subjects were reluctant to have their anthropometric measurements taken.

3.8 Survey non-Response

Non-response means absence from home or refusal of the selected subject from the household to be interviewed (Magnani, 1997). When a no reply from a selected household was encountered, inquiries were made regarding whether the house is inhabited or not, and neighbours were asked about the time by which the family members would be back home; this task was much easier in villages. In certain areas, mainly the cities, the concierge was asked about the availability of the household members, and in certain cases, he would decide if the team can enter the building or not.

When the random selection in the household falls on a subject who was not available due to one reason or another, the team would ask for an appropriate time by which the subject becomes accessible and revisits the household. Due to logistic matters, priority in revisits was allocated for non-response rather than refusals cases. Non-response and/ or refusals were documented on each team's attendance sheet (Appendix M).

Throughout the study a total of 3178 households were visited in the various districts of Lebanon, out of which 2836 participated in the survey, providing an acceptable non-response rate of 10.7%.

A limitation of this study is that profiles of those who refused to participate were not taken.

3.9 Data Entry and Data Cleaning

3.9.1 Data Entry

The Statistical Package for the Social Sciences version 18 (SPSS Inc.) was used for data entry of the coded "adult questionnaire" including anthropometric measurements. Data entry was done concurrently with data collection and thereafter until completed.

Dietary Data

In dietary surveys, an estimation of food and nutrient intake at the population level is determined, an outcome that requires food composition databases that are adequate and representative of national food supplies (Williamson , synthesis report No2, 2006.) Similar to other developing countries, Lebanon lacks extensive local food composition data resources. As there exists no other realistic cost-effective approach to the analysis of population based dietary intake data (FAO, 1990), it is inevitable for researchers to import or borrow values from other sources, such as American, European or regional databases.

To report estimates of energy and macronutrients that fulfil the objectives of this study, the Nutritionist Pro software (www.firstdatabank.com) was used for the analysis of the participants' 24-hour recalls for several reasons, mainly its adaptation to population-based food intake surveys previously carried out in Lebanon (Sibai et al., 2003, Nasreddine et al., 2009).The nutrient contents of frequently-consumed dishes and food brands were already compiled into its flexible database. Notably, a major amount of these nutrient values was obtained by chemical analysis of foods and popular mixed dishes in Lebanon and the Middle East, carried out at the American university of Beirut–Lebanon (Pellet and Shederevian, 1970). Other values were added by comparison with a similar food in the database.

The Nutritionist Pro software also has many desirable features such as ease of data entry and automatic coding, the inclusion of both weight/ volume equivalency information for each food item, and the variety of mixture foods. Specifically, the energy and nutrient values are provided for foods eaten as raw as well as cooked, with detailed description of the various methods of food preparation. This feature makes it easier for the researcher to compare and select foods that resemble the local foods in their description as much as possible and as needed. Finally, the Nutritionist pro software provides the researcher with the ability to calculate simultaneously the major component of foods, energy sources, the macro-nutrients, as well as micro-nutrients.

Several factors render many databases limited in terms of local applicability. It should be thus recognized that some degree of bias on surveys outcome related to food variations among countries would possibly occur (Greenfield & Southgate, 2003).

Foods are biological compounds that show natural variation in their nutrient composition due to environmental, agricultural, and industrial (storage, processing and packaging) factors, as well as cultural practices in food preparation and consumption (Latham, 1997). The degree of variation in nutrient composition also varies for different nutrients; micronutrient (vitamin and mineral) values vary more widely than macronutrient (carbohydrate and protein) values, with the exception of fat, which is extremely variable, particularly in meats where the lean to fat ratio can vary extensively (Greenfiled & Southgate, 2003; Buzzard, 1998). Moreover, a margin of error is also existent in food analysis conducted in even very sophisticated laboratories, larger for some nutrients than for others (Latham, 1997). For instance, differences mostly in vitamins and minerals in vegetables and fruits have been established in a comparison between Latin American, German, and British food composition tables (Garcia et al., 2003). Also, certain products in some countries may be fortified or enriched with specific nutrients. Local foods do not always have a similar nutrient composition to comparable foods from elsewhere. For example, wheat grown in the United States has naturally higher selenium content than wheat grown in Europe (Williamson - synthesis report No2, 2006.).

The drawbacks imposed by the use of the Nutritionist pro software database, primarily designed for the local American market, are recognized in this study. The limitation for precise dietary data analysis is also acknowledged and treated with caution. The inevitability of using ingredients analysed for the American market to complete a local recipe may have enacted restriction on obtaining precise estimates of total energy and macronutrients consumed. Yet, the need for absolute accuracy in epidemiological studies using large groups of individuals is not as great as in clinical settings assessing single subjects (FAO, 1990).

The researcher has worked towards improving the representativeness of the database to provide reliable data outcome for this study as much as possible. The researcher has practiced careful judgment whenever there was a need to select foods from the database that mostly resemble, in their treatment and preparation before consumption, the local Lebanese foods.

The researcher has also updated the software to be more suitable for the study population. The following was carried out:

1. Lacking information on certain foods and food brands repeatedly reported by the adult target population was obtained from the manufacturer's data.

2. Using the software's automated coding system, locally-consumed foods from standardized local Lebanese recipes, collected by the interviewers throughout the field work, were later added to the software database for nutrient calculation and analysis, thus preventing the loss of detailed description and preparation of a certain cultural food by pre-coded recipes (priori coding). Recipe data were systematically broken down into constituent ingredient and compiled into the database with careful ruling on type of food selected.

3. Evaluation of the food composition database was continuously carried out for the relevance of the foods and food descriptions, as well as for accuracy and completeness of the food and nutrient data throughout the data-entry process. Any missing food consumed by the population or any missing nutrient value for nutrients of interest for the study was added.

For the objectives of the study, only computation of energy intake and macronutrients was required, and therefore any adjustments for micronutrients content, such as vitamin A or iron fortified versus unfortified products, was not carried out.

Data-entry of all new local food mixtures and recipes as well as the subjects' 24-hour recalls extended till after the data collection period. After completion of data-entry of all participants' recalls, estimates of energy and macro-nutrient intakes were then computed and exported into the SPSS software for analysis. These estimates obtained may present some degree of measurement error related to the dietary data instrument itself as well as to the limitations of the nutrient analysis database used in the study. This is to be expected in nutritional epidemiology (Buzzard, 1998).

Food sources of energy for the Lebanese adult population were assembled into 28 food groups (Appendix N) from the 24-hour recalls using the nutritionist–pro software (www.firstdatabank.com). This was carried out to investigate percentage energy intake from the various food groups for obese versus non-obese participants.

The decision of the food groups was primarily made based on the previously-reported food consumption pattern of the adult population in Lebanon (Nasreddine et al., 2005). Food groups were further dissociated or added in reference to the exchange lists for meal planning food groups structure (The American Diabetes Association and the American Dietetic Association, 2008). For instance, dairy was divided into regular dairy and low fat dairy, vegetables into starchy and non-starchy, etc. Popular traditional Lebanese mixed dishes and western dishes were also grouped under "traditional composite" and "Western composite".

The total number of diaries which were included in the food group analysis was 2162, representing 85% of the collected 24-hour recalls (n=2540), and randomly selected based on proportional sampling from each Govern ate. The final sample (n= 1654) was obtained after exclusion of implausible reporters of energy intake from the analysis (24%, which is the same percentage as for the whole sample). The decision to include only a subsample for food group analysis was mainly related to logistic difficulties and time constraints.

The IPAQ

Data on physical activity was cleaned, coded and processed according to the guidelines for data processing and analysis of the international physical activity questionnaire, protocol for short form (IPAQ, 2005-Appendix O). When "Don't know" or "refused to answer" responses were reported, and when data were missing for time or days, the whole case was considered as missing. Responses of less than 10 minutes physical activity were recoded into "zero" or "No physical activity". Thus, only bouts of activity lasting for more than 10 minutes at a time were included in the computation process. Separate scores on walking, moderate-intensity, and vigorous-intensity physical activity were then computed as the total duration (in minutes) of each type of activity per week. A measure of total physical activity was calculated by weighting each type of activity by its energy requirements defined in METs (multiples of the resting metabolic rate; walking=3.3 METs, Moderate intensity= 4.0METs, Vigorous intensity= 8.0METs), in order to yield a score in MET-minutes/week categorized into three levels of activity: low, moderate, and high (IPAQ, 2005-Appendix O):

Low

- No activity is reported OR
- Some activity is reported but not enough to meet Categories 2 or 3 (Moderate or high level physical activity)

Moderate

Any of the following 3 criteria

- 3 or more days of vigorous activity of at least 20 minutes per day OR
- 5 or more days of moderate-intensity activity and/or walking for at least 30 minutes per day OR
- 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes/week.

High

Any one of the following 2 criteria

- Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week OR
- 7 or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 MET-minutes/week

3.9.2 Data Cleaning

Data cleaning was carried out on all variables, outliers were explored for the dependent variables including body mass index (BMI Kg/m^2), waist circumference (cm) and percent body fat, and the independent variables physical activity and energy intake, using the SPSS box plot.

The box plot displays summary statistics for the distribution of the variable values by plotting the median, the 25th percentile, the 75th percentile, as well as values that are far removed from the rest. The length of the box corresponds to the interquartile range, i.e. the difference between the 75th and the 25th percentiles; 50% of the cases have values within the box.

The box plot includes two categories of cases with outlying values: the extreme values that are more than 3 box-lengths from the upper (75th percentile) or lower edge of the box (25th percentile), and the outliers with values that are between 1.5 - 3 box-lengths from the upper (75th percentile) or lower edge of the box (25th percentile).

All outliers were examined to check the cases which should be removed from the analysis. BMI (16 outliers), waist circumference (8 outliers), and percent body fat (4 outliers) were in agreement with all outlier cases, i.e. when BMI was high, so were all the other anthropometric characteristics. For percent body fat, the cases identified as outliers at the lower extreme were also underweight, a category that was not to be included in the data analysis. Similarly, for physical activity computed as METs minutes/week, the majority of subjects reporting extreme physical activity were found to be in occupations requiring long hours of high physical effort such as construction, diving, military, and manual farming. One subject was found to have reported no logical hours of physical activity in relation to both either occupational or leisure nature. The case was investigated as to whether there was an error of documentation in questionnaire, data entry, or over-reporting on the behalf of the subject. As the subject’s telephone number was available, the subject was called and the time of physical activity performed was corrected.

As for dietary data, at the end of the 24-hour recall collection, the participants were asked the following question: “Is this 24-hour recall representative of your usual intake? If it isn’t, please state the reason”. All those who stated that their 24-hour recall was not representative, and therefore unusual, were excluded from the dietary analysis, but they were included for analysis where they provided other data (anthropometric, physical activity). A total of 74 participants reported an unusual intake for one reason or another, and were excluded from the analysis. For some of these 74 individuals, the reasons stated did indeed include a weight loss diet. These 74 individuals were excluded from the Phase 1 and Phase 2 dietary analysis.

Of interest, there were some individuals who said ‘Yes’ to the question, but also said (later on in the interview) that they were on a weight loss diet or watching their weight; as this was ‘normal’ (i.e. they were usually on a weight loss diet or watching their weight), they considered this as their usual diet.
Twenty six (26) outliers were then identified by the box plot; however, further investigation was carried out on reported energy intake following the revised Goldberg method (Goldberg et al., 1991; Black, 2000a; Black, 2000b) to identify implausible reporters, and build on dietary inferences following their exclusion from the analysis.

3.10 Definition of Variables

A subset of data derived from the adult questionnaire was used for analysis in this thesis. It could be categorized into 3 major sets of variables:

1. Demographic and socioeconomic: age, sex, marital status, family history of obesity, education, work status, income level, and household assets and characteristics.

2. Anthropometric characteristics: the anthropometric measurements data sheet provided information on body weight (kg), height (cm), waist circumferences, (cm) and skinfold thicknesses (mm)

   - BMI was calculated as weight (Kg) divided by height in meters squared, and recoded into three comparison variables according to the WHO classification: ideal: BMI= 18.5-24.9Kg/m^2, overweight BMI = 25.0-29.9 Kg/m^2, and obese BMI≥ 30 Kg/m^2.

   - Percent body fat was computed from the sum of the four measured skinfolds according to the Durnin and Womersley formula (Durnin & Womersley, 1974). Sex specific cut off points of 25% and 32% of body fat for men and women respectively were used as obesity indicators and increased health risk.

   - Waist circumference measurement was recoded into categorical sex- specific cut off points of ≥ 94 cm in men and ≥ 80 cm in women, and used as an indicator of abdominal obesity and increased risk for metabolic diseases.

3. Lifestyle characteristics: diet, physical activity, smoking and alcohol intake.

   - Diet composition: Computed from the participants' single 24-hour recall (as previously described) and expressed in tertiles of total energy and percent energy from macronutrients consumption. A sub-sample of the subjects' 24-hour recalls (n=1654) was analysed for percent energy consumed from the various food groups.

   - Three levels of physical activities were used to classify study population (www.IPAQ.ki.se):

     - Low: absence of physical activity or level of activities not meeting the threshold of moderate activity, and thus classified as inactive or sedentary (Sjostrom et al., 2006)

     - Moderate: Minimum level of activity (Level of activity equivalent to half an hour of moderate-intensity physical activity on most days)

- High: Health enhancing level of activity representing 5 days by 30 minutes of moderate intensity activity or 3 days by 20 minutes of vigorous intensity activity on top of the basal 60 minutes of moderate activity per day (at least 1500 to 3000 MET[@] min/week) (Sjostrom et al., 2006; Branca et al., 2007c; IPAQ, 2005-Appendix N)

- The amount of time spent sitting per day (reported as Median values and interquartile ranges) was used as a proxy measure of sedentary behaviour among the study population (Sjostrom et al., 2006).

All variables analysed to examine the association between obesity and its covariates in this thesis were categorical and in turn classified into two major types:

1. Dependent Variable (outcome variable) :

   - Body Mass Index (BMI): BMI ≥30Kg/m^2

2. Independent Variables**:** include socio-demographic, lifestyle, and dietary intake covariates that were examined in association with obesity prevalence and as obesity predictors.

In order to avoid presentation of extraneous details, and to simplify interpretation of tabulated study data, researchers would opt to combine/collapse the many-valued study variable into fewer categories, using for example median or tertile splits. Similarly, in this study new variables were created based on the recoded values of existing ones and according to their frequency distributions.

Following is a summary of variables used in the study, the reasons they were collected, the methods of collection, and the manner in which they are used in the analysis. A further detailed list of these variables and how they were coded / recoded is included in Appendix P.

Table 3.4 Summary of Variables Used in the Study

Variable	Reason for inclusion in the study	Method of collection	Inclusion in analysis
Weight/ height	Anthropometric indices to determine BMI	Measured at interview	-BMI
BMI(Kg/m$^{2)}$	Outcome Variable	Computed from weight and height measures	-Classified according to WHO cut-off to determine Obesity prevalence -Dependent Variable in regression analysis
Skinfold thicknesses	Anthropometric indices to determine % Body Fat	Measured by skinfold calliper at interview	-%BF
Percent Body Fat	Anthropometric index of body composition	Computed according to Siri Equation	-Descriptive analysis (ANOVA)
Waist circumference	Anthropometric index of abdominal obesity	Measured at interview	-Descriptive analysis (ANOVA)
Sex, age, Marital Status	Demographic characteristics reported to be associated with obesity	Self-reported at interview	-Cross tabulation with BMI -Independent variables in regression analysis
Education Level , Work Status	Socioeconomic indicator reported to be associated with obesity	Self-reported at interview	-Cross tabulation with BMI -Independent variables in regression analysis
Income	Socioeconomic indicator reported to be associated with obesity	Self- reported at interview	-Cross tabulation with BMI -excluded from regression analysis due to large # of missing cases
House ownership,	Indicator of Socioeconomic Status	Self- reported at interview	-Cross tabulation with BMI
Household Assets	Socioeconomic indicator reported to be associated with obesity	Computed from assets in the house +car+mobile	-Cross tabulation with BMI -Independent variable in regression analysis
Crowding index	Socioeconomic indicator reported to be associated with obesity	Computed from family size and #of rooms in the house	-Cross tabulation with BMI -Independent variable in regression analysis
Family History of obesity	Reported to be associated with obesity	Self-reported	-Independent variable in regression analysis

Table 3.4 (Cont'd)- Summary of Explanatory Variables Used in the Study

Variable	Reason for inclusion in the study	Method of collection	Inclusion in analysis
Physical Activity	Component of the energy balance equation associated with obesity	Self -reported using the International Physical Activity Questionnaire	-Cross tabulation with BMI -Independent variable in regression analysis
Smoking, alcohol consumption	Lifestyle factors reported to be associated with obesity	Self- reported at interview	-Cross tabulation with BMI -Independent variables in regression analysis
Energy Consumption	Component of the energy balance equation associated with obesity	Computed from a single 24 hour recall collected at interview	-Descriptive Analysis (ANOVA) -Cross tabulation with BMI -Independent variable in regression analysis
%Energy Consumption form Macronutrients	Chemical Composition of the diet reported to be associated with obesity	Computed as percent of total energy intake	Descriptive Analysis (ANOVA) -Cross tabulation with BMI -Independent variable in regression analysis
Consumption of regular meals	-Reported to be a preventive measure to obesity -Cultural belief	Determined from number of meals reported to be consumed /day by participant	-Independent Variable in regression analysis (simple age stratified model)
Snacking, number of snacks /day	Frequent snacking reported to be associated with obesity	Self-reported at interview	-Independent Variable in regression analysis (simple age stratified model)
Eating at TV	-Associated with increased food consumption -Cultural belief	Self-reported at interview	-Independent Variable in regression analysis (simple age stratified model)
Trying to increase consumption of fruits, vegetables	-Perceived as health behaviour to improve weight status	Self-reported at interview	Independent Variable in regression analysis (simple age stratified model)
Trying to decrease fat , sugar consumption	-Perceived as health behaviour to improve weight status	Self-reported at interview	Independent Variable in regression analysis (simple age stratified model)
Trying to increase Physical Activity	-Perceived as lifestyle behaviour to improve weight status	Self-reported at interview	Independent Variable in regression analysis (simple age stratified model)

3.11 Statistical Methods

All Statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS 18) (SPSS Inc.). The original study sample was 2697; however, underweight subjects (BMI < 18.5) (n=50) and missing cases (n=39) were excluded yielding a sample of 2608. The statistical analysis plan for this thesis was arrived at in discussion with Adetayo Kasim who is a medical statistician working in Wolfson Research Institute at Durham University, and also with Doctor Abla Sibai who is a professor at the faculty of Health Sciences at the American University of Beirut.

The statistical analysis was performed on the study population (n=2608) in two phases:

1. **Phase 1 Analysis:**

    a. To determine obesity prevalence among the study population.

    b. To examine association between sociodemographic and dietary variables with obesity in the study population. Analysis included all participants excluding underweight subjects and those with missing BMI data **(n=2608).**

2. **Phase 2 Analysis:** Additional exploratory analysis was carried out to identify implausible reporters of energy intake (sec 3.12) and to build on dietary inferences following the exclusion of under- and over-reporters of energy intake. The analysis included participants having measured weight and height **and** reporting dietary intake **(n=2540)**. Associations between the independent variables and the dependent outcome (BMI) were re-examined, excluding implausible reporters of energy intake (under-and over- reporters).

Figure 3.3 presents the adult study sample size included in each phase of the data analysis. The analysis structure of phase 1 and phase 2 is described in the next section and summarized in **Figures 3.4** and **3.5** respectively.

3.11.1 Descriptive Statistics

Statistical testing included analysis of variance (ANOVA) and chi-square test, where significance was considered at $p < 0.05$.

Phase 1 Analysis

1. Sociodemographic characteristics of the study population were examined by cross tabulation. Data are presented by gender and 3 age strata: young adults (20-39 years), midlife adulthood (40-64years), and older adults (≥ 65 years).

2. Anthropometric measurements of the study sample: BMI, waist circumference, and percent body fat, were expressed as mean values plus or minus standard deviations

(Mean ±SD). Data are presented for men and women separately in 10-year age groups, with the last age category including all those ≥ 70 years.

3. Estimates for the prevalence of obesity, elevated percent body fat, and waist circumference were determined among the study population by cross tabulation. Data are presented for men and women separately in 10-year age groups, with the last age category including all those ≥ 70 years.

4. Dietary intake characteristics of study sample: Energy intake and percent energy consumption from macronutrients were expressed as mean values plus or minus standard deviations (Mean ±SD). Data are presented for men and women separately in 10-year age groups, with the last age category including all those ≥ 70 years

5. Prevalence of the various levels of physical activity (low, moderate, high) in the study sample was examined by cross tabulation (chi-square test). Data are presented for both genders, as well as for men and women separately, in 10-year age groups, with the last age category including all those ≥ 70 years.

6. Unadjusted bivariate relations between the independent variables (socio demographic characteristics, diet and physical activity) and the outcome variable BMI (Kg/m^2) were examined by cross tabulation (chi square values), separately for men and women.

Phase 2 Analysis

1. Anthropometric measurements and dietary intake characteristics of the study sample classified as under-reporters, over-reporters, and acceptable reporters were expressed as mean values plus or minus standard deviations (Mean ±SD). Data are presented for males and females separately.

2. Unadjusted bivariate relations between socio-demographic characteristics and classification into under-reporters, over-reporters, and acceptable reporters were examined by cross tabulation. Data are presented for males and females separately.

3. Mean percent energy intake from various food groups by obese and non-obese subjects was examined using independent t-test.

3.11.2 Logistic Regression

Statistical analysis included a series of age stratified simple and multivariate regression models, for men and women separately.

Phase 1 Analysis

Simple as well as multivariate logistic regression analysis was carried out, with percent obese (BMI ≥ 30kg/m^2) -compared to non-obese- as the dependent variable and a number of potential baseline characteristics as the independent variables, such as age, gender, education, marital status, income, smoking and alcohol intake, physical exercise and diet. Total energy consumption and proportion of energy intake from macronutrients (fat, protein, and carbohydrates) were divided into tertiles and included in the model as categorical variables depending on their frequency distribution.

The regression analysis conducted was stratified by three age strata: young adults (20-39 years), midlife adulthood (40-64 years), and older adults (≥ 65years) (Isaacs JS et al., 2009). Prevalence odd ratios (ORs) and their 95% confidence intervals (CI) were calculated to estimate the magnitude of association between obesity and the different social, demographic, and behavioural factors. The logistic regression will be presented in two steps, for men and women separately:

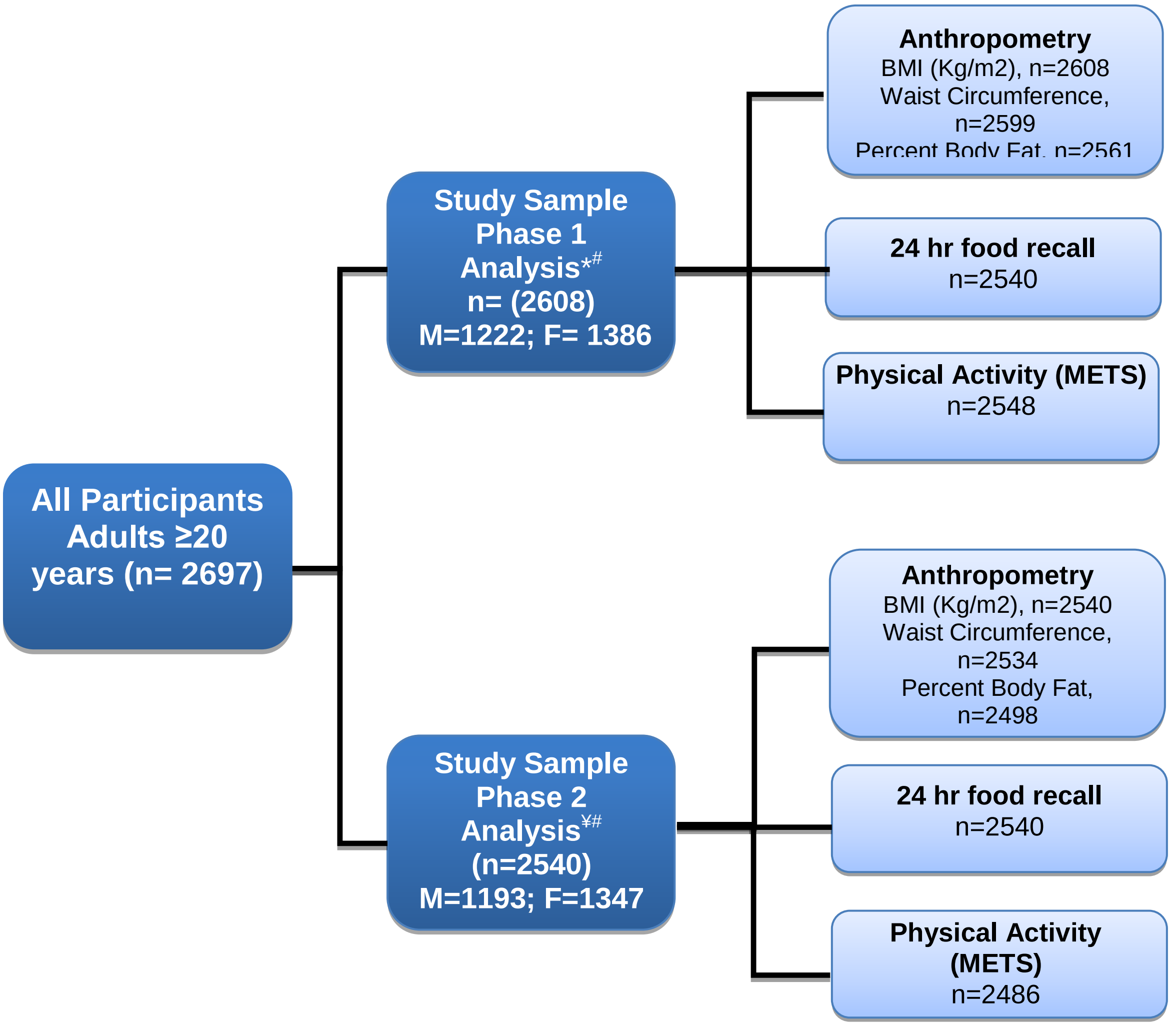
Step 1: Simple logistic regression; each of the independent variables was explored individually.

Step 2: Multivariate regression; controlling for sociodemographic, dietary and physical activity independent variables.

The criteria for inclusion of variables in the final multivariate model were the statistical significance at the bivariate level and the theoretical importance of the variable as a possible contributing factor to obesity as suggested by the literature. Moreover, to decrease multicolinearity and obtain a statistically stable model, variables with the highest Standard Error were constantly omitted from the initial model until the magnitude of SE of all variables in the final one ranged between 0.001-5.0 (Chan YH, 2004).

Phase 2 Analysis

Based on the above results, multivariate logistic regression was conducted without going through the steps of phase 1. The same final multivariate model as in phase 1 was used, excluding over- and under-reporters of energy intake. These implausible reporters were identified by the revised Goldberg Method (Goldberg et al., 1991; Black, 2000a; Black, 2000b) as described in the subsequent section.



***** All participants excluding underweight subjects (n=50) and those with missing BMI (n=39)
¥ All participants having measured weight & height and reporting dietary intake , excluding underweight subjects
Strategy for phase 1 analysis and phase 2 analysis are described in figures 3.3 and 3.4

Figure 3.3 Adult Study sample included in data analysis

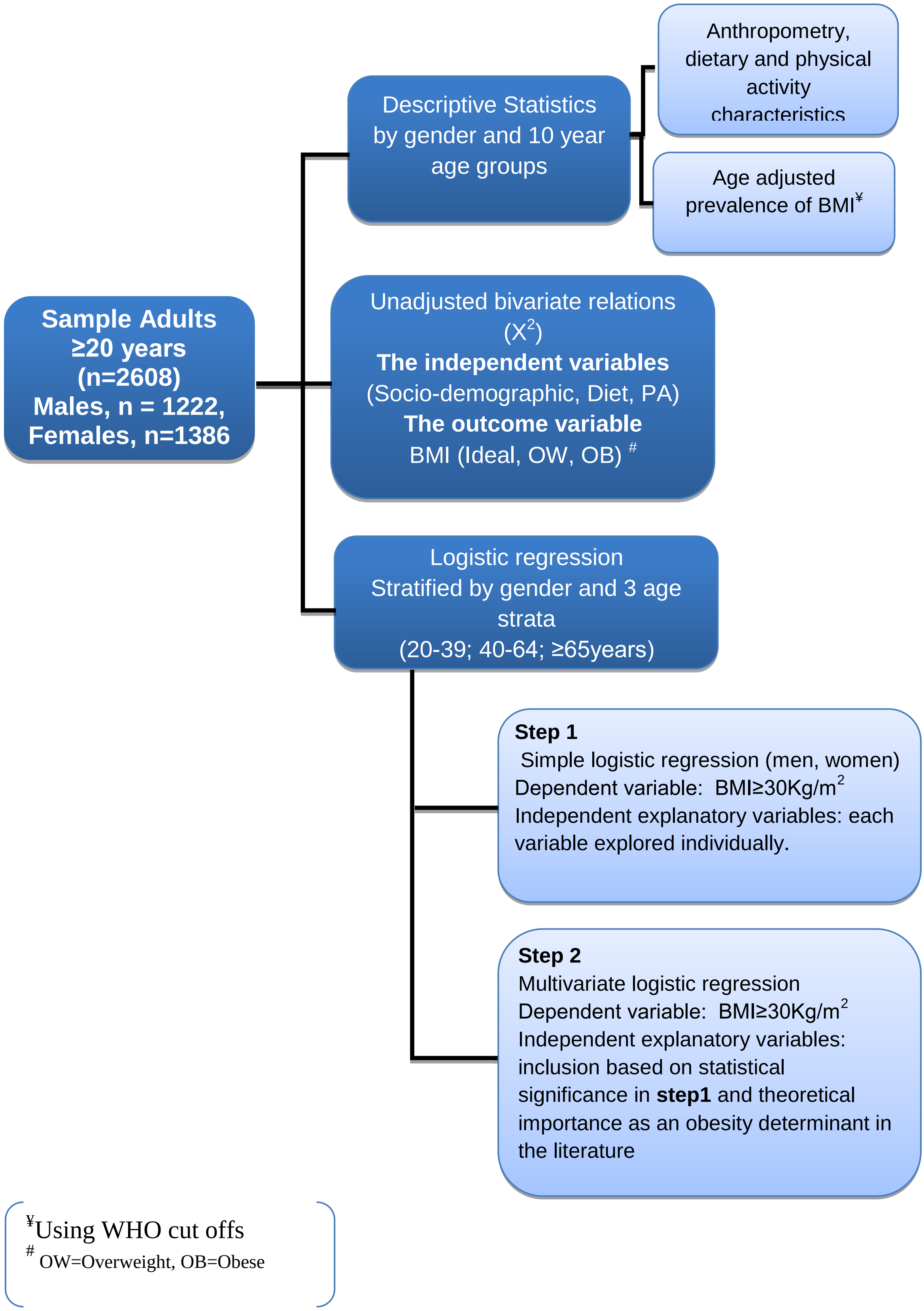
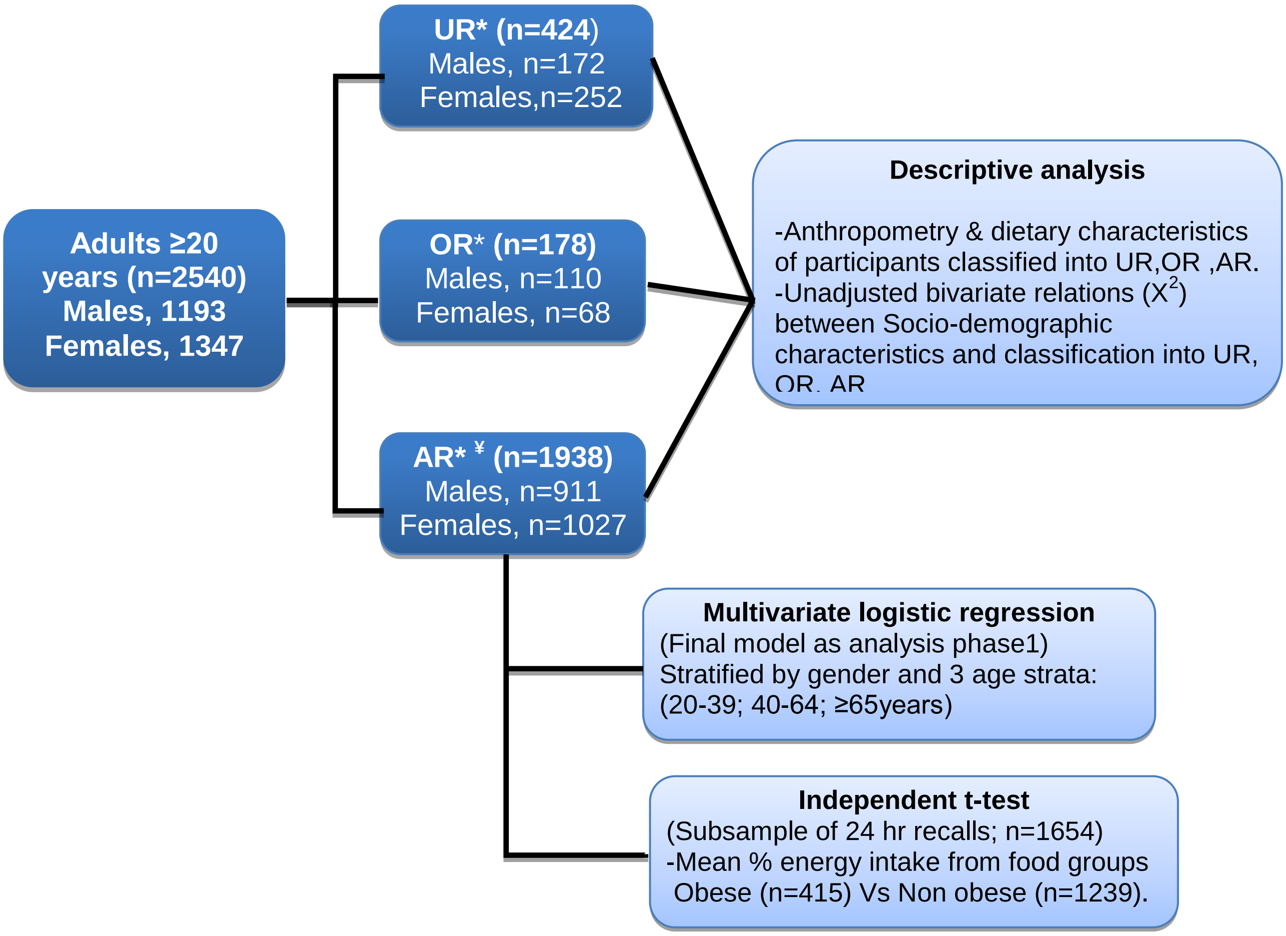


Figure 3.4 Phase 1 Analysis: All participants excluding underweight subjects (n=50) and those with missing BMI (n=39)



* Identified by the revised Goldberg Method
UR= Under-reporters, OR= Over-reporters, AR= Acceptable reporters,
¥% Obese: Males 26.8%; Females 24.1%

Figure 3.5 Phase 2 Analysis: Plausible reporters of energy Intake

3.12 Identification of Implausible Reporters of Energy Intake in the Current Study Using the Revised Goldberg Method

The objective of this section is to identify implausible reporters of energy intake with the hypothesis that using only plausible reporters will result in better association between energy consumption and weight status.

Ideally, implausible reporters would be identified by comparing reported energy intakes (rEIs) with objective estimates of energy intake such as the doubly labelled water (DLW) technique. However, such methods are often not feasible in large-scale studies as they are relatively costly (Samuel et al., 2004).

Several indirect methods were suggested for identifying implausible reporters in large studies assessing a dietary aetiology of obesity. Among the most widely used procedures is the method first developed by Goldberg and co-workers (Goldberg et al., 1991), which assesses the validity of reported energy intake (rEI) by comparing total energy expenditure (TEE) with rEI when both are expressed as a multiple of basal metabolic rate (BMR). In other words, during weight stability, rEI/BMR =TEE/BMR, the TEE/BMR ratio is also known as the physical activity level (PAL), so the equation can be rewritten as rEI/BMR =PAL (McCrory et al., 2002).

Two cut-offs for the agreement between PAL and rEI/BMR were first developed by Goldberg et al. (Goldberg et al., 1991) and their application was later demonstrated and revised by Black et al. (Black et al., 2000b; Black, 2000a).

CUT-OFF 1 was set at a PAL of 1.35, representing a minimum plausible value for weight maintenance for most individuals, and thus values of rEI/BMR less than 1.35 would be considered as having poor validity because it is unlikely that most individuals would be able to maintain weight with a usual energy intake below this minimum level (McCrory et al., 2002). This cut off, as defined in the original paper by Goldberg (Goldberg et al., 1991), is the simpler equation since it does not require any probabilistic calculations to allow for differences between short-term measurements and habitual intake.

CUT-OFF 2 involves a statistical comparison between rEI/BMR and PAL, accounting for both biological variability and measurement errors for both energy intake and total energy expenditure (Goldberg et al., 1991; Black, 2000a), and answers to the question of whether or not the reported intake is a plausible measure of the actual diet during the measurement period. This standard Goldberg cut-off (Goldberg et al., 1991) sets only a lower cut-off since under-reporting, defined as a condition in which healthy subjects with stable weights report a lower energy intake that is biologically improbable and inconsistent (Kant, 2002), was the more common aspect of dietary assessment (Sumar et al., 2003).

The equation principles of the Goldberg cut-offs and the factors to be used in it were further recapped by Black (Black, 2000a; Black, 2000b), recommending that CUT-OFF 1 no longer be used to identify inaccurate reports of energy intake because it ignores biological variability and measurement errors for both energy intake and TEE. Black recommended the use of a revised Goldberg CUTOFF 2 (Black, 2000a) that determines not only the lower limits but also the upper limits for detecting both under- and over reporting (Black, 2000a), especially when individual evaluation of energy intake is needed, as in regression analysis for diet disease associations (Black, 2000a; McCrory et al., 2002; Mendez et al., 2011). These minimum cut-offs, representing the 95% lower limit (-2SD) below which subjects are underreporting, and maximum cut-offs, the upper (+2SD) confidence limits above which subjects are considered as over-reporting, are derived via a statistical comparison between rEI/BMR and PAL as described below (Black, 2000a; Black, 2000b).

The revised Goldberg Cut-off (Black 2000a; Black 2000b)

EI: BMR > PAL x exp [SDmin x {(S/100)/√n}] (lower limit)

EI: BMR < PAL x exp [SDmax x {(S/100)/√n}] (upper limit)

The values used for each factor are pooled means from doubly labelled water (DLW) studies and recommended by Black (Black, 2000a) as suitable average values to be substituted in the revised Goldberg CUTOFF 2 where:

- **PAL** is the presumed average PAL for the population under study (Black, 2000a)
- **SD** is standard deviation: for a 95% confidence interval for the comparison between rEI/BMR and PAL, SDmin = -2 and SDmax =+2.
- **S** is the factor that accounts for variation in EI, BMR and energy requirements, and is calculated by: $S = \sqrt{(CV^2_{wEI}/d) + CV^2_{wB} + CV^2_{tP}}$, where
- **CV_{wEI}** is the within-subject variation in energy intake = 23%
- **d** is the number of days of diet assessment
- **CV_{wB}** is the within-subject variation in repeated BMR measurements or the precision of estimated compared with measured BMR= 8.5%
- **CVtP** is the between-subject variation in PAL= 15%

In the current study, subjects are classified as under-reporters (UR), over-reporters (OR), and acceptable reporters (AR), according to their calculated reported energy intake and estimated basal metabolic rate ratio (EIrep: BMRest ratio), and the lower and upper Goldberg cut-offs for n=1, since dietary data is analysed on an individual level by regression for the examination of potential relationship between energy intake and BMI (Megan et al., 2002). The study population mean PAL of 1.35 which classifies this study population as inactive according to the Food and Agriculture Organization (FAO, 2001) was used as the yardstick PAL (Men mean PAL= 1.44; Women mean PAL = 1.28).

Because the Schofield equations have been found to lead to overestimation of BMRs among obese and sedentary subjects (Horgan & Stubbs, 2003; Alfonzo-Gonzalez et al., 2004), in the current study, implausible reporters were classified by using an alternative BMR equation: the Mifflin St Jeor; this equation has been shown to correspond well with measured BMR values in both obese and non-obese subjects (Mifflin et al., 1990; Frankenfield et al., 2005; Mendez et al., 2011).

While it is important to identify inaccurate reports of energy intake, as noted by Black (Black, 2000a), it is also important to note that the use of the Goldberg cut-off for doing so has **evident limitations**:

1. The lower sensitivity of the Goldberg cut-off for identifying inaccurate energy intake reports at the individual level (McCrory, 2002), especially where a particular choice of PAL for comparison with EI: BMR at individual activity level, may result in differential sensitivity of the cut-off if the selected PAL for one level is close to the true value but that for another level is not (Black, 2000b).

2. Certain researchers consider that the use of the 95% confidence limits (± 2 SD) for the agreement between rEI/BMR and PAL as suggested by Goldberg (Goldberg et al., 1991) and Black (Black, 2000a, 2000b) as another limitation of the Goldberg cut-off as it only identifies extremely inaccurate reporting (McCrory, 2002). These same authors suggested the use of more stringent cut-off of ±1 SD (86% confidence limits) (McCrory, 2002; Mendez et al., 2011). However, the Goldberg cut-off authors argue that the identification of inaccurate reporters should be based on a standard statistical comparison because while the measured energy intake may not represent habitual intake, it could still represent actual intake during the measurement period (Goldberg et al., 1991; Black, 2000a).

To improve the general quality of the dietary data in this study, evaluation of the validity of reported energy intake was carried out using the revised Goldberg Method (Black, 2000a; Livingstone & Black, 2003), its recommended 95% confidence limits (±SD), and a study mean PAL of 1.35 for the identification of distinct implausible reporters with the argument that a valid or correct report is one that measures the true intake during the period of study (Livingstone & Black, 2003). Relevant charted data will be presented in the results chapter referring to this lower and upper cut-off value, detailed calculations of which are described in section 3.12.1.

3.12.1 Calculations of the Goldberg Cut-offs for this Study According to the Goldberg Statistical Formula

Following the pooled mean values given by Black (Black, 2000b), the Goldberg cut-off was calculated for the study population with d=1 (one 24-hour recall was taken per subject and n=1 (for individual regression associations) as described below:

EI: BMR > PAL x exp [SDmin x {(S/100)/√n}] (lower limit)

EI: BMR < PAL x exp [SDmax x {(S/100)/√n}] (upper limit), where

$$S = \sqrt{(CV^2_{wEI}/d) + CV^2_{wB} + CV^2_{tP}}$$

&

d=1, n=1

$$S = \sqrt{(23^2/1) + (8.5)^2 + (15)^2}$$

S =28.74

- **Goldberg Cut off for the study population:** SD= ±2 (95% confidence limit), Study population Mean PAL= 1.35.

Lower limit	Upper limit
EI: BMR > 1.35 x exp [-2 x {0.2874/√1}]	EI: BMR < 1.35 x exp [+2 x {0.2874)/√1}]
EI: BMR > 1.35 x exp (-0.5748)	EI: BMR < 1.35 x exp (+0.5748)
EI: BMR > 1.35 x 0.5628	EI: BMR < 1.35 x 1.7767
EI: BMR > 0.76	**EI: BMR < 2.39**

The lower cut-off (-2SD) was determined at PAL<0.76, the value below which it was statistically unlikely that the reported intake represented either 'habitual' long-term intake or a low intake obtained by chance (Black, 2000b). The upper cut-off limit (+2SD) was determined at PAL>2.4.

3.12.2 Distribution of Plausible and Implausible Reporters among the Study Population

Table 3.5 shows the distribution of the study population classified as acceptable, over- and under-reporters by gender according to the calculated revised Goldberg minimum cut off of 0.76 (-2SD) and maximum cut off of 2.4 (+2SD). The proportion of under-reporters was higher in women (18.7%) compared with men (14.4%), whereas over-reporting was higher in men than in women (9.2% and 5% respectively). Overall, the bias was to under-reporting (16.7%), a proportion that is almost double than in over-reporting (7%). This non-adjusted association between gender and the distribution of plausible and implausible reporters was found to be significant at $p<0.05$; however, there was no significant association with age as shown in Table 3.6.

Table 3.5 The number of subjects designated as under-reporters, over- reporters and acceptable reporters (UR, OR, AR) of energy intake by gender (n=2540)

Reporting Group	Gender [a]		
	Men % (n)	Women % (n)	Total % (n)
Under-reporters(UR)	14.4 (172)	18.7 (252)	16.7 (424)
Over-reporters(OR)	9.2 (110)	5.0 (68)	7.0 (178)
Acceptable-reporters(AR)	76.4 (911)	76.2 (1027)	76.3 (1938)
Total	100 (1193)	100 (1347)	100 (2540)

*Determined by revised Goldberg Method: Goldberg Cut-off A: UR<0.76; AR 0.76-2.4; OR>2.4
[a] Pearson Chi-Square=22.694; P=0.000

Table 3.6 Distribution of study subjects designated as under-reporters, over-reporters and acceptable reporters by age (n=2540)

Reporting Group	Age groups [a]		
	20-39 % (n)	40-64 % (n)	≥65 % (n)
Under-reporters(UR)	16.8 (226)	16.6 (153)	16.5 (45)
Over-reporters(OR)	7.8 (105)	6.9 (64)	3.3 (7.0)
Acceptable-reporters(AR)	75.4 (1013)	76.5 (706)	80.2 (219)
Total	100 (1344)	100 (923)	100 (273)

[a] Pearson Chi-Square=7.347; P=0.119

Chapter 4: Results

4.1 Results of Phase 1 Analysis

Descriptive statistics as well as age-stratified simple and multivariate regressions analysis of the association of socio demographic and lifestyle factors with obesity are presented in this section for all participants with measured weight and height excluding underweight subjects (n=50) and subjects with missing BMI (n=39). (n=2608, M=1222, F=1386).

4.1.1 Sociodemographic Characteristics of Study Population

Sociodemographic information related to the study population is presented in Tables 4.1 and 4.2., and compared to available data on the sociodemographic profile of the general Lebanese adult population.

Among the study participants, celibacy (never married) was higher in males than females in the age group 20-39 years (66.7% and 40.9%; respectively), whereas marriage rates were comparable between both genders in the age group 40-64 years (87% in males and 77.1% in females). In the older age group ≥65 years, the proportion of married men was higher than that of women (82.7% Vs 32.3%); more women reported being widowed, divorced, or separated (58.6% vs. 13.3%).

Educational attainment was comparable between both genders in the age groups 20-39 years and 40-64 year, and more men ≥ 65 years reported having a high school (14.7%) or university diploma (12.0%) as compared with women (6.8% and 3.8% respectively).

Employment was higher in men in all age groups, and more men were self-employed as compared with women. House ownership, an income of 1-3 million Lebanese pounds per month, and a medium self-perceived level of socioeconomic status were factors reported by the majority of the study participants.

Alcohol consumption and smoking were higher among males than females in all age groups. A higher proportion of young males 20-39 years of age exhibited a higher level of physical activity than females (27.9% and 19.7% respectively), whereas the reverse was reported at the age group 40-64 years (20.1% in males and 28.5% in females).

Compared with sociodemographic characteristics reported for the general population in various surveys, this study sample is reasonably representative of the Lebanese adult population. Average male and female celibacy (never married) in Lebanon was reported to be 57.5% in males and 43.4% in females 20-39 years of age, 5.5% in males and 10.8% in females aged 40-64 years, and 2% in males and 5.4% in females ≥ 65 years (Ministry of social affairs, 2006). The celibacy trend observed in this study reflects that of the general population.

Illiteracy was reported to be higher in Lebanese women than in men (16% and 8% respectively); however, above primary level education, the proportion of men and women achieving each level was broadly equivalent (Yaacoub & Badre, 2012). Among the study participants, above primary level education was comparable between males and females except those at the age group ≥65 years. In 2009, the economic activity rate for men 25 to 60 years was reported to be as high as 90%, whereas it peaked at 47% for those aged 25-29 years and gradually declined thereafter (Yaacoub & Bader, 2011). In general, more women worked as salaried employees, and more working men were business owners or self-employed (Yaacoub & Bader, 2011).

Comparable with this study data, physical activity was reported to be prevalent in 55% of Lebanese adults≥ 15 years (Al-Tannir, 2009), and smoking and alcohol consumption were reported to be higher among males than females > 15 years (Ghandour, 2009; WHO, 2003).

Mean Household size of study participants was (4.0±1.863), with a monthly mean income of 816.899±1.370.934 Lebanese pounds. This is comparable to the average family size of 4 reported for the Lebanese population (Ministry of social affairs, 2008). The average monthly income for the Lebanese population was recently reported to be approximately 1,540,000 L.P. (Yaacoub & Badre, 2012).

Table 4.1 Socio-demographic factors reported by the baseline sample adults≥20 years by age and gender (n=2608)

Variable	**Males (n=1222)**			**Females (n=1386)**		
	Age Groups (years)					
	20-39	**40-64**	**≥65**	**20-39**	**40-64**	**≥65**
Marital Status	**% (n)**					
Single	66.7(425)	9.2(40)	4.0(6)	40.9 (303)	7.0(36)	9.0(12)
Married	32.2(205)	87.6(380)	82.7(124)	57.8 (428)	77.1(394)	32.3(43)
Divorced, Separated, Widowed	1.1(7)	3.2(14)	13.3(20)	1.3 (10)	15.9(81)	58.6(78)
Educational level	**% (n)**					
Preliminary or less	8.0(51)	31.6(137)	54.0(81)	8.6(64)	26.2(134)	66.2(88)
Complimentary	24.9(159)	27.9(121)	19.3(29)	21.7(161)	28.2(144)	23.3(31)
High school / Diploma	28.2(180)	21.4(39)	14.7(22)	28.0(208)	28.0(143)	6.8(9)
University	38.9(248)	19.1(83)	12.0(18)	41.6(309)	17.6(90)	3.8(5)
Work Status						
Doesn't work/retired	5.5(35)	17.3(75)	64.0(96)	49.1(364)	79.1(404)	96.2(128)
Government employee	10.2(65)	11.8(51)	2.7(4)	4.7(35)	5.3(27)	0.0(0)
Private sector employee	33.9(216)	19.1(83)	3.3(5)	26.0(139)	8.0(41)	1.5(2)
Self employed	37.0(236)	51.8(225)	30.0(45)	7.3(54)	7.0(36)	2.3(3)
Student / volunteer work	13.3(85)	0.0(0)	0.0(0)	12.9(96)	0.6(3)	0.0(0)
Income (Lebanese Pounds)	**% (n)**					
< 1 Million	18.4(109)	38.8(155)	53.1(69)	31.4(217)	46.0(214)	59.1(65)
1-3 Million	60.3(358)	48.5(194)	40.0(52)	52.4(362)	44.9(209)	35.5(93)
>3 Million	21.4(127)	12.8(51)	6.9(9)	16.2(112)	9.0(42)	5.5(6)
House ownership	**% (n)**					
Owns house	72.2(458)	72.0(309)	78.2(115)	69.7(511)	69.5(353)	73.3(96)
Rents house	27.8(176)	28.0(120)	21.8(115)	30.3(222)	30.5(155)	26.7(35)
Crowding Index						
CI<1 person /room	39.2(250)	30.6(132)	66.4(99)	28.5(210)	38.7(198)	64.1(84)
CI≥1 person /rood	60.8(387)	69.4(299)	33.6(50)	71.5(528)	61.3(313)	35.9(47)
Self-perceived socioeconomic status	**% (n)**					
Low SES	12.6(80)	38.3(164)	34.5(51)	14.7(108)	30.8(157)	25.6(34)
Middle SES	82.1(523)	57.5(245)	59.5(88)	80.2(589)	66.2(337)	70.7(94)
High SES	5.3(34)	4.4(19)	6.1(9)	5.0(37)	2.9(15)	3.8(5)
Alcohol consumption	**% (n)**					
No	45.9(293)	47.0(204)	47.3(71)	69.3(514)	69.3(354)	72.9(97)
Yes	54.1(345)	53.0(230)	52.7(79)	30.7(228)	30.7(157)	27.1(36)
Smoking	**% (n)**					
No	32.4(207)	29.3(127)	34.0(51)	54.4(404)	42.3(216)	54.1(72)
Yes	67.6(431)	70.7(307)	66.0(99)	45.6(338)	57.7(295)	45.9(61)
Physical activity	**% (n)**					
Low	49.8(307)	47.0(199)	43.2(64)	47.7(346)	33.1(166)	59.4(79)
Moderate	22.2(137)	32.9(139)	41.9(62)	32.6(237)	38.4(193)	24.8(33)
High	27.9(172)	20.1(85)	14.9(22)	19.7(143)	28.5(143)	15.8(21)

Table 4.2 Household Mean size and average income per month of the study population (n=2608)

Variable	**Mean±SD**
Household size (family members)	4.30±1.863
Household income/month (Lebanese Pounds)	816,899±1,370,934

4.1.2 Anthropometric Measurements of Study Population: the Outcome (BMI)

4.1.2.1 Anthropometric Measurements of Male Adults

Table 4.3 presents the mean BMI (Kg/m^2), waist circumference, and % body fat values (±SD) of the study adult males≥20 years. Mean values for BMI increased progressively with increasing age, until the age of 40-49 years (BMI=28.5±45.1), and remained constant thereafter. However, the Mean BMI values for all age groups were greater than the 25 Kg/m^2, the WHO cut off point for overweight.

The waist circumference (cm) showed the same trend as the BMI, remaining fairly constant after the age of 40 years. Mean percent body fat also increased with age, presenting highest mean value in the age group 50-59 years (32.4±6.5), with a reverse in the trend in the older categories; however, it is still higher compared with the younger age groups (20-39 years).

A comparatively parallel trend is noticeable in the relationship between BMI and percent body fat with aging, as shown in **Figure 4.1**; however, BMI steadied at an earlier age than percent body fat.

For further details on the anthropometric measurements of male participants in the study, data are also presented as median and interquartile ranges in Appendix Q.

Table 4.3 Anthropometric measurements of male participants by 10 year age groups (n=1222)

Variables	Age Groups					
	20-29 n = 357	**30-39** n =281	**40-49** n = 218	**50-59** n = 152	**60-69** n = 104	**70+** n =110
	Mean ± SD					
Weight (Kg)	80.2±15.6[a]	84.3±16.4[b]	85.5±15.5[b]	85.1±14.7[b]	80.4±14.2[a]	77.9±13.3[a]
Height (cm)	175.6±6.5[d]	174.9±6.9[d]	173.1±6.5[c]	171.8±7.3[c]	168.4±6.7[b]	166.2±7.0[a]
BMI (kg/m2)	25.9±4.4[a]	27.5±4.6[b]	28.5±5.1[c]	28.7±4.2[c]	28.2±4.2[c]	28.1±3.9[c]
Waist circum. (cm)[¥]	87.7±12.5[a]	94.8±12.0[b]	97.9±12.7[c]	99.9±12.2[c]	98.1±12.9[c]	100.1±11.3[c]
%Body Fat [#]	21.1±5.2[a]	24.9±4.1[b]	29.3±5.7[c]	32.4±6.5[e]	30.9±5.9[d]	29.9±5.9[cd]

*In any one row, mean values with superscripts of the same letter are not significantly different; mean values with superscripts of different letters are significantly different at $p < 0.05$.
P values for Mean BMI, weight, height, waist circumference and % body fat were derived from one way ANOVA.
[¥] Waist circumference (n= 1217)
[#] % body fat (n=1198). Percent body fat was computed from the sum of the four measured skinfolds according to the Durnin and Womersley formula (Durnin & Womersley, 1974).

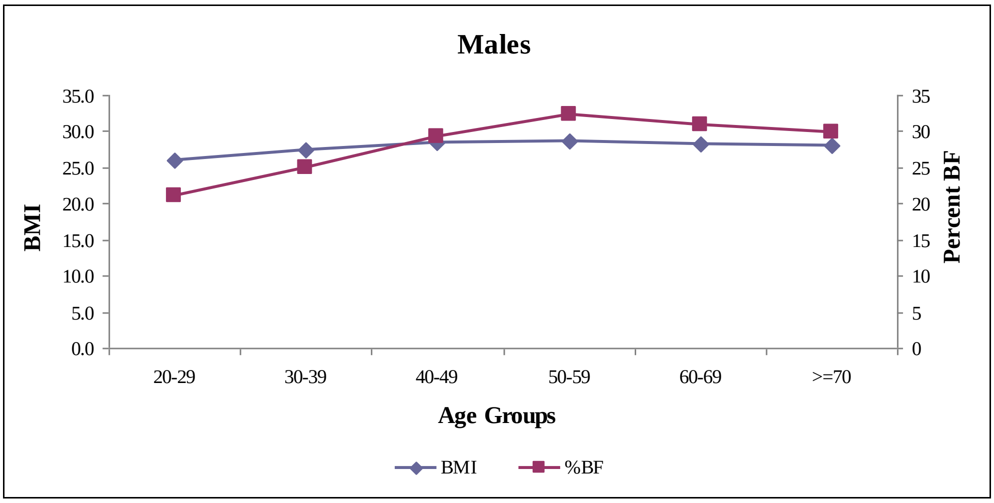


Figure 4.1 Relationship between body mass index and body fat for male adults ≥20 years by 10 year age groups.

4.1.2.2 Anthropometric Measurements of Female Adults

As presented in Table 4.4, and compared with men, women showed a slightly lower BMI estimates overall before the age of 40 years; however, the mean BMI increased steadily with age, peaking at the 50 -59 year age group (BMI=30.4±5.7) , and remaining constant throughout the older age groups. Only the age group 20-29 years showed an ideal BMI estimate (23.7±4.0). Both mean waist circumference and mean percent body fat increased significantly throughout the age groups, with the highest waist circumference mean value apparent at the 70+ year age group (100.9±15.3), whereas fat showed a constant trend after peaking at 50-59 years (42.1±3.9). For further details on the anthropometric measurements of study female participants, data are also presented as median and interquartile ranges in Appendix Q.

Table 4. 4 Anthropometric characteristics of female participants by 10 year age groups (n=1386).

Variables	Age Groups					
	20-29 n = 393	30-39 n =349	40-49 n = 277	50-59 n = 158	60-69 n = 126	70+ n =83
	Mean ± SD					
Weight (Kg)	61.9±10.9[a]	67.59±13.2[b]	71.7±15.6[c]	74.5±14.2[c]	71.8±14.1[c]	73.5±13.8[c]
Height (cm)	161.6±5.9[d]	160.7±5.7[d]	158.9±5.6[c]	156.6±5.8[b]	154.4±6.4[a]	154.2±6.5[a]
BMI (kg/m2)	23.7±4.0[a]	26.3±4.9[b]	28.4±6.0[c]	30.4±5.7[d]	30.1±5.6[d]	31.0±6.2[d]
Waist circum. (cm)	78.1±10.3[a]	83.5±11.8[b]	87.7±12.6[c]	95.4±14.8[d]	96.2±13.6[d]	100.9±15.3[e]
% Body Fat	30.9±5.0[a]	33.5±4.6[b]	37.2±4.5[c]	42.1±3.9[d]	40.9±4.4[d]	41.5±4.9[d]

*In any one row, mean values with superscripts of the same letter are not significantly different; mean values with superscripts of different letters are significantly different at $p < 0.05$.
P values for Mean BMI, weight, height, waist circumference and % body fat were derived from one way.
[¥] Waist circumference (n= 1382)
[#] % body fat (1363). Percent body fat was computed from the sum of the four measured skinfolds according to the Durnin and Womersley formula (Durnin & Womersley, 1974).

As in men, the BMI and percent body fat in women showed also a parallel trend with aging (**Figure 4.2**). Both mean percent body fat and mean BMI increased at the 50-59 years age group.

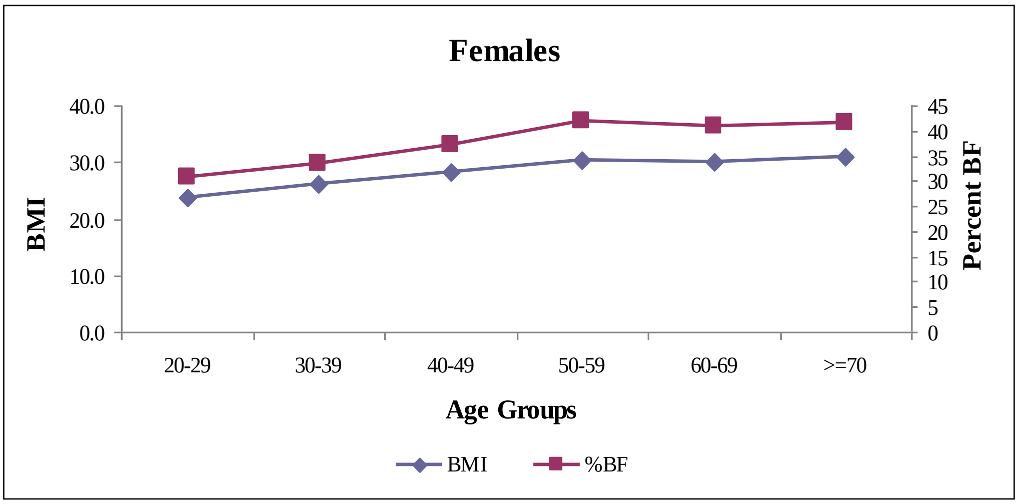


Figure 4.2 Relationship between body mass index and body fat for female adults ≥20 years by 10 year age groups

4.1.3 Prevalence of Ideal Body Weight, Overweight, and Obesity among Study Population

Among the study population (Table 4.5), ideal body weight (BMI=18.5-24.9 kg/m^2) was generally higher in women than in men (42.1% vs. 31.2%), and more evidently so among the age groups from 20 -39 years (69.5% vs. 47.1%), with a reverse trend observed at two decades later (16.5% vs. 17.8%). The prevalence of overweight (BMI =25.0 to 29.9 kg/m^2) was estimated at 36.5% in both genders: 42.1% in men and 31.4% in women. Across the age groups, the proportions were also higher for men than women, peaking however at the same age group of 40-49 years for both genders (men 47.2%; women 43.7%). Obesity prevalence rates (BMI≥30 kg/m^2) changed with increasing obesity class, where in overall obesity class 1 (BMI=30-34.9 kg/m^2) prevalence rates were still higher among men (21.21%) than women (16.2%), mainly across the early age groups. The trend was reversed in obesity class 2 (BMI= 35-39.9 kg/m^2) and obesity class 3 (BMI ≥ 40 kg/m^2), where estimates were generally higher among women starting at the age of 40 years and increasing with age.

Table 4.5 Prevalence of Body Mass Index[1] among Lebanese adults 20-74 years by age groups and gender (n=2608*)

	Age Groups						
	20-29 (n=750)	**30-39 (n=630)**	**40-49 (n=495)**	**50-59 (n=310)**	**60-69 (n=230)**	**70+ (n=193)**	**Total (n=2608)**
Ideal Body Weight BMI= 18.5 to 24.9 Kg/m^2 % (n)							
Men[a]	47.1 (168)	31.7 (89)	21.1 (46)	17.8 (27)	21.2 (22)	24.5 (27)	31.1 (379)
Women[b]	69.5 (273)	50.4 (176)	27.8 (77)	16.5 (26)	16.7 (21)	12.0 (10)	42.1 (583)
Both Genders[c]	58.8 (441)	42.1 (265)	24.8 (123)	17.1 (53)	18.7 (43)	19.2 (37)	36.9 (962)
Overweight BMI= 25 to 29.9 Kg/m^2 % (n)							
Men[a]	35.9 (128)	44.8 (126)	47.2 (103)	44.1 (67)	46.2 (48)	41.8 (46)	42.4 (518)
Women[b]	21.9 (86)	28.1 (98)	43.7 (121)	34.8 (55)	36.5 (46)	34.9 (29)	31.4 (435)
Both Genders[c]	28.5 (214)	35.6 (224)	45.3 (224)	39.4 (122)	40.9 (94)	38.9 (75)	36.5 (953)
Class I Obesity BMI= 30 to 34.9 Kg/m^2 % (n)							
Men[a]	13.4 (48)	17.4 (49)	24.8 (54)	28.9 (44)	28.8 (30)	30.0 (33)	21.1 (258)
Women[b]	6.9 (27)	16.0 (56)	15.2 (42)	26.6 (42)	27.8 (35)	27.7 (23)	16.2 (225)
Both Genders[c]	10.0 (75)	16.7(105)	19.4 (96)	27.7 (86)	28.3 (65)	29.0 (56)	18.5 (483)
Class II Obesity BMI= 35 to 39.9 Kg/m^2 % (n)							
Men[a]	2.5 (9)	3.9 (11)	4.1 (9)	9.2 (14)	2.9 (3)	3.6 (4)	4.1 (50)
Women[b]	1.3 (5)	3.7 (13)	8.3 (23)	16.5 (26)	12.7 (16)	15.7 (13)	6.9 (96)
Both Genders[c]	1.9 (14)	3.8 (24)	6.5 (32)	12.9 (40)	8.3 (19)	8.8 (17)	5.6 (146)
Class III Obesity BMI>=40 Kg/m^2 % (n)							
Men[a]	1.1 (4)	2.1 (6)	2.8 (6)	0.0 (0)	1.0 (1)	0.0 (0)	1.4 (17)
Women[b]	0.5 (2)	1.7 (6)	5.1 (14)	5.7 (9)	6.3 (8)	9.6 (8)	3.4 (47)
Both Genders[c]	0.8 (6)	1.9 (12)	4.0 (20)	2.9 (9)	3.9 (9)	4.1 (8)	2.5 (64)

a Pearson Chi-Square=100.523; P=0.000,
b Pearson Chi-Square=317.895; P=0.000,
c Pearson Chi- Square=363.287; P=0.000
1Using WHO cut offs.

Figure 4.3 shows the prevalence of obesity (BMI≥30 kg/m^2) in Lebanese adult males and females by 10-year age groups.

Prevalence rates for obesity (BMI ≥30 kg/m^2) were similar for both genders (26.6%), with the lowest (8.7%) and highest (53%) prevalence rates found in females aged 20-29 years and 70+ years respectively. Men showed higher prevalence rates at the younger age groups, whereas corresponding estimates for women increased over those for men at the age of 50 years and above.

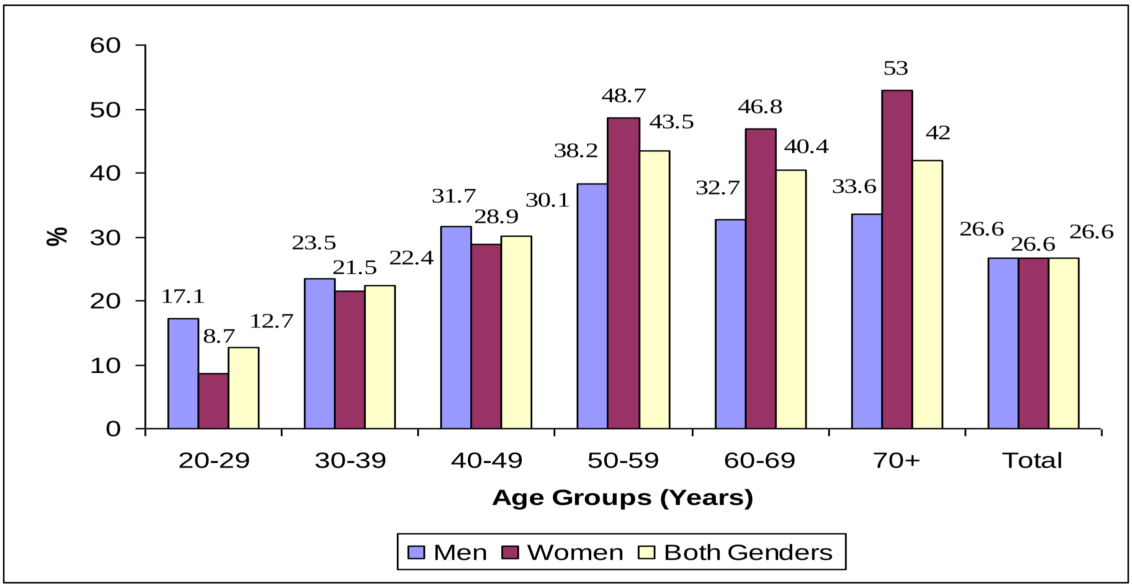


Figure 4.3 Prevalence of obesity (BMI≥30 Kg/m^2) in Lebanese adults≥20 years by 10-year age groups and gender.

4.1.4 Prevalence of Obesity in Lebanon Compared with Selected Neighbouring Countries

Figure 4.4 reproduces data for obesity prevalence in selected countries in the Middle East and North Africa (MENA) region in comparison with those obtained in the current study. Current estimates of obesity prevalence in Lebanese adults are approaching those of neighbouring countries, such as Tunisia and the UAE, although with dissimilar proportions between men and women.

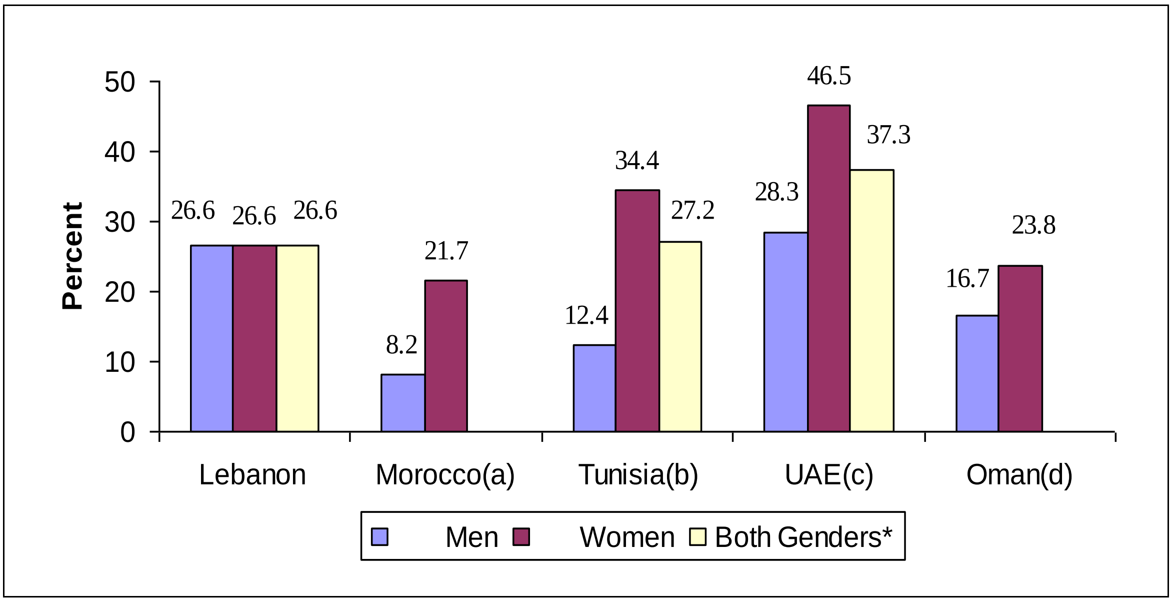


Figure 4.4 Prevalence of obesity (BMI≥30 Kg/m^2) among adults (≥ 20 years) in selected countries of the Eastern Mediterranean Region compared with the current data on Lebanon (2008)
(a) Tazi et al., 2000. (b) Ghannem et al., 1997 (c) Baynouna et al., 2008
(d) Al_Lawati et al., 2004(Overall prevalence data not available for Morocco and Oman).

4.1.5 Prevalence of Abdominal Obesity and Elevated Percent Body Fat in Lebanese Adults ≥20 years

Figure 4.5 presents percent distribution of adiposity in the adult study sample according to elevated percentage of body fat; **Figure 4.6** shows percent distribution by age and gender of the study sample at risk of metabolic disease using waist circumference. Both men and women showed rising trends in both characteristics with increasing age, with prevalence rates peaking at the age group 50-59 years. Compared with men, women presented a higher overall proportion of adiposity (69.2% vs. 58.5%, $p<0.05$) and percent at risk for metabolic disorders (61.9% vs. 52.2%, $p<0.05$).

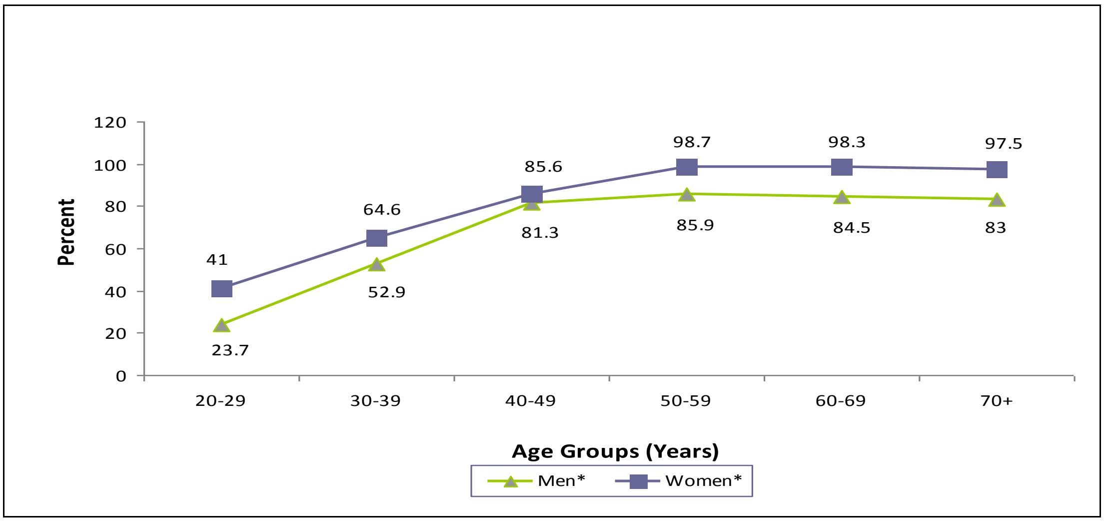


Figure 4.5 Percent distribution of subjects with elevated percentage of body fat, by age and gender (n=2561)
Δ, men (n=1198) (% body fat: ≥25); Pearson chi square =327.318, P=0.000; □, women (n=1363) (% body fat: ≥32); Pearson chi square =333.622, P=0.000.

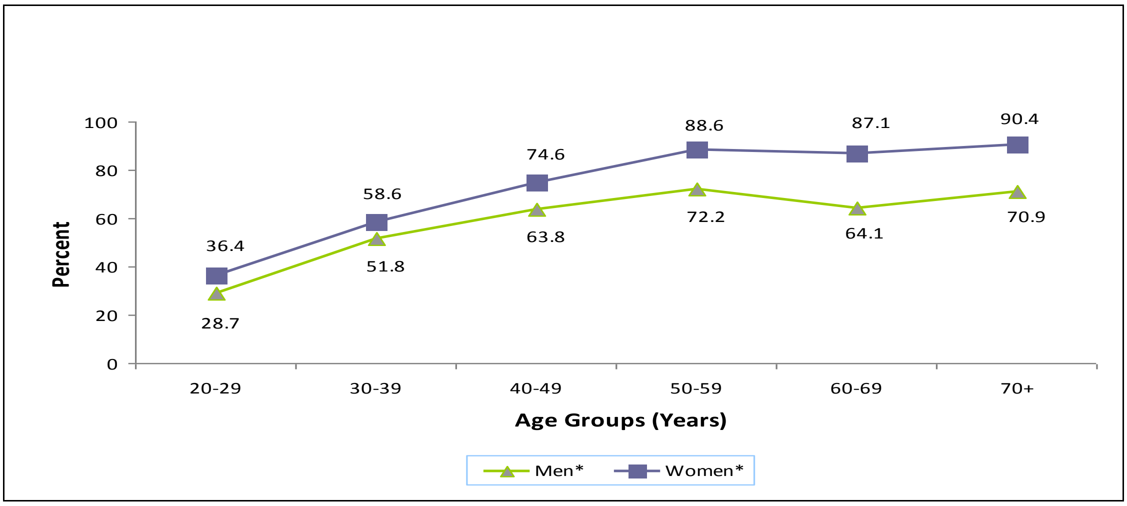


Figure 4.6 Percent distribution of subjects with elevated waist circumference, by age and gender (n=2599).
Δ, men (n=1217) (WC: ≥94 cm; Pearson chi square =135.512, P=0.000; □, women (n=1382) (WC: ≥80 cm); Pearson chi square =241.271, P=0.000.

4.1.6 Socio Demographic Characteristics of Study Participants Associated with the Prevalence of World Health Organization Classes of Body Mass Index (Ideal =18.5-24.9Kg/m2, overweight =25.0-29.9 Kg/m2, and obese ≥ 30Kg/m2)

Appendix R presents tables which report the unadjusted association between the independent socio-demographic variables and the dependent variable Body Mass Index (Kg/m^2) for males and females ≥20 years.

In men, the initial cross tabulation showed a significant association of BMI with age, marital status, and education ($p<0.05$). Of the lifestyle factors, alcohol intake and physical activity were significantly related to the incidence of ideal body weight, overweight, or obesity. With respect to socio-economic indicators, house ownership, household assets, as well as work status distributions exhibited a significant association with the BMI classes ($p<0.05$).

Similarly, in women, significant associations were observed between BMI, age, marital status, education, and work status ($p<0.05$). However, of the socioeconomic characteristics, household assets but not house ownership, as well as income and self-perception of socioeconomic status, exhibited a significant association with BMI.

4.1.7 Dietary Intake of Study Population: Mean Total Energy Intake and Mean percent Energy Consumption from Macronutrients

Mean intakes of total energy (±SD) and mean percent energy consumption from macronutrients (±SD) are presented in Table 4.6 and Table 4.7 for adult males and females respectively, by 10 year age groups. Mean values were computed after exclusion of subjects who reported that their 24-hour recall was not representative of their habitual intake (n=74) plus extreme highest and lowest outliers (n=10) determined by the SPSS stem and leaf method.

Total mean energy consumption (± SD) was 10234±5585 KJ for the adult male population ≥20 years and 6979±3632 KJ for the adult female population ≥20 years.

Among adult males, mean energy intake estimates were similar at the early age groups; however, they were significantly lower at the age of 60 years. Estimates of mean energy intake among women showed no significant variation across the age groups until the age of 70 years, at which mean intake was significantly less compared with the age groups from 20 to 69 years.

In both men and women, estimates of mean percent energy consumption from fat (Tables 4.6 and 4.7) were higher across all the age groups than the average distribution range of 20-35 % recommended by the National Academy of Sciences for adults aged 19 to 70 years (Dietary reference intakes, 2002). Overall, mean percent energy consumption from fat was 36.7±10.1 and 37.4±11.0 in adult males and females respectively.

Mean intakes of percent energy from carbohydrates were constant among all age groups in males, and increased at the age groups of 40-49 years and 70+ years among females, generally remaining within the recommended intake of 45-65%.

Table 4.6 Diet composition of Lebanese adult males ≥20 years by 10 year age groups (n=1193)

Variables	**Age groups**					
	20-29 n = 350	**30-39 n =274**	**40-49 n =211**	**50-59 n = 150**	**60-69 n =102**	**70+ n =106**
	Mean ± SD					
Energy consumption (KJ)	11133±6100^{b}	10845±5686	10602±6296^{b}	9975±4539^{b}	8108±3774^{a}	7460±2799^{a}
Energy consumption from fat (%)	36.2±9.6^{a}	36.6±9.7^{a}	37.1±10.0^{a}	37.2±10.3^{a}	37.4±11.5a	36.8±11.1^{a}
Energy consumption from carbohydrate (%)	48.8±10.6^{a}	48.2±10.9^{a}	47.4±11.4^{a}	47.5±11.7^{a}	47.3±13.4^{a}	49.3±12.0^{a}
Energy consumption from protein (%)	14.5±4.8^{a}	14.9±5.2^{a}	14.9±5.6^{a}	15.2±4.9^{a}	15.0±5.1^{a}	14.2±3.3^{a}

*In any one row, mean values with superscripts of the same letter are not significantly different; mean values with superscripts of different letters are significantly different at $p < 0.05$.
P values for Mean Kjoules, % kJ from fat, % kJ from carbohydrates, and % calories from protein were derived from one way ANOVA.

Table 4.7 Diet composition of Lebanese adult females ≥20 years by 10 year age groups (n=1347).

Variables	**Age groups**					
	20-29 n = 380	**30-39 n =341**	**40-49 n =272**	**50-59 n = 153**	**60-69 n =121**	**70+ n =80**
	Mean ± SD					
Energy consumption (KJ)	7426±3748^{c}	6983±3690^{bc}	7296±3828^{c}	6598±3200^{bc}	6259±3644^{ab}	5778±2430^{a}
Energy consumption from fat (%)	38.9±10.5^{c}	37.7±11.0^{bc}	37.0±11.4^{abc}	35.9±11.4^{abc}	36.1±11.3^{ab}	34.6±9.5^{a}
Energy consumption from carbohydrate (%)	48.1±10.8^{a}	48.9±12.4^{a}	50.0±11.7^{ab}	49.2±12.9^{ab}	49.4±12.1^{ab}	51.8±10.5^{b}
Energy consumption from protein (%)	14.1±5.0^{a}	14.3±4.9^{a}	14.1±4.3^{a}	15.8±7.0^{b}	15.2±6.3^{ab}	14.8±4.7^{ab}

*In any one row, mean values with superscripts of the same letter are not significantly different; mean values with superscripts of different letters are significantly different at $p < 0.05$.
P values for Mean Kjoules, % kJ from fat, % kJ from carbohydrates, and % calories from protein were derived from one way ANOVA.

4.1.8 Physical Activity Levels among Study Population

4.1.8.1 Health Enhancing Physical Activity, Minimal Activity, and Sedentariness

The prevalence of the various levels of physical activity among the study population is presented in Table 4.8. In general, only 22.7% exhibited high or sufficient levels of physical activity for health enhancement, and 31.8% showed moderate or minimal activity levels recommended for people of all ages (walking per week at least 5 days for 30 minutes)(Branca et al, 2007c). Inactivity or sedentariness prevalence was high among all age groups (45.5%), exhibiting a lower prevalence rate at middle age (35.5 % at the 50-59 years age group), replaced by increasing both minimal and high levels health-enhancing physical activity, but with reversing estimates again thereafter.

The total prevalence of sufficiently-active men and women was nearly similar (23.5% vs. 22.6% respectively). However, the prevalence rate among young males aged 20-29 years was 2 fold higher than that of females of the same age group (31.0% vs. 15.1% respectively), and the trend was reversed at the age group 40-49 years (Tables 4.9 and 4.10). All in all, females demonstrated a higher prevalence rate of moderate physical activity than did males (34.0% vs. 28.5% respectively), and more men were inactive or sedentary (48.0%) as compared with women (43.4%).

4.1.8.2 Sitting Time

In this study, sitting time is used as an independent proxy measure of sedentary behaviour. It includes time spent sitting at work, at home, while doing course work, and during leisure time (sitting at a desk, visiting a friend, reading, watching TV).

The amount of daily sitting time (median hours) in the Lebanese adult population is reported in Table 4.11 as median hours and interquartile ranges for both genders by 10 year age groups. Gender differences were minimal; however, at certain age groups (20-29 years, 30-39 years, and 50-59 years), women exhibited less sitting time than men.

All in all, as Table 4.12 shows, the proportion of males spending more than 10 hours of their time sitting was higher than that of females in the age groups 20-69 years.

Table 4.8 % Prevalence of the various levels of physical activity in the Lebanese adult population (both genders) ≥20years by 10 year age groups (n=2633)

Age Group	Physical Activity Level[1] Low % (n)	Moderate % (n)	High % (n)
20-29 (n=762)	50.4 (384)	27.7 (211)	21.9 (167)
30-39 (n=631)	46.8 (295)	28.4 (179)	24.9 (157)
40-49 (n=497)	41.0 (204)	35.0 (174)	23.9 (119)
50-59 (n=306)	35.5 (108)	40.2 (123)	24.5 (75)
60-69 (n=236)	42.8 (101)	33.1 (78)	24.2 (57)
≥70 (n=201)	52.7 (106)	35.3 (71)	11.9 (24)
20-70+ (n=2633)	45.5 (1198)	31.8 (836)	22.7 (599)

*Pearson Chi-square=72.564; p=0.000

Table 4.9 % Prevalence of the various levels of physical activity in adult Lebanese males≥20years by 10 year age groups (n=1187)

Age Group	Physical Activity Level[1] Low % (n)	Moderate % (n)	High % (n)
20-29 (n=339)	44.5 (151)	24.5 (83)	31.0 (105)
30-39 (n=277)	56.3 (156)	19.5 (54)	24.2 (67)
40-49 (n=213)	54.5 (116)	28.6 (61)	16.9 (36)
50-59 (n=147)	38.1 (56)	36.1 (53)	25.9 (38)
60-69 (n=102)	42.2 (43)	40.2 (41)	17.6 (18)
≥70 (n=109)	44.0 (48)	42.2 (46)	13.8 (15)
20-70+ (n=1187)	48.0 (570)	28.5 (338)	23.5 (279)

*Pearson Chi-square=53.901; p=0.000

Table 4.10 % Prevalence of the various levels of physical activity in adult Lebanese females≥20years by 10 year age groups (n=1361)

Age Group	Physical Activity Level[1] Low % (n)	Moderate % (n)	High % (n)
20-29 (n=385)	55.3 (213)	29.6 (141)	15.1 (58)
30-39 (n=341)	39.0 (133)	36.1 (123)	24.9 (85)
40-49 (n=272)	31.6 (86)	37.9 (103)	30.5 (83)
50-59 (n=155)	32.9 (51)	44.5 (69)	22.6 (35)
60-69 (n=125)	44.8 (56)	25.6 (32)	29.6 (37)
≥70 (n=83)	62.7 (52)	26.5 (22)	10.8 (9)
20-70+ (n=1361)	43.4 (591)	34.0 (463)	22.6 (307)

*Pearson Chi-square=72.564; p=0.000

Table 4.11 Median hours spent sitting* on average per day in the Lebanese adult population ≥20 years, by 10 year age groups and gender

	Males (n=1216)		Females (n=1380)	
Age Group	**Median hours**	**Interquartile range (P25-P75)**	**Median hours**	**Interquartile range (P25-P75)**
20-29	10	(7 -13)	9	(6 -11)
30-39	10	(8 -12)	9	(7 -11)
40-49	10	(8 -13)	10	(7 -12)
50-59	11	(8 -13)	9	(7 -12)
60-69	11	(9 -13)	10	(8 -12)
≥70	12	(10-14)	12	(10 -13)
20-70+years	10	(8 -13)	10	(7 -12)

Table 4.12 Prevalence of amount of time spent sitting per day, lesser or above the median of the distribution of hours sitting down/typical day for all participants (excluding underweight subjects), by 10 year age groups and gender (n=2596)

Age Group	**Sitting hours/d***					
	<10 hours sitting /d (n=1580)			**≥10 hours sitting /d (n=1016)**		
	Males[a]	Females[b]	Both Genders[c]	Males[a]	Females[b]	Both Genders[c]
	% (n)					
20-29	59.6 (212)	72.3 (284)	66.2 (496)	40.4 (144)	27.7 (109)	33.8 (253)
30-39	60.6 (169)	72.3 (251)	67.1 (420)	39.4 (110)	27.7 (96)	32.9 (206)
40-49	54.8 (119)	62.8 (172	59.3 (291)	45.2 (98)	37.2 (102)	40.7 (200)
50-59	46.7 (71)	67.7 (107	57.4 (178)	53.3 (81)	32.3 (51)	42.6 (132)
60-69	47.1 (49)	64.0 (80)	56.3 (129)	52.9 (55)	36.0 (45)	43.7 (100)
≥70	34.3 (37)	34.9 (29)	34.6 (66)	65.7 (71)	65.1 (54)	65.4 (125)
20-70+years	54.0 (657)	66.9 (923)	60.9 (1580)	46.0 (559)	33.1 (457)	39.1 (1016)

[a] Pearson Chi_Square=31.512; p=0.000
[b] Pearson Chi_Square=50.639; p=0.000
[c] Pearson Chi_Square=78.767; p=0.000

4.1.8.3 Socio Demographic Characteristics of Study Participants Associated with the Prevalence of the Three Levels of Physical Activity as Determined by IPAQ (Low, Moderate, and High)

Appendix S presents tables which report unadjusted association between certain socio-demographic variables and the various levels of physical activity for adult males and females ≥20 years

In both men and women, the initial cross-tabulation showed a significant relationship between physical activity level, marital status, work status, income, and household assets (p<0.05), but not with education.

Among females, their distribution was greater in the high level of physical activity among those who were married, with an income of less than 1 million, lower household assets and education, and those who do not work (mostly housewives).

In men, higher prevalence rates were observed in the high level category of physical activity among students, single men, with an income greater than 6 million Lebanese pounds and less household assets.

4.1.9 Age Stratified Simple Regression Analysis of the Association of socio Demographic, and Lifestyle Factors with Obesity (BMI≥30Kg/m^2) in Lebanese Adults ≥20 Years

All potential independent variables in addition to those covariates of theoretical importance were explored individually in a simple logistic regression, with % obese compared to non-obese as the dependent variable.

Tables 4.13 and 4.14 report results stratified by three age strata: young adults (20-39 years), midlife adulthood (40-64 years), and older adults (≥65years), for males and females respectively.

Age

In males, obesity risk increased significantly at the age group 30-39 years (OR=1.52; 95% CI: 1.03-2.25). In females, the odds of being obese more than doubled in the young and midlife age strata and was highest in the age groups 30-39 years (OR=2.89; 95% CI: 1.87-4.64) and 50-59 years (OR=2.34; 95% CI: 1.56-3.51).

Marital Status

The initial cross-tabulation showed that married adults of both genders exhibited higher obesity prevalence estimates than those who were single, widowed, or divorced. This relationship was reflected in higher age-adjusted odds ratio across the age groups, significant only in males aged 30-39 years (OR=2.63; 95% CI: 1.61-4.29).

Education and Work Status

In females, the odds of being obese were significantly lower among those reporting a university level education at the age groups 20-39 (OR=0.47; 95% CI: 0.22-0.89) years and 40-64 years (OR=0.45; 95% CI: 0.25-0.82). No significant association was observed with work status.

In men, work status showed positive association with obesity risk. In men 20-39 years, the odds of being obese were 2 times higher in those working as employees (OR=2.87; 95% CI: 1.39-5.92), and 3 times higher in those who reported being self-employed

(OR=3.15; 95% CI: 1.50-6.6). No significant association was noted with educational attainment.

Socioeconomic Indicators

Significant odds ratios were observed in both males and females with increasing household assets, however in a contrasting manner. In males, the odds increased with increasing household assets, significantly at the age 40-64 years (OR=1.64; 95% CI: 1.01-2.69). In females, the odds ratios decreased with increasing household assets also significantly at the same age group 40-64 years (OR=0.34; 95% CI: 0.16-0.72). Crowding index as an indicator of socioeconomic level showed lower odds ratios with higher socioeconomic level (CI< 1 person per room), significantly for females at the age group 20-39 (OR=0.34; 95% CI: 0.16-0.72).

For income, the number of subjects with missing data was high (n= 233) and therefore the results of this category will not be described.

Dietary Intake

The odds for obesity showed a decreasing trend for both males and females in the second tertile of energy consumption (Men, 7000-10500Kj; Women, 5000-7500Kj) in the age group 20-39 years. However, this relationship was significant only in females (OR=0.46; 95% CI: 0.26-0.80).

In men, obesity risk significantly increased in those 40-64 years of age and consuming 32-42% of energy from fat (OR=1.74; 95% CI: 1.05-2.90).

Both men and women aged 20-39 years, consuming regular three meals on a daily basis, were less likely to be obese than their counterparts who reported skipping one or more meal per day, as shown by the significant decrease in the odds ratios for males (OR=0.63; 95% CI: 0.42-0.94) and for females (OR=0.59; 95% CI: 0.38-0.93).

Frequency of snacking as well as number of snacks per day showed an increasing trend in obesity risk among males of all age groups, however not significant. Females showed non-significant discrepancies in the relationship between snacking and obesity in the three age strata, where odds ratios decreased with more frequent snacking in the age group 40-64 and increased among older adults. Also, a non-significant positive trend was observed between increased number of snacks consumed per day and increased risk of obesity. This might be attributed to the fact that when asking participants about snacks in this study, the room was open to all types of snacks whether healthy (fruits, vegetables and whole grains) or unhealthy (processed snacks, sweets and desserts), and the quantity of foods consumed per snack per day was not specified.

Men and women aged 20-39 years reporting attempt to change their eating habits, such as decreasing their fat consumption, had higher odds of being obese (Men: OR=2.45; 95% CI: 1.65-3.66) (Women: OR=2.26;95%CI:1.34-3.80).

Physical Activity

High physical activity was significantly associated with decreased obesity risk in males aged 40-64 years (OR=0.33; 95% CI: 0.17-0.63). In females, moderate physical activity showed decreasing odds for obesity in all age groups and significantly in participants aged 20-39 years (OR=0.58; 95% CI: 0.35-0.95) and older adults ≥64 years (OR=0.35; 95% CI: 0.15-0.81).

Participants who reported attempt to increase their physical activity were at decreased risk for obesity, significantly in females aged 40-64 years (OR=0.59; 95% CI: 0.40-0.87) and ≥64 years (OR=0.37; 95% CI: 0.16-0.85).

Smoking and Alcohol Consumption

Smoking was positively associated with obesity prevalence among females at the age group 20-39 years (OR=1.61; 95% CI: 1.06-2.45).

The age-adjusted negative association between alcohol consumption and obesity was significant in males in the age group 40-64 years (OR=0.66; 95% CI: 0.44-0.99), and in females in the age group 20-39 years (OR=0.44; 95% CI: 0.26-0.75). Moderate intakes of 1-2 drinks per time were also found to be negatively associated with obesity, significantly in females aged 20-39 years (OR=0.40; 95% CI: 0.23-0.71).

Table 4.13 Odds ratio estimates and their 95% confidence intervals from simple logistic regression associating individual, social, lifestyle and dietary factors with obesity for Lebanese adult **males** ≥20 years; stratified by age (n=1222)

Variable (reference category)	**Age Groups** 20 – 39 (n=638) OR (95% CI)	40 – 64 (n=434) OR (95% CI)	≥65 (n=150) OR (95% CI)
Age (years)			
20 to 29	1.0		
30 to 39	1.52*(1.03-2.25)		
40 to 49		1.00	
50 to 59		1.33 (0.86-2.05)	
60 to 64		0.76 (0.41-1.42)	
65 to 70			1.00
≥ 70			0.68 (0.32-1.44)
Marital Status			
Single (Never married)	1.00	1.00	1.00
Married	2.63*(1.61-4.29)	1.36 (0.72-2.56)	2.67 (0.94-7.58)
Education	1.00	1.00	NA
Primary and lower	2.14 (0.92-4.98)	0.97 (0.61-1.53)	
Intermediate/Secondary/Tech	1.27 (0.52-3.06)	0.82 (0.45-1.49)	
University			
Education			
Primary and lower	NA	NA	1.00
Intermediate and higher			0.88 (0.44-1.73)
Work Status			
Does not work	1.00	1.00	1.00
Employee	2.87*(1.39-5.92)	1.15 (0.56-2.85)	0.18 (0.02-1.55)
Self Employed / owner	3.15* (1.50-6.6)	1.81 (0.99-3.32)	0.94 (0.44-1.98)
Income (Lebanese Lira)			
< 1 Million	1.00	1.00	1.00
1-3 Million	1.15 (0.66-2.01)	1.07 (0.68-1.68)	1.05 (0.49-2.24)
>3 Million	1.05 (0.53-2.06)	1.17 (0.60-2.27)	1.62 (0.39-6.65)
House Ownership			
Owns House	1.00	1.00	1.00
Rents House	0.63 (0.39-1.02)	1.00 (0.64-1.57)	0.91 (0.40-2.10)
Household Assets			
< 7 items	1.00	1.00	1.00
7-8 items	1.39 (0.84-2.28)	1.64*(1.01-2.69)	0.82 (0.31-2.17)
>9 items	1.60 (0.99-2.59)	1.39 (0.85-2.29)	1.81 (0.58-5.62)
Crowding Index			
≥ 1 person / room	1.00	1.00	1.00
<1 person / room	1.27 (0.85-1.89	0.82 (0.52-1.28)	1.13 (0.55-2.32)
SES_SELF			
Low	1.00	1.00	1.00
Middle	1.05 (0.58-1.89)	1.20 (0.78-1.85)	1.23 (0.59-2.57)
High	1.06 (0.39-2.89)	0.56 (0.17-1.79)	2.75 (0.65-11.69)
Smoking			
No	1.00	1.00	1.00
Yes	1.33 (0.86-2.06)	0.76 (0.49-1.17)	0.77 (0.38-1.56)

Table 4.13 (cont'd) Odds ratio estimates and their 95% confidence intervals from simple logistic regression associating individual, social, lifestyle and dietary factors with obesity for Lebanese adult **males** ≥20 years; stratified by age (n=1222).

Variable (reference category)	**Age Groups**		
	20 – 39 (n=638) OR (95% CI)	**40 – 64 (n=434) OR (95% CI)**	**≥65 (n=150) OR (95% CI)**
Alcohol	1.00	1.00	1.00
No	0.67 (0.45-1.00)	0.66* (0.44-0.99)	1.09 (0.55-2.13)
Yes			
Alcohol Freq	1.00	1.00	1.00
No alcohol	0.85 (0.49-1.30)	0.65 (0.40-1.07)	1.47 (0.66-3.24)
< once per week	0.67 (0.39-1.15)	0.81 (0.44-1.45)	0.94(0.31-2.84)
1-2 times/week	0.39* (0.17-0.90)	0.49 (0.23-1.02)	0.62(0.20-1.92)
≥ 3 times per week			
Alcohol Drinks/time	1.00	1.00	1.00
No alcohol	0.71 (0.41-1.21)	0.66 (0.41-1.08)	1.12(0.55-2.25)
1-2 drinks /time	0.65 (0.41-1.03)	0.65 (0.39-1.08)	0.93(0.25-3.44)
3 or more drinks/time			
Physical Activity	1.00	1.00	1.00
Low	0.92 (0.55-1.53)	0.94 (0.59-1.48)	0.85 (0.41-1.76)
Moderate	0.93 (0.58-1.50)	0.33*(0.17-0.63)	0.93 (0.34-2.55)
High			
Family History of obesity	1.00	1.00	1.00
No	1.86* (1.26-2.76)	2.24* (1.48-3.39)	1.66 (0.82-3.37)
Yes			
Energy Consumption(KJ/d)			
Low(<7000)	1.00	1.00	1.00
Moderate(7000-10500)	0.70 (0.42-1.18)	1.24 (0.75-2.04)	0.68 (0.31-1.48)
High(>10500)	0.94 (0.58-1.52)	1.13 (0.67-1.91)	0.94 (0.34-2.57)
Energy consumption from Fat (%)			
Low (<32%)	1.00	1.00	1.00
Moderate (32-42%)	1.11 (0.60-1.70)	1.74*(1.05-2.90)	0.68 (0.30-1.52)
High: (>42%)	1.23 (0.73-2.06)	1.56 (0.93-2.63)	0.60 (0.24-1.46)
Energy consumption from Carbohydrates (%)			
Low (<45)	1.00	1.00	1.00
Moderate(45-65)	0.84 (0.53-1.34)	1.19 (0.75-1.91)	0.92 (0.40-2.14)
High(>=65)	0.85 (0.52-1.40)	0.72 (0.42-1.22)	1.22 (0.53-2.77)
Energy consumption from Proteins (%)			
Low (<12%)	1.00	1.00	1.00
Moderate (12-15%)	1.50 (0.88-2.55)	0.98 (0.57-1.68)	0.81 (0.31-2.06)
High (>=15%)	1.51 (0.92-2.49)	0.85 (0.51-1.40)	1.91 (0.84-4.33)
Consumption of Regular 3 Meals Daily			
No	1.00	1.00	1.00
Yes	0.63 *(0.42-0.94)	1.01 (0.67-1.51)	0.84 (0.41-1.75)

Table 4.13 (cont'd) Odds ratio estimates and their 95% confidence intervals from simple logistic regression associating individual, social, lifestyle and dietary factors with obesity for Lebanese adult **males** ≥20 years; stratified by age (n=1222).

Variable (reference category)	**Age Groups**		
	20 – 39 (n=638) OR (95% CI)	**40 – 64 (n=434) OR (95% CI)**	**≥65 (n=150) OR (95% CI)**
Frequent Snacking Daily (*Snack_br_reg)*			
No			
Yes	1.00	1.00	1.00
	1.41 (0.94-2.09)	1.40 (0.93-2.10)	1.84 (0.92-3.68)
Number of Snacks/day*(reg)*			
1-3 snacks	1.00	1.00	1.00
>3 snacks	1.53 (0.79-2.94)	1.31 (0.53-3.21)	0.36(0.04-3.41)
Eating at TV			
No	1.00	1.00	1.00
Yes	0.93 (0.63-1.39)	0.77 (0.50-1.16)	0.66 (0.29-1.44)
Trying to increase PA			
No	1.00	1.00	1.00
Yes	0.90 (0.61-1.33)	0.72 (0.48-1.10)	1.11 (0.56-2.18)
Trying to Decrease Fat Consumption			
No	1.00	1.00	1.00
Yes	2.45*(1.65-3.66)	1.25 (0.83-1.88)	1.21(0.62-2.37)
Trying to Decrease Sugar Consumption			
No	1.00	1.00	1.00
Yes	2.09*(1.38-3.16)	1.25 (0.83-1.88)	1.21 (0.62-2.37)
Trying to Decrease Fruit_Veg Consumption			
No	1.00	1.00	1.00
Yes	1.04 (0.70-1.55)	1.35 (0.87-2.07)	1.02 (0.47-2.20)

*significant at p<0.05

Table 4.14 Odds ratio estimates and their 95% confidence intervals from simple logistic regression associating individual, social, lifestyle and dietary factors with obesity for Lebanese adult **females** ≥20 years; stratified by age (n=1386)

Variable (reference category)	Age Groups 20 – 39 (n=742) OR (95% CI)	40 – 64 (n=511) OR (95% CI)	≥65 (n=133) OR (95% CI)
Age (years)			
20 to 29	1.0		
30 to 39	2.89*(1.87-4.64)		
40 to 49		1.00	
50 to 59		2.34*(1.56-3.51)	
60 to 64		1.89* (1.12-3.18)	
65 to 70			1.00
≥ 70			1.04 (0.51-2.10)
Marital Status			
Single (Never married)	1.00	1.00	1.00
Married	1.63(0.96-2.78)	1.05 (0. 67-1.63)	1.24 (0.58-2.64)
Education			
Primary and lower	1.00	1.00	NA
Intermediate/Secondary/Tech	0.68 (0.36-1.29)	0.72 (0.46-1.10)	
University	0.47* (0.22-0.89)	0.45*(0.25-0.82)	
Education			
Primary and lower	NA	NA	1.00
Intermediate and higher			0.52 (0.25-1.09)
Work Status			
Does not work	1.00	1.00	NA
Employee	0.79 (0.49-1.29)	0.74 (0.42-1.30)	
Self Employed / owner	0.87 (0.39-1.96)	0.44 (0.19-1.01)	
Income (Lebanese Lira)			
< 1 Million	1.00	1.00	1.00
1-3 Million	0.79 (0.50-1.26)	0.78 (0.52-1.16)	0.43* (0.19-0.98)
>3 Million	0.71 (0.35-1.41)	0.39* (0.18-0.85)	0.34 (0.06-1.99)
House Ownership			
Owns House	1.00	1.00	1.00
Rents House	1.28 (0.83-1.96)	1.43 (0.96-2.13)	1.54 (0.69-3.43)
Household Assets			
< 7 items	1.00	1.00	1.00
7-8 items	0.69 (0.41-1.16)	0.69 (0.45-1.07)	1.04 (0.39-2.73)
>9 items	0.62 (0.36-1.07)	0.34* (0.16-0.72)	0.36 (0.89-1.51)
Crowding Index			
≥ 1 person / room	1.00	1.00	1.00
<1 person / room	0.50*(0.29-0.86)	0.69 (0.46-1.02)	0.84 (0.41-1.73)
SES_SELF			
Low	1.00	1.00	1.00
Middle	0.48*(0.29-0.80)	0.78 (0.52-1.16)	2.24 (0.97-5.13)
High	0.55 (0.19-1.59)	0.22 (0.48-1.04)	2.57 (0.37-17.60)
Smoking			
No	1.00	1.00	1.00
Yes	1.61*(1.06-2.45)	1.02 (0.17-1.49)	0.77 (0.38-1.54)

Table 4.14 (cont'd) Odds ratio estimates and their 95% confidence intervals from simple logistic regression associating individual, social, lifestyle and dietary factors with obesity for Lebanese adult **females** ≥20 years; stratified by age (n=1386)

Variable (reference category)	Age Groups 20 – 39 (n=742) OR (95% CI)	40 – 64 (n=511) OR (95% CI)	≥65 (n=133) OR (95% CI)
Alcohol			
No	1.00	1.00	1.00
Yes	0.44* (0.26-0.75)	0.75 (0.51-1.12)	0.74 (0.34-1.60)
Alcohol Freq			
No alcohol	1.00	1.00	1.00
1< once time/week	0.50*(0.28-0.89)	0.94 (0.61-1.44)	0.89 (0.38-2.04)
≥1-2 times/week	0.27*(0.82-0.89)	0.24*(0.11-0.69)	0.33 (0.06-1.80)
Alcohol Drinks/time			
No Alcohol	1.00	1.00	1.00
1-2 drinks/time	0.40*(0.23-0.71)	0.78 (0.52-1.19)	0.86 (0.39-1.92)
3 or more drinks /time	0.63 (0.19-2.28	0.41(0.11-1.56)	0.21 (0.02-2.66)
Physical Activity			
Low	1.00	1.00	1.00
Moderate	0.58*(0.35-0.95)	0.88 (0.56-1.37)	0.35*(0.15-0.81)
High	0.70 (0.40-1.23)	1.05 (0.65-1.68)	0.42 (0.16-1.11)
Family History of obesity			
No	1.00	1.00	1.00
Yes	2.86* (1.84-4.45)	3.19* (2.17-4.68)	3.79* (1.73-8.30)
Energy Consumption(kJ)			
Low(<5000)	1.00	1.00	1.00
Moderate(5000-7500)	0.46*(0.26-0.80)	1.04 (0.66-1.63)	1.08 (0.48-2.42)
High(>7500)	0.92 (0.56-1.50)	1.09 (0.68-1.72)	0.58 (0.23-1.47)
Energy consumption from Fat (%)			
Low (<32%)	1.00	1.00	1.00
Moderate (32-42%)	0.91 (0.54-1.52)	0.86 (0.55-1.36)	1.12 (0.49-2.53)
High: (>42%)	0.81 (0.48-1.38)	1.34 (0.85-2.09)	1.11 (0.46-2.69)
Energy consumption from Carbohydrates (%)			
Low (<45)	1.00	1.00	1.00
Moderate(45-65)	0.79 (0.47-1.32)	0.93 (0.59-1.47)	0.44 (0.17-1.13)
High(>=65)	1.00 (0.60-1.67)	0.87 (0.56-1.36)	0.69 (0.29-1.62)
Energy consumption from Proteins (%)			
Low (<12%)	1.00	1.00	1.00
Moderate (12-15%)	0.68 (0.41-1.19)	0.77 (0.48-1.26)	0.66 (0.25-1.60)
High (>=15%)	0.91 (0.56-1.49)	0.88 (0.56-1.37)	0.78 (0.31-1.86)
Consumption of Regular 3 Meals Daily			
No	1.00	1.00	1.00
Yes	0.59 *(0.38-0.93)	0.76 (0.52-1.10)	0.64 (0.31-1.31)

Table 4.14 (cont'd) Odds ratio estimates and their 95% confidence intervals from simple logistic regression associating individual, social, lifestyle and dietary factors with obesity for Lebanese adult **females** ≥20 years; stratified by age (n=1386)

Variable (reference category)	**Age Groups**		
	20 – 39 (n=742) OR (95% CI)	**40 – 64 (n=511) OR (95% CI)**	**≥65 (n=133) OR (95% CI)**
Frequent Snacking Daily (*Snack_br_reg*)			
No	1.00	1.00	1.00
Yes	0.90 (0.59-1.36)	0.12 (0.77-1.63)	1.34 (0.66-2.72)
Number of Snacks/day*(reg)*			
1-3 snacks	1.00	1.00	NA
>3 snacks	1.84 (0.84-4.01)	1.68 (0.81-3.47)	
Eating at TV			
No	1.00	1.00	1.00
Yes	1.43 (0.92-2.21)	1.15 (0.78-1.70)	1.15 (0.54-2.46)
Trying to increase PA			
No	1.00	1.00	1.00
Yes	0.88 (0.58-1.34)	0.59*(0.40-0.87)	0.37* (0.16-0.85)
Trying to Decrease Fat Consumption			
No	1.00	1.00	1.00
Yes	2.26*(1.34-3.80)	1.03 (0.68-1.59)	1.72(0.70-4.24)
Trying to Decrease Sugar Consumption			
No	1.00	1.00	1.00
Yes	1.49 (0.98-2.25)	1.35 (0.93-1.96)	1.66 (0.83-3.32)
Trying to Decrease Fruit_Veg Consumption			
No	1.00	1.00	1.00
Yes	1.23 (0.77-1.97)	1.23 (0.82-1.85)	1.24 (0.56-2.74)

*significant at p<0.05

4.1.10 Multivariate Analysis of the Association of Socio Demographic and Lifestyle Factors with Obesity (BMI≥30Kg/m^2) among Lebanese Adults ≥20 Years

Results of the multivariate regression analysis are presented in Tables 4.15 and 4.16 for males and females respectively.

The final multivariate model included socio-demographic characteristics: age, marital status, education, work status, as well as household assets and crowding index as indicators of economic status. For lifestyle and dietary factors, smoking, physical activity, alcohol consumption, energy consumption, fat consumption, and intake of meals were also integrated. Criteria for inclusion of the variables are described in Chapter 3.

4.1.10.1 Obesity in Adult Males

Socio-economic Characteristics

In young adult males aged 20-39 years (Table 4.15), the odds of being obese increased among those who were married (OR=2.28; 95% CI: 1.34-3.89), working as employees (OR=2.40; 95% CI: 1.08-5.31), or self-employed (OR=2.41; 95% CI: 1.05-5.66), and had more than nine accessible household assets including home essentials, a transport vehicle, and a mobile phone (OR=1.83; 95% CI: 1.65-3.26).

In men 40-64 years, the odds of being obese significantly doubled among those who reported self-employment (OR=2.05; 95% CI: 1.06-3.98) and availability of seven essential household assets and transportation vehicle (OR=2.05; 95% CI: 1.15-3.02).

Elderly married men had the highest frequency of obesity compared with those who reported never being married (OR=3.49; 95% CI: 1.10-11.0). Availability of household assets, car and a mobile indicating a better socio-economic status did not show any significant effects on obesity incidence in this age stratum. As most men ≥ 65 years were retired or not working (n=257), the variable work status was not entered in the model.

Educational level did not show any association with obesity in all age groups.

Dietary Intake

No relationship was found between energy consumption and frequency of obesity. Also, intake of daily regular meals did not show any significance in decreasing the odds of obesity among men in all age groups

Lifestyle Factors

Smoking, alcohol consumption, and physical activity did not show any significant association in the three age strata.

Family history of obesity: Obesity significantly increased among those who reported family history of obesity in adult males across the three age strata.

Table 4.15 Odds ratio estimates and their 95% confidence intervals from multivariate logistic regression associating individual, social, lifestyle and dietary factors with obesity for Lebanese adult **males** ≥20 years; Stratified by age & adjusted for all the variables included in the model (n=1222)

Variable (reference category)	Age Groups 20 – 39 (n=638) OR (95% CI)	40 – 64 (n=434) OR (95% CI)	≥65 (n=150) OR (95% CI)
Age (years)			
20 to 29	1.00		
30 to 39	0.80 (0.47-1.37)		
40 to 49		1.00	
50 to 64		1.38 (0.87-2.19)	
65 to 70			1.00
≥ 70			0.91 (0.38-2.15)
Marital Status			
Single(Never married)	1.00	1.00	1.00
Married	2.28*(1.34-3.89)	1.08 (0.52-2.21)	3.49*(1.10-11.0)
Education			
Primary and lower	1.00	1.00	NA
Intermediate/Secondary/Tech	2.13 (0.82-5.48)	0.89 (0.52-1.50)	
University	1.11 (0.39-3.16)	0.69 (0.34-1.41)	
Education			
Primary and lower	NA	NA	1.00
Intermediate and higher			0.94 (0.40-2.17)
Work Status			
Does not work	1.00	1.00	NA
Employee	2.40*(1.08-5.31)	1.38 (0.66-2.88)	
Self Employed / owner	2.41*(1.05-5.66)	2.05*(1.06-3.98)	
Household Assets			
< 7 items	1.00	1.00	1.00
7-8 items	1.43 (0.83-2.50)	2.05*(1.15-3.64)	0.70 (0.22-2.15)
>9 items	1.83*(1.03-3.26)	1.68 (0.93-3.02)	1.83 (0.50-6.67)
Crowding Index			
≥ 1 person / room	1.00	1.00	1.00
< 1 person / room	1.21 (0.78-1.90)	0.87 (0.51-1.47)	1.16 (0.51-2.65)
Smoking			
No	1.00	1.00	1.00
Yes	1.25 (0.76-2.06)	0.74 (0.45-1.21)	0.64 (0.28-1.44)
Alcohol			
No	1.00	1.00	1.00
Yes	0.66 (0.42-1.03)	0.63 (0.40-1.01)	0.99 (0.44-2.19)
Physical Activity			
Low	1.00	1.00	1.00
Moderate_ High	0.99 (0.64-1.55)	0.86 (0.55-1.35)	0.88 (0.41-1.91)
Family History of obesity			
No	1.00	1.00	1.00
Yes	1.85*(1.20-2.86)	2.28*(1.46-3.60)	2.64*(1.17-5.93)

Table 4.15 (cont'd) Odds ratio estimates and their 95% confidence intervals from multivariate logistic regression associating individual, social, lifestyle and dietary factors with obesity for Lebanese adult **males** ≥20 years; Stratified by age & adjusted for all the variables included in the model . (n=1222).

Variable (reference category)	Age Groups 20 – 39 (n=638) OR (95% CI)	40 – 64 (n=434) OR (95% CI)	≥65 (n=150) OR (95% CI)
Energy Consumption(KJ)			
Low(<7000)	1.00	1.00	1.00
Moderate(7000-10500)	0.57 (0.33-1.01)	1.18 (0.68-2.04)	0.71 (0.28-1.80)
High(>10500)	0.73 (0.43-1.28)	1.11 (0.61-2.01)	0.88 (0.29-2.70)
Energy consumption from Fat (%)			
Low (<32%)	1.00	1.00	1.00
Moderate (32-42%)	1.15 (0.68-1.94)	1.54 (0.88-2.68)	0.64 (0.25-1.65)
High: (>42%)	0.74 (0.43-1.28)	1.47 (0.82-2.62)	0.55 (0.19-1.58)
Consumption of Regular 3 Meals Daily	1.00	1.00	1.00
No (skips one or more meal)	0.66 (0.42-1.03)	0.82 (0.52 1.28)	0.73 (0.31-1.69)
Yes(eats 3 regular meals daily)			

*significant at p<0.05

4.1.10.2 Obesity in Adult Females

Socio-economic Characteristics

Obesity increased with increasing age among females 20-64 years old (Table 4.16). The risk of obesity doubled in the age group 20-39 years (OR=2.64; 95% CI: 1.53-4.54) and almost tripled in the 40-64 years age strata (OR=2.97; 95% CI: 1.88-4.70). Marriage was significantly predictive of obesity at the age of 20-39 years (OR=1.86; 95% CI: 1.02-3.39). On the other hand, those who were more educated as well as those who were self-employed (aged ≤64 years) had a lower risk of obesity (test for trend p<0.05). Odds of obesity decreased with better socio-economic status evaluated by household assets and crowding index in all age groups. Obesity decreased significantly among women 40-64 years of age with increasing availability of household assets to 7- 8 items (OR=0.53; 95% CI: 0.32-0.88) and to ≥9 items (OR=0.36; 95% CI: 0.14-0.90). Crowding index was found to be the significant factor in decreased obesity prevalence among women aged 20-39 years (OR=0.51; 95% CI: 0.27-0.95).

Dietary Intake

Odds of obesity decreased significantly in the second tertile of energy intake (5000-7500 KJ/day) as compared with lower intake of less than 5000 KJ per day in young adult females 20-39 years of age (OR=0.47; 95% CI: 0.26-0.85), but showed no significant predictive effect at higher intakes in the same group or at any intake in the other age strata. Higher intakes of energy (>7500 KJ per day) showed a significant increasing trend of obesity in females aged 40-64 and a reverse trend among older adults (test for trend p <0.05).

Obesity was also associated with high energy intake from fat (>42%) in females 40-64 years of age (test for trend p <0.05), but no significant trend was shown in the other age groups.

Consumption of three regular meals daily did not show any significant association with obesity in all age strata.

Lifestyle Factors

Similar to men, smoking showed no relationship with obesity prevalence among women. However, alcohol consumption, estimated as having consumed alcohol during the last 12 months (OR=0.52; 95% CI: 0.29-0.93), and moderate to high physical activity estimated as Met minutes/week (OR=0.58; 95% CI: 0.36-0.93), were significantly associated with decreased obesity among young adult females.

Family history of obesity: Similar to men, family history of obesity was a major predictive factor of obesity among all age groups.

Table 4.16 Odds ratio estimates and their 95% confidence intervals from multivariate logistic regression associating individual, social, lifestyle and dietary factors with obesity for Lebanese adult **females** ≥20 years; Stratified by age & adjusted for all the variables (n=1386)

Variable (reference category)	Age Groups		
	20 – 39 (n=742) OR (95% CI)	**40 – 64 (n=511) OR (95% CI)**	**≥65 (n=133) OR (95% CI)**
Age (years)			
20 to 29	1.00		
30 to 39	2.64*(1.53-4.54)		
40 to 49		1.00	
50 to 64		2.97*(1.88-4.70)	
65 to 70			1.00
≥ 70			0.87 (0.37-2.06)
Marital Status			
Single(Never married)	1.00	1.00	1.00
Married	1.86*(1.02-3.39)	1.06 (0.64-1.75)	1.04 (0.41-2.68)
Education			
Primary and lower	1.00	1.00	NA
Intermediate/Secondary/Tech	0.67 (0.33-1.36)	0.85 (0.51-1.41)	
University	0.66 (0.28-1.52)	0.50 (0.23-1.10)	
Education			
Primary and lower	NA	NA	1.00
Intermediate and higher			0.57 (0.22-1.43)
Work Status			
Does not work	1.00	1.00	NA
Employee	1.10 (0.62-1.95)	1.47 (0.73-2.97)	
Self Employed / owner	0.89 (0.36-2.17)	0.55 (0.23-1.13)	
Household Assets			
< 7 items	1.00	1.00	1.00
7-8 items	0.72 (0.40-1.28)	0.53*(0.32-0.88)	0.87 (0.25-3.04)
>9 items	0.77 (0.40-1.51)	0.36*(0.14-0.90)	0.39 (0.07-1.98)
Crowding Index			
≥ 1 person / room	1.00	1.00	1.00
< 1 person / room	0.51*(0.27-0.95)	0.75 (0.47-1.18)	0.81 (0.33-1.97)
Smoking			
No	1.00	1.00	1.00
Yes	1.46 (0.92-2.33)	0.78 (0.51-1.20)	0.81 (0.34-1.41)
Alcohol			
No	1.00	1.00	1.00
Yes	0.52*(0.29-0.93)	1.04 (0.64-1.69)	0.91 (0.35-2.32)
Physical Activity			
Low	1.00	1.00	1.00
Moderate_ High	0.58*(0.36-0.93)	0.90 (0.58-1.41)	0.45 (0.19-1.03)
Family History of obesity			
No	1.00	1.00	1.00
Yes	2.71*(1.68-4.36)	3.96*(2.58-6.07)	3.57*(1.36-8.36)

Table 4.16 (cont'd) Odds ratio estimates and their 95% confidence intervals from multivariate logistic regression associating individual, social, lifestyle and dietary factors with obesity for Lebanese adult **females ≥20 years**; Stratified by age & adjusted for all the variables (n=1386)

Variable (reference category)	Age Groups 20 – 39 (n=742) OR (95% CI)	40 – 64 (n=511) OR (95% CI)	≥65 (n=133) OR (95% CI)
Energy Consumption(KJ)			
Low(<7000)	1.00	1.00	1.00
Moderate(7000-10500)	0.47*(0.26-0.85)	0.98 (0.58-1.65)	1.37 (0.52-3.62)
High(>10500)	0.94 (0.57-1.70)	1.15 (0.68-1.94)	0.56 (0.18-1.72)
Energy consumption from Fat (%)			
Low (<32%)	1.00	1.00	1.00
Moderate (32-42%)	1.03 (0.59-1.80)	0.83 (0.49-1.39)	1.31 (0.49-3.43)
High: (>42%)	0.97 (0.54-1.74)	1.34 (0.80-2.29)	0.97 (0.32-2.90)
Consumption of Regular 3 Meals Daily			
No (skips one or more meal)	1.00	1.00	1.00
Yes(eats 3 regular meals daily)	0.78 (0.47-1.29)	0.73 (0.47-1.11)	0.76 (0.32-1.81)

*significant at p<0.05

4.2 Results of Phase 2 Analysis

Presented in this section are descriptive statistics related to the classification of reporters of energy intake into plausible and implausible , followed by the results of multivariate analysis of the association of socio demographic and lifestyle factors with obesity, excluding implausible reporters of energy intake using the revised Goldberg cut-off (n=2540; M=1193, F=1347).

4.2.1 Anthropometric Characteristics and Diet Composition of Plausible and Implausible Reporters of Energy Intake

Among men, over-reporters of energy intake exhibited a significantly lower BMI (26.2±4Kg/m^2) and lower waist circumference (90.1±11.4cm) as compared with both acceptable reporters (BMI 27.5±4.6 Kg/m2, WC 95.3±12.6cm) and under-reporters (BMI 28.2±5.2 Kg/m^2, WC 95.9±14.6cm). No significant difference in these anthropometric indices was observed between men identified as under- and acceptable reporters (Table 4.17). Yet, the mean BMI of each category of reporters falls within the overweight range (25-29.9 Kg/m^2).

Mean energy consumption was significantly different among plausible reporters (9883±3134 KJ), under-reporters (4222±1075 KJ), and over-reporters (22580±6748 KJ). Under-reporters conveyed significantly lower percent energy consumption from fat (33.6±11.2) and higher percent energy consumption from carbohydrates (51.4±12.9), as compared with both acceptable and over-reporters.

Table 4.17 Mean BMI, Mean Waist Circumference and Mean Energy Intake of adult male study participants ≥ 20years, classified as Under-Reporters (UR)*, Over-Reporters (OR)* and Acceptable Reporters (AR)* of energy intake (n= 1193)

Males			
	Under-reporters (n=172)	**Over-reporters (n=110)**	**Acceptable reporters (n=911)**
Variables	Mean ± SD		
BMI(Kg/m^2)	28.2±5.2^a	26.2±4.0^b	27.5±4.6^a
Waist circumference(cm)	95.9±14.6^a	90.1±11.4^b	95.3±12.6^a
Energy Intake (KJ)	4222±1075^a	22580±6748^c	9883±3134^b
Fat (E %)	33.6±11.2^a	39.8±11.3^c	37.0±9.6^b
Carbohydrates (E %)	51.4±12.9^a	44.1±12.1^c	48.1±10.8^b
Protein (E %)	15.6±6.2^b	13.9±4.7^a	14.8±4.8$^{a\,b}$

*Determined by revised Goldberg Method : Goldberg Cut-off: UR<0.76; AR 0.76-2.4; OR>2.4
†In any one row, mean values with superscripts of the same letter are not significantly different; mean values with superscripts of different letters are significantly different at $p < 0.05$.
P values for Mean BMI, Waist Circumference, and Kjoules were derived from one way ANOVA.

Table 4.18 Mean BMI, Mean Waist Circumference and Mean Energy Intake of adult female study participants ≥ 20years, classified as Under-Reporters (UR)*, Over-Reporters (OR)* and Acceptable Reporters (AR)* of energy intake (n= 1347)

Females			
	Under-reporters (n=252)	**Over-reporters (n=68)**	**Acceptable reporters (n=1027)**
Variables	Mean ± SD		
BMI(Kg/m^2)	29.3±6.8^a	25.6±5.5^b	26.7±5.4^b
Waist circumference(cm)	90.7±14.6^a	82.6±13.2^b	85.7±14.1^b
Energy Intake (KJ)	3343±895^a	17342±5573^c	7188±2167^b
Fat (E %)	34.2±11.8^a	40.2±14.0^b	38.0±10.4^b
Carbohydrates (E %)	51.3±13.4^a	46.3±14.2^b	48.8±11.0^{ab}
Protein (E %)	15.8±7.5^a	14.2±6.7^b	14.1±4.3^b

*Determined by revised Goldberg Method : Goldberg Cut-off: UR<0.76; AR 0.76-2.4; OR>2.4
†In any one row, mean values with superscripts of the same letter are not significantly different; mean values with superscripts of different letters are significantly different at $p < 0.05$.
P values for Mean BMI, Waist Circumference, and Kjoules were derived from one way ANOVA.

On the other hand, women who under-reported had a significantly higher BMI (29.3±6.8Kg/m^2) and waist circumference (90.7±14.6cm), conveyed significantly lower mean energy consumption (3343±895 KJ), lower percent energy from fat (34.2±11.8), but higher percentages from both carbohydrates (51.3±13.4) and proteins (15.8±7.5) as compared with their counterparts (acceptable and over-reporters of energy intake (Table 4.18). Generally, the current study showed that Lebanese adult males greater or equal to 20 years of age and with lower mean BMI values tended to over-report, whereas adult women with higher mean BMI values tended to under-report their energy intake.

4.2.2 Sociodemographic Characteristics of Study Participants Associated with their Classification into Under-reporters (UR), Over-reporters (OR) and Acceptable Reporters (AR) of Energy Intake

As shown in Tables 4.19 and 4.20, both males and females showed a significant association between body mass index and classification into plausible and implausible reporters of dietary intake ($p<0.05$).

In women, a higher proportion of under reporters was found in overweight and obese women (40.1% and 34.3%, respectively) as compared with those with ideal BMI (25.6%). None of the lifestyle factors or socioeconomic indicators showed a similar relation with plausibility of dietary reporting.

In men, physical activity, education, the crowding index, and work status distributions exhibited significant associations with the frequency of plausible or implausible reporting of dietary intake.

Table 4.19 Descriptive characteristics of Male study participants (n=1193) associated with classification into under-reporters (UR), acceptable reporters (AR), and over-reporters (OR) according to the Goldberg cut-off*

Males					
	Goldberg Cut –off Classification				
	UR(<0.76)	**AR(0.76-2.4)**	**OR(>2.4)**		
Total sample % (n)	14.4 (172)	76.4(911)	9.2(110)		
Variables				Chi square	P value*
BMI(Kg/m^2)[1] % (n)				**16.946**	**0.002**
Ideal	25.6 (44)	30.6 (279)	41.8 (46)		
Overweight	40.1 (69)	42.6 (388)	44.5 (49)		
Obese	34.3 (59)	26.8 (244)	13.6 (15)		
Marital Status % (n)				**1.311**	**0.519**
Single(Never married)	45.3 (78)	41.1 (374)	44.0 (48)		
Married	54.7 (94)	58.9 (537)	56.0 (61)		
Education % (n)				**14.006**	**0.03**
Preliminary or less	19.8 (34)	22.1 (201)	22.7 (25)		
Complimentary and higher	51.2 (88)	49.1 (447)	50.9 (56)		
University	29.1 (50)	28.9 (263)	26.4 (29)		
Household Assets % (n)				**6.137**	**0.189**
<7items	38.5 (65)	45.5 (413)	43.1 (47)		
7-8 items	29.0 (49)	26.2 (238)	33.9 (37)		
≥ 9 items	32.5 (55)	28.2 (256)	22.9 (25)		
Crowding Index[#] % (n)				**19.609**	**0.000**
≥1 person/room	56.5 (96)	58.9 (535)	80.0 (88)		
< 1 person /room	43.5 (74)	41.1 (373)	20.0 (22)		
PA(METs) % (n)				**13.907**	**0.008**
Low intensity	54.3 (98)	76.0 (424)	42.1 (45)		
Moderate intensity	27.4 (45)	29.4 (261)	21.5 (23)		
High intensity	18.3 (30)	22.9 (204)	36.4 (39)		
Work Status % (n)				**23.535**	**0.003**
does not work + retired	18.0 (31)	18.2 (166)	6.4 (7)		
GOV employee	4.7 (8)	11.1 (101)	6.4 (7)		
private sector employee	26.7 (46)	23.1 (210)	36.4 (40)		
owner business-self employed	43.0 (74)	40.9 (372)	43.6 (48)		
student/volunteer work	7.6 (13)	6.7 (61)	7.3 (8)		

*Determined by revised Goldberg Method; Goldberg Cut-off: UR<0.76; AR 0.76-2.4; OR>2.4
[1] BMI classification according to the WHO cut offs (WHO, 2004);
[#] Crowding Index= number of persons in the household divided by the number of rooms, excluding kitchen & bathrooms.
*Significant at P<0.05. P-values were derived from chi-square test for all the socio - demographic characteristics distributions

Table 4. 20 Descriptive characteristics of Female study participants (n=1347) associated with classification into under-reporters (UR), acceptable reporters (AR), and over-reporters (OR) according to the Goldberg cut-offs**

Females					
	Goldberg Cut –off Classification				
	UR(<0.76)	**AR(0.76-2.4)**	**OR(>2.4)**		
Total sample **% (n)**	18.7 (252)	76.2(1027)	5.0(68)		
Variables				Chi square	P value*
BMI(Kg/m²) [1] % (n)				**30.799**	**0.000**
ideal	31.3 (79)	44.1 (453)	48.5 (33)		
Overweight	28.6 (72)	31.7 (326)	33.8 (23)		
Obese	40.1 (101)	24.1 (248)	17.6 (12)		
Marital Status % (n)				**2.070**	**0.355**
Single(Never married)	34.5 (87)	38.4 (394)	42.4 (22)		
Married	65.5 (165)	61.6 (632)	67.6 (46)		
Education %(n)				**6.567**	**0.161**
Preliminary or less	21.0 (53)	20.1 (206)	19.1 (13)		
Complimentary and higher	56.3 (142)	49.4 (507)	50.0 (34)		
University	22.6 (57)	30.6 (314)	30.9 (21)		
Household Assets %(n)				**6.829**	**0.145**
<7items	59.0 (147)	56.6 (578)	53.7 (36)		
7-8 items	25.7 (64)	25.4 (260)	17.9 (12)		
≥ 9 items	15.3 (38)	18.0 (184)	28.4 (19)		
Crowding Index[#] %(n)				**3.586**	**0.166**
≥1 person/room	69.2 (173)	63.8 (654)	58.8 (40)		
< 1 person /room	30.8 (77)	36.2 (371)	41.2 (28)		
PA(METs) %(n)				**1.344**	**0.854**
Low intensity	44.9 (111)	43.1 (434)	47.1 (32)		
Moderate intensity	33.2 (82)	33.8 (341)	35.3 (24)		
High intensity	21.9 (54)	23.1 (233)	17.6 (12)		
Work Status %(n)				**2.782**	**0.947**
does not work + retired	67.1 (169)	63.7 (654)	64.7 (44)		
GOV employee	03.2 (8.0)	0 4.7 (48)	04.4 (3)		
private sector employee	16.7 (42)	17.4 (179)	16.2 (11)		
owner business-self employed	07.1 (18)	06.7 (69)	08.8 (6)		
student/volunteer work	06.0 (15)	07.5 (77)	05.9 (4)		

[1] BMI classification according to the WHO cut offs (WHO, 2004).
[#] Crowding Index= number of persons in the household divided by the number of rooms, excluding kitchen & bathrooms.
*Significant at P<0.05.
P-values were derived from chi-square test for all the socio -demographic characteristics distributions

4.2.3 Multivariate Analysis of the Association of Socio-demographic and Lifestyle Factors with Obesity (BMI≥30Kg/m²) among Lebanese Adults ≥ 20 Years Excluding Implausible Reporters of Energy Intake (under-and over-reporters)

The relationship between energy consumption and obesity among study subjects aged 20 years and above was re-examined including only plausible reporters of dietary intake. Results of the multivariate regression analysis are presented in Tables 4.21 and 4.21 for males and females respectively.

Associations of Sociodemographic, Dietary, and Physical Activity Factors with Obesity in Adult Males (after the exclusion of both categories of mis-reporters)

In young adult males aged 20-39 years, the significantly increased odds of being obese remained among those who were married (OR=2.54; 95% CI: 1.38-4.66), and reported accessible household assets including home essentials, a transport vehicle, and a mobile phone (OR=2.51; 95% CI: 1.626-5.01). The work status variable lost its significant effect on the odds of obesity incidence in this age group, however continued in midlife years (40-64) with the odds more than tripled for those reporting self-employment or business ownership (OR=3.50; 95% CI: 1.54-7.94). Then again, significance of household assets to increased obesity odds in the latter age group was lost (Table 4.21).

Even after the exclusion of implausible reporters from the regression analysis, no significant relationship was found between energy consumption and frequency of obesity in males across all age strata. Conversely, alcohol showed significant decreased likelihood of obesity in the age group 40-64 years (OR=0.54; 95% CI: 0.32-0.92).

The relationship of family history to obesity disappeared in the young age stratum; however, it remained significantly increased in the next two strata.

As in the multivariate analysis including all study subjects, age did not show any significant odds on obesity incidence among males of plausible dietary intake.

Table 4. 21 Odds ratio estimates and their 95% confidence intervals from multivariate logistic regression associating individual, social, lifestyle and dietary factors with obesity **for acceptable Lebanese male reportes of energy intake ≥ 20 years (n=911);** Stratified by age & adjusted for all the variables included in the model

Males			
	Age Groups		
Variable (reference category)	**20 – 39** (n=443) **OR (95% CI)**	**40 – 64** (n=316) **OR (95% CI)**	**≥65** **(n=120)** **OR (95% CI)**
Age (years)			
20 to 29	1.00		
30 to 39	0.62 (0.33-1.15)		
40 to 49		1.00	
50 to 64		1.34 (0.79-2.27)	
65 to 70			1.00
≥ 70			0.911 (0.32-2.57)
Marital Status			
Single(Never married)	1.00	1.00	1.00
Married	2.54*(1.38-4.66)	1.09 (0.49-2.42)	4.57*(0.12-18.7)
Education			
Primary and lower	1.00	1.00	NA
Intermediate/Secondary/Tech	1.72 (0.60-4.93)	1.03 (0.56-1.87)	
University	0.76 (0.23-2.50)	0.91 (0.40-2.02)	
Education			
Primary and lower	NA	NA	1.00
Intermediate and higher			0.81 (0.31-2.07)
Work Status			
Does not work	1.00	1.00	NA
Employee	2.25(0.91-5.54)	2.12 (0.87-5.17)	
Self Employed / owner	1.99 (0.76-5.19)	3.50* (1.54-7.94)	
Household Assets			
< 7 items	1.00	1.00	NA
7-8 items	1.39 (0.72-2.69)	1.84(0.94-3.60)	
≥9 items	2.51*(1.26-5.01)	1.16 (0.60-2.25)	
Household Assets			
< 7 items	NA	NA	1.00
≥7 items			1.26 (0.41-3.85)
Crowding Index			
≥ 1 person / room	1.00	1.00	1.00
< 1 person / room	1.21 (0.72-2.04)	0.91 (0.51-1.64)	1.53 (0.56-4.12)
Smoking			
No	1.00	1.00	1.00
Yes	1.12 (0.63-1.99)	0.79 (0.45-1.39)	0.45 (0.17-1.14)
Alcohol			
No	1.00	1.00	1.00
Yes	0.81 (0.48-1.37)	0.54*(0.32-0.92)	1.04 (0.42-2.60)
Physical Activity			
Low	NA	NA	1.00
Moderate_ High			0.97 (3.99-2.36)

Table 4.21 (cont'd) Odds ratio estimates and their 95% confidence intervals from multivariate logistic regression associating individual, social, lifestyle and dietary factors with obesity for **acceptable Lebanese male reportes of energy intake ≥ 20 years** (n=911); Stratified by age & adjusted for all the variables included in the model

Males			
	Age Groups		
Variable (reference category)	**20 – 39** (n=443) **OR (95% CI)**	**40 – 64** (n=316) **OR (95% CI)**	**≥65** **(n=120)** **OR (95% CI)**
Physical Activity			
Low	1.00	1.00	NA
Moderate	0.85 (0.43-1.66)	1.31 (0.75-2.31)	
High	1.07 (0.59-1.94)	0.54 (0.25-1.16)	
Family History of obesity			
No	1.00	1.00	1.00
Yes	1.48 (0.89-2.46)	2.01*(1.21-3.34)	2.52*(1.01-6.28)
Energy Consumption(KJ)			
Low(<8368)	1.00	1.00	NA
Moderate(8368-11297)	1.12 (0.57-2.17)	1.00 (0.54-1.83)	
High(≥11297)	1.59 (0.84-3.01)	1.40 (0.72-2.73)	
Energy Consumption(KJ)			
Low(<6276)	NA	NA	1.00
Moderate(6276-8368)			2.26(0.70-7.27)
High(≥8368)			1.55 (0.48-4.96)
Energy consumption Fat (%)			
Low (<32%)	1.00	1.00	1.00
Moderate (32-42%)	0.83 (0.45-1.52)	1.18 (0.62-2.25)	0.61 (0.20-1.86)
High: (≥42%)	1.06 (0.55-2.04)	1.35 (0.69-2.64)	0.55 (0.16-1.80)
Consumption of Regular 3 Meals Daily			
No (skips one or more meal)	1.00	1.00	1.00
Yes(eats 3 regular meals daily)	0.66 (0.39-1.11)	0.79 (0.47-1.33)	1.94 (0.65-5.79)

.Analysis carried out excluding under-reporters n=172, over-reporters n=110, and underweight subjects n=7
*significant at p<0.05

Associations of Sociodemographic, Dietary, and Physical Activity Factors among Adult Females (after the exclusion of both categories of mis-reporters)

The effect of age on obesity incidence remained in females 20- 39 years and 40-64 years old; however, the significance of marriage to obesity incidence at the young age (20-39 years) disappeared. Crowding index indicative of higher socioeconomic status remained to be a significant factor in decreased obesity prevalence (OR=0.42; 95% CI: 0.18-0.94) in the young age stratum 20-39 years. Household assets, also a variable used to evaluate socioeconomic status, lost its significance as a predictor of decreased obesity in women aged 40-64 years, whilst it was apparent when regression was carried out on all female respondents.

The impact of excluding implausible reporters of energy intake in multivariate regression accentuated the association between energy consumption and the odds of obesity among adult females. A significant predictive positive effect emerged in the third tertile of energy consumption (>=8368 KJ/day) among young adult females aged 20-39 years (OR=2.62; 95% CI: 1.23-5.59) and in midlife among adult females aged 40-64 years (OR=1.90; 95% CI: 1.02-3.55) (Table 4.22).

As for life style factors, smoking showed a significant positive relationship with obesity prevalence among young women. Moderate to high physical activity estimated as Met minutes/week remained significantly associated with decreased obesity among young adult females (OR=0.34; 95% CI: 0.17-0.64), emerged in females greater or equal to 64 years of age (OR=0.33; 95% CI: 0.12-0.90), but not in females aged 40-64 years.

Family history of obesity remained a major predictive factor of obesity among plausible female respondents in all age groups.

Table 4. 22 Odds ratio estimates and their 95% confidence intervals from multivariate logistic regression associating individual, social, lifestyle and dietary factors with obesity **for acceptable Lebanese adult female reporters of energy intake, ≥20 years(n= 1027)***; Stratified by age & adjusted for all the variables

Females			
Variable (reference category)	**20 – 39** (n=529) **OR (95% CI)**	**40 – 64** (n=370) **OR (95% CI)**	**≥65** (n=96) **OR (95% CI)**
Age (years)			
20 to 29	1.00		
30 to 39	4.08*(1.92-8.64)		
40 to 49		1.00	
50 to 64		3.87*(2.25-6.67)	
65 to 70			1.00
≥ 70			0.92 (0.33-2.53)
Marital Status			
Single(Never married)	1.00	1.00	1.00
Married	1.81(0.82-3.97)	0.99 (0.55-1.79)	0.98 (0.33-2.91)
Education			
Primary and lower	1.00	1.00	NA
Intermediate/Secondary/Tech	0.45 (0.17-1.19)	0.71 (0.39-1.28)	
University	0.62 (0.21-1.85)	0.41 (1.63-1.02)	
Education			
Primary and lower	NA	NA	1.00
Intermediate and higher			0.65 (0.21-1.99)
Work Status			
Does not work	1.00	1.00	NA
Employee	1.36 (0.65-2.87)	1.59 (0.72-3.49)	
Self Employed / owner	1.31 (0.43-4.03)	0.88 (0.32-2.38)	
Household Assets			
< 7 items	1.00	1.00	NA
7-8 items	1.03 (0.49-2.16)	0.72(0.40-1.29)	
≥9 items	0.85 (0.35-2.05)	0.50(0.17-1.46)	
Household Assets			
< 7 items	NA	NA	1.00
≥7 items			0.24*(0.06-0.92)
Crowding Index			
≥ 1 person / room	1.00	1.00	1.00
< 1 person / room	0.42*(0.18-0.94)	0.66(0.38-1.13)	0.56 (1.96-1.59)
Smoking			
No	1.00	1.00	1.00
Yes	1.85*(1.01-3.41)	0.69 (0.42-1.14)	0.80 (0.29-2.20)
Alcohol			
No	1.00	1.00	1.00
Yes	0.61(0.29-1.29)	0.98 (0.56-1.72)	0.99 (0.32-2.99)
Physical Activity			
Low	1.00	1.00	1.00
Moderate_ High	0.34*(0.17-0.64)	0.89 (0.53-1.49)	0.33*(0.12-0.90)

Table 4.22 (cont'd) Odds ratio estimates and their 95% confidence intervals from multivariate logistic regression associating individual, social, lifestyle and dietary factors with obesity for **acceptable Lebanese adult female reporters of energy intake, ≥20 years(n= 1027)**; Stratified by age & adjusted for all the variables

Females			
Variable (reference category)	**20 – 39** (n=529) **OR (95% CI)**	**40 – 64** (n=370) **OR (95% CI)**	**≥65** (n=96) **OR (95% CI)**
Family History of obesity			
No	1.00	1.00	1.00
Yes	2.39*(1.28-4.5)	3.67*(2.22-6.05)	4.79*(1.54-15.14)
Energy Consumption(KJ)			
Low (<6276)	1.00	1.00	NA
Moderate (6276-8368)	1.87 (0.86-4.07)	1.50 (0.84-2.66)	
High (≥8368)	2.62*(1.23-5.59)	1.90*(1.02-3.55)	
Energy Consumption(KJ)			
Low(<5020)	NA	NA	1.00
Moderate(5020-6276)			0.72 (0.20-2.58)
High(≥6276)			0.49 (0.15-1.59)
Energy consumption Fat (%)			
Low (<32%)	1.00	1.00	1.00
Moderate (32-42%)	1.23 (0.58-2.62)	1.03 (0.55-1.90)	1.06 (0.34-3.32)
High: (>42%)	1.10 (0.46-2.19)	1.37 (0.73-2.58)	0.71 (0.18-2.70)
Consumption of Regular 3 Meals Daily	1.00	1.00	1.00
No (skips one or more meal)	0.75 (0.39-1.43)	0.67 (0.41-1.11)	0.97 (0.33-2.86)
Yes(eats 3 regular meals daily)			

Analysis carried out excluding under-reporters n=252, over-reporters n=68, underweight subjects n=35
*significant at $p<0.05$

4.2.4 Energy Consumption from Various Food Groups by Obese and Non-obese Study Participants ≥ 20 Years

Food sources of energy for the Lebanese adult population were assembled into 28 food groups from the 24-hour recalls using the nutritionist–pro software (www.firstdatabank.com). Percent mean energy intakes (±SD) from each food group for both obese (BMI≥30 Kg/m^2) and non-obese subjects (BMI<30 Kg/m^2), excluding all implausible reporters (n=602), are presented in Table 4.23.

The analysis included all food groups for completeness; however, the purpose of this analysis was to investigate the consumption percent energy from key food groups evidenced to be related to obesity.

Interestingly, obese subjects reported significantly higher intakes of the fruits and vegetables groups and lower intakes of all sorts of beverages, fried potatoes, and chips groups. Obese subjects also reported lower intakes of all other foods perceived as "unhealthy" including fast foods, sugar, cakes, ice cream, and Arabic sweets (such as

Baklava, maamoul, etc… mostly made with ghee, sugar and sugar syrup, nuts, cheese, or heavy cream); however, this was significant only in the "other desserts" group that included puddings, cookies, hard candy, nougat, Turkish delights with biscuits, and in the "chocolates group" that included chocolate bars and chocolate spreads. The mean percent energy intake from the dietary fats and oils group (includes added oil, butter, margarine, mayonnaise, avocado, olives, tahini (sesame paste), beef tallow, lard, ghee, creams for sauces, cream added on puddings and desserts), was significantly higher in the obese group ($p<0.05$).

Then again, obese subjects reported consuming significantly lower percent daily energy intake from the cereals group that included all types of breakfast cereals, cereal bars, and cakes.

Table 4. 23 Mean Total Energy Intake and percent Mean Energy Intake from various food groups for obese and non-obese subjects of acceptable reporting of energy intake (n= 1654)

	Not Obese(BMI<30) n=1239	**Obese(BMI>=30) n=415**	
	Mean Kjoules ±SD		**P- value**
Energy Intake (kJ)*	8309±2887	8890±1140	0.000
Food Groups	**Mean % Kjoules ±SD**		
Bread	17.0±13.5	18.0±13.7	0.157
Cereals*	0.3±2.0	0.1±0.9	0.001
Starch & Starchy Vegetables	5.9±10.8	6.2±10.8	0.606
Legumes	0.7±2.7	0.8±3.4	0.787
Fruits*	4.3±5.8	6.1±8.0	0.000
Vegetables*	2.5±4.5	3.4±6.2	0.013
Meat & Meat Products	11.3±13.6	10.9±12.5	0.657
Eggs	0.7±2.9	0.6±3.1	0.424
Dairy Full Fat	7.2±8.6	6.8±7.6	0.324
Dairy Low Fat	0.48±2.3	0.48±2.1	0.985
Nuts and Seeds	2.5±8.1	2.4±8.4	0.810
Traditional Composite	6.6±12.6	7.3±13.2	0.364
Composite Western	0.59±5.0	0.63±4.7	0.892
Soft Drinks*	2.4±4.3	1.8±3.6	0.003
Other Beverages*	1.8±4.0	1.4±2.9	0.036
Alcohol	0.8±3.5	0.6±2.6	0.242
Fried Potatoes *	2.7±5.8	1.8±4.2	0.001
Chips*	0.76±3.4	0.43±2.0	0.019
Fats & Oils*	9.4±10.3	11.2±11.4	0.005
Fast Foods	4.2±11.9	3.2±11.5	0.129
Pastries	8.6±16.2	8.5±16.7	0.876
Sugar & Sweets	1.6±2.7	1.5±2.7	0.524
Chocolates*	1.7±5.0	0.9±3.5	0.000
Arabic Sweets	1.7±6.9	1.9±7.6	0.404
Cakes	1.2±4.3	0.8±3.9	0.067
Ice Cream	0.6±3.1	0.4±1.9	0.142
Other Desserts*	1.5±4.9	0.9±4.0	0.029
Condiments	0.4±2.1	0.4±1.9	0.992

*significant at $p<0.05$

Chapter 5: Discussion

This study is the second national cross-sectional study to estimate obesity prevalence and its associated factors among Lebanese adults. The discussion on BMI estimates and obesity prevalence will be based on the total sample included in the analysis (Phase 1), whereas discussion on associations will be based on the results from regression analysis after the exclusion of implausible reporters of dietary intake (Phase 2).

Current prevalence estimates are compared with those of a previous national study carried out in Lebanon in 1997(Research article in Appendix T). The two surveys were very similar in terms of sampling method and study population, although the sample size in the 2008 survey (n=2697) was larger than the 1997 survey (n=1216). The two surveys were also very similar in terms of assessment tools; both used face to face interviews for data collection and used a one-day 24-hr recall method for dietary assessment. The method of assessment for physical activity used in the 1997 survey (using a simple question which asked whether the participant was involved in leisure time physical activity three times a week) was different to that used in the 2008 survey (IPAQ).

A table summarizing and comparing methods, sample characteristics, and findings of both studies are presented in Appendix U.

5.1 Study Limitations and Strengths

5.1.1 Limitations

Cross sectional nature of the study

The findings of this study should be considered in light of its limitations. Cross sectional studies are usually conducted to estimate the prevalence of the outcome of interest for a given population and investigate its association with risk factors. They are limited, however, by the fact that they are carried out at one time point and give no indication of the sequence of events; whether exposure occurred before, after or during the onset of the disease (in this case, obesity) outcome (Silva, 1999). Being based on prevalent (existing) rather than incident (new) cases, cross sectional studies are of limited value to investigate causal relationships and therefore infer causality (Mann, 2003). It is rather difficult to differentiate cause and effect from simple association, where often there are a number of possible explanations (Mann, 2003). For instance, it cannot be assumed that inactivity precedes obesity when inactivity can, on the other hand, be a consequence of obesity (Silva, 1999).

Cross sectional studies are however capable of revealing the presence or absence of a relationship between the study variables and prevalent (existing) cases. This implies a need for caution, since prevalent cases may not be representative of all cases of the disease. Cases of short duration, corrected by intervention or ended by death, have a smaller chance of being detected in a one-time prevalence survey (Breslow & Day, 1980). On the other hand, cases of long duration, such as an enduring obesity, may be over represented in a cross sectional study. The characteristics of these long-duration cases may, on average, differ in a variety of ways from the characteristics of all cases of the disease being studied. Associations between outcomes and exposures of long duration are particularly difficult to establish using cross-sectional studies. Nevertheless, cross sectional studies indicate associations that may exist and are therefore useful in public health planning, understanding disease aetiology, and for generating hypothesis for future research (Mann, 2003).

Data collection

The data collection involved face to face interviews and the interviewer was challenged with participants' compliance possibly related to social and cultural factors. There is the possibility that the study subjects were providing socially desirable responses probably affecting the validity of reported answers and contributing to information bias (Yu & Tse, 2012).

The 24 hour recall instrument

The choice of the dietary assessment tool to be used for the quantification of food intake in a sample population should be properly considered as it may influence research results. All dietary assessment methods share a major source of error identified as misreporting of food consumed (Mendez et al., 2011), and the issue appears to be more challenging in data collected from large nutrition surveys. For this study, the 24-hour recall was chosen as the dietary assessment tool, and the justification for its use is stated in the methods chapter. The 24-hour recall was executed following standardised procedures. Using the revised Goldberg cut-off method (Black et al., 2000a; Black et al., 2000b), a considerable number of mis-reporters was identified in this study. This may be due to several reasons. First, this study collected a single 24-hour recall per participant, and it is documented that the first 24 hr. recall, regardless of the day of the week, is associated with significant under-reporting (Yunsheng et al., 2009). Second, the attitude, general manners, probing procedure, and non-verbal and verbal language expressed by the interviewer might have conveyed messages affecting the likelihood of misreporting (Thompson & Subar, 2008). Third, the cognitive process required by the participant to complete the recall, which may vary by socioeconomic and educational level, might have imposed difficulties in recalling the food consumed and in estimating food portion size by certain groups within the study population. Social taboos and the tendency to report socially desirable responses may have also added to the possibility of mis-reporting of dietary intake (Yu & Tse, 2012). Considering all the above, it is probable that a face-to-face interview for dietary data collection is not the preferred tool to use for the Lebanese adult population.

On balance, and in an ideal world, the researcher would have preferred to use a 24-hour recall but over a number of days.
However, in terms of response rate, the face-to-face tool was very successful.

The International Physical Activity Questionnaire (IPAQ)

Overestimation might be particularly true in self-reported physical activity levels (Maddison et al., 2007). In addition to overestimation, another source of bias might originate from the use of the International Physical Activity Questionnaire for those participants ≥65 years. The IPAQ has been validated for use in subjects 15-65 years of age (Craig et al., 2003), and therefore its use in older adults might have led to misclassification of physical activity among this population group.

Anthropometric measurements

Although all interviewers were trained on standardised procedures that were implemented for all anthropometric measurements, there was always the potential for imprecision of measurement, probably related to errors made by the measurer (observer error), or faulty technique caused by carelessness, poor motivation, fatigue, or boredom. Performing anthropometric measurements for the obese participants was most challenging. Technical difficulties in determining skinfold thickness were encountered, and full compliance by the subject was difficult to obtain.

Another source of inaccuracy in measurement information is recording mistakes, mostly related to recording of numbers.

Non response

Participants in any survey are likely to differ in some of their characteristics from those who do not respond (Silva, 1999). Lack of baseline information on non-respondents is a limitation in this study. However, the extent of bias, if any, which could have been introduced into this study by the absence of non-responders, could not be assessed.

Variables included in the study

A lot of information can be collected about potential risk factors in a cross-sectional study. It is a good opportunity to gain a broad base of knowledge about subjects who have or do not have the outcome of interest. This study is a component of a larger behavioural risk survey. To maintain optimum response level, only variables that were commonly reported in the literature as most strongly associated with obesity were collected and included in the analysis.

However, further information would have been useful to assess whether other risk factors were associated with obesity in this population. Studies have reported mixed evidence of positive associations between food insecurity (Franklin et al., 2011), food stamps programs (Zagorsky & Smith, 2009), family structure (Pinot de Moira et al., 2009) and obesity. Food security and level of household income may constitute a potential risk factor for obesity in the Lebanese population, and it would have been interesting to analyse these data.

Menopause, childbearing history, and breastfeeding practices were reported to have a persistent effect on adiposity in women in developed countries, regardless of socioeconomic status, smoking and physical activity (Bobrow et al., 2012). It would have been also interesting to investigate their association with weight gain in Lebanese women.

Analysis

Socioeconomic indicators

The household socioeconomic indicator based on assets ownership used in the study is a proxy indicator and does not produce results similar to those obtained from direct measurements of income and expenditure when reliably collected (Uthman, 2009; Howe et al, 2009). Although information on income (Lebanese pounds) was collected during the face to face interviews, the variable was dropped from the analysis due to the large number of missing cases.

Older participants

The study has shown an increase in obesity (BMI≥30) prevalence rate across the age groups (**Figure 4.4**). For the age group ≥70 years, although an increase in obesity prevalence rate has been shown, this finding should be looked at with caution due to several factors; one is height measurement difficulties in the elderly related to spine curvature or inability to stand in full height; another is the change in body composition that occurs with age. Whereas BMI appears to have excellent validity as a measure of absolute fat mass adjusted for height in young and middle aged adults (Buzzard, 1998), it may underestimate body fat in persons who have lost muscle mass (Kaplan et al., 2003), such as the older population. At this age group, the relative contribution of abdominal circumference to information on total fatness is likely to increase with age due to reduced validity of BMI as a measure of fatness because of age-related variation in lean mass (Willet, 1998). Accordingly, given its practicality and relative ease of measurement, waist circumference would have been the preferred anthropometric index to measure adiposity in the elderly and it would have probably been more relevant to use the waist circumference as the study outcome for this age group (≥70 years) instead of the BMI, and as the dependent variable in the regression analysis.

Nevertheless, when the data was analysed excluding elderly subject greater or equal to 75 years of age, the results were not different compared with the whole study population. Also, height did not appear to shrink after 75 years of age (data on mean height for male and female study participants aged ≥ 70 years is presented in Appendix V).

Lesson learned

Every instrument, whether dietary or anthropometric, has its advantage and disadvantage, and the researcher should acknowledge the limitations of these instruments and careful judgement should be carried out in the interpretation of the data collected and analysed. Most importantly, any dietary assessment tool to be used for a certain population should be validated beforehand.

5.1.2 Strengths

The strengths of this study include the large sample drawn from all the six Governates of Lebanon coupled with sufficient data quality capable of offering new nationwide information that would add to the understanding of the epidemiology of obesity in Lebanon and provide constructive evidence on the prevalence of obesity and its correlates among the Lebanese adult population. These correlates which include socioeconomic status, dietary intake and physical activity can be more rigorously studied using a cohort or randomized controlled studies for future interventions.

Data on food intake and physical activity were cleaned and processed according to standardized procedures; consistency and completeness of the whole data set was continuously re-checked by the thesis researcher. Physical activity data were categorized and analysed following the IPAQ scoring guidelines; and the dietary data collected by the 24 hour recall instrument were entered solely by the researcher of this thesis thus ensuring data uniformity. Furthermore, implausible reporters of energy intake were identified using the revised Goldberg method and were later excluded from analysis of food intake, thus adding validity to the study findings regarding associations between energy consumption and BMI. Anthropometric measures, mainly weight and height were measured by trained nutritionists using calibrated instruments thus ruling out the possibility of reported underestimation or overestimation of weight and height, and consequently BMI.

5.2 Current Estimates of Body Mass Index, Waist Circumference and Body Fat Percentage among Lebanese Adults

This study shows that the adult Lebanese population currently exhibits a mean BMI value that is greater than the optimal adult mean values of 21 kg/m^2 and 23 kg/m^2 specified by the WHO for developed and developing countries respectively (WHO, 2002; Peixoto et al., 2007). This BMI value is observed in both genders and across all age groups (Tables 4.4 and 4.5). Compared with mean BMI values determined in a previous national cross-sectional study carried out in 1997 (Sibai et al., 2003), this study indicates an increase in total mean BMI ranging between 1.6 Kg/m^2 in women and 2 Kg/m^2 in men, alarmingly exceeding the recently reported worldwide estimates of 0.5Kg/m^2 per decade for women and 0.4Kg/m^2 per decade for men (Finucane et al., 2011).

This study also shows an unfavourable peaking of the BMI mean values at midlife in both men (40-49 y) and women (50-59 y), a finding that is in relative accordance with most data from large population studies revealing that mean body weight and BMI gradually increase during most of adult life; they reach peak values at 50-59 years of age in both men and women (Villareal et al., 2005). Also, it is reported that after the age of 60 years, mean body weight and BMI tend to decrease (Villareal et al., 2005); however, these observations which were obtained from cross-sectional studies can be affected by survival bias, because obese persons have higher mortality rates at younger ages (Villareal et al., 2005; Fontaine, 2003). In fact, data from longitudinal cohort studies suggest that body weight and BMI do not change, or decrease only slightly, in older adults (60-70 years old at study entry) (Villareal et al., 2005). In the current study, mean BMI values were flat after peaking in both genders, however the plateau effect was apparent earlier in men.

Mean percent body fat showed a trend similar to that of BMI among women, and exhibited a mean value higher than the recommended healthy cut off of 32% at a young age of 30-39 years. In men, unhealthy mean percent body fat of greater or equal to 25% was noted at midlife (40-49 years). Mean waist circumference (cm) surged to an unhealthy range also at midlife in men and both mean waist circumference and body fat increased at the same age in women (30-39 years age group); however, mean waist circumference (cm) reached its highest significant mean value at the age of 70 years and onwards among women.

As BMI alone neither distinguishes fat from lean tissue nor represents adiposity directly (Flegal et al., 2010), the concurrent increase of mean BMI, mean % BF and mean waist circumference (cm) shown in this study indicates the prevalence of adiposity, mainly abdominal obesity, among this study population.

5.2.1 Prevalence of Obesity across the Age Groups among Lebanese Adults and in Comparison with those in other Countries

Findings of this study indicate that 1 in 4 Lebanese adults is obese (26.6%). This is almost 1.5 folds higher than the prevalence estimate of 17% reported in the cross-sectional study of 1997 (Sibai et al., 2003). Also in this period, narrowing of the gender differential in obesity prevalence has been noted due to a more accelerated increase in obesity prevalence among men when compared to the 1997 estimate. In general, the present data show that obesity has increased from 14.3% to 26.6% in men and from 18.8% to 26.6% in women within a 12-year interval.

Interestingly, in some developed countries such as France, the percentage of obese subjects was also reported to be similar in both genders (Janghorbani et al., 2007). However, it is imperative to point out that this overall similarity in obesity prevalence reported in this study in both genders is fuelled by overriding differences in the distribution across the age groups; women had a lower prevalence than that of men at a younger age (20-49 years) but a higher one at the age of 50 years and onward at the obesity classes II and III. Currently, and as the results of this study demonstrate, there is a higher proportion of men than women in obesity class I (21.1% and 16.2%, respectively), most prominent at the younger age group of 20-29 years (13.4% vs. 6.9%). On the other hand, women exhibited higher overall proportions in obesity class II and class III, a problem not to be ignored, with the prevalence rate almost magnified by 2 fold at every decade towards midlife.

Another significant finding is the movable upturn that occurred within a decade in obesity prevalence among the young women compared with the results of the previous national study (Sibai et al., 2003). The proportion of these young women in obesity class I (BMI 30-34.99Kg/m2) has almost doubled in the age groups 20 -29 years and 30-39 years, increasing from 3.9 % to 6% and from 7.9 to 16%, respectively. In obesity class II, the proportion of women aged 50-59 years has increased from 7.1% to 16.5%. An escalation was also noted in the total prevalence of clinical obesity class III (BMI ≥ 40Kg/m^2) in both genders, from the reported estimate of 0.7 % in 1997(Sibai et al., 1997) to the current value of 2.5% one decade later, presenting a nearly 3 fold increase in the prevalence. Such a rising trend within a decade, particularly in clinical obesity, entails adverse health risks if it were to reach the reported prevalence of morbid obesity in women from neighbouring countries of the MENA region, ranging from 3.2% to 4.6% in Egypt, Kuwait and Saudi Arabia (Galal, 2002; Sibai et al., 2010; Al-Kandari, 2006; Al-Nozha et al., 2005), to levels that are almost 3 times higher (12.0%) in Iraq (Al-Tawil et al., 2007).

This trend in the population distribution indicates the shift in obesity to earlier age groups among the Lebanese adults, more alarmingly of the class II and III types, mainly among women. This trend is similar to that in developed countries such as the United States where even though the overall rates of increase for obesity (proportion of the population with BMI>30 Kg/m^2) may have decreased in the last decade as reported by Flegal and colleagues (2010), the population distribution among men and women greater or equal to 20 years of age points toward a faster increase in the prevalence of the extreme weight categories of obesity classes II and III (14.3%), particularly in women (Strum, 2007; Ryan & Kushner, 2010).

Similarly, a smaller proportion of people with lower BMI has been noted , as reported among the adult population in the United Kingdom (Popkin, 2010), as well as an increased prevalence of clinical obesity (≥40 Kg/m^2): from 0.2% in men and 1.4% in women to 0.8% in men and 2.6 % in women within a decade (Rennie & Jebb, 2005).

Compared with other countries of the Middle East and North Africa (MENA) region (**Figure 5.1**), current adult obesity prevalence estimates in Lebanon are still lower than those of oil-rich affluent countries such as Kuwait and Saudi Arabia (39.8% and 43.8%, respectively) (WHO, 2012), as well as other neighbouring Mediterranean countries with similar economic classification such as Syria (38.2%) (Rastam et al., 2006) and Jordan (37.8%) (Zindah et al., 2008).

Within a decade, Lebanon showed an increase in obesity prevalence among its adult population as compared to other countries of similar or higher economic development (**Figure 5.2**). Turkey, of a similar economic classification as Lebanon, has experienced levelling off of obesity prevalence among its adult population, possibly as a result of intervention policies and programs (Koca et al., 2009). Although France had the lowest prevalence rates one decade earlier, it appears to be currently experiencing a rise in obesity estimates almost approaching that of Turkey. Lately, Kuwait and USA, both classified as high income countries, may have been experiencing almost steady but still high obesity prevalence estimates.

To wrap up, current obesity prevalence among Lebanese adults is high (26.6%), and as elsewhere, gender differentials persist across the age groups, where the prevalence becomes more prominent at the age groups 50 and onwards in women as compared with men; women exhibit lower proportions than men at the younger age groups (20-49 years), but higher overall proportions at the higher BMI values (≥ 35).

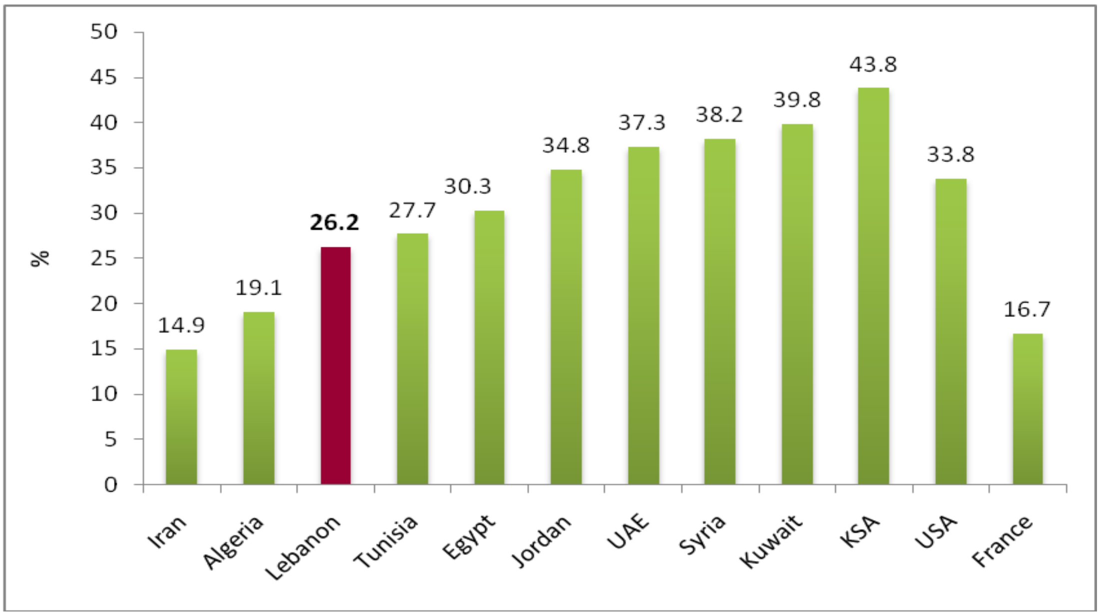


Figure 5.1 Obesity Prevalence across countries of different economic development
*Compiled from the World Health Organization. (2012). *Global Database on Body Mass Index.* Retrieved on February 2012 from http://apps.who.int/bmi/index.jsp

In brief, Figure 5.1 shows that adult obesity prevalence in Lebanon is comparable to that of Tunisia (≥20 years), lower than that of Egypt (25-64 years), Jordan (≥18 years), KSA (≥30years), Kuwait (21-77 years), Syria (18-65 years), UAE (≥20 years), and USA (≥20 years), and_higher than that of Algeria (≥20 years) , Iran (≥25 years), and France (18-74 years).

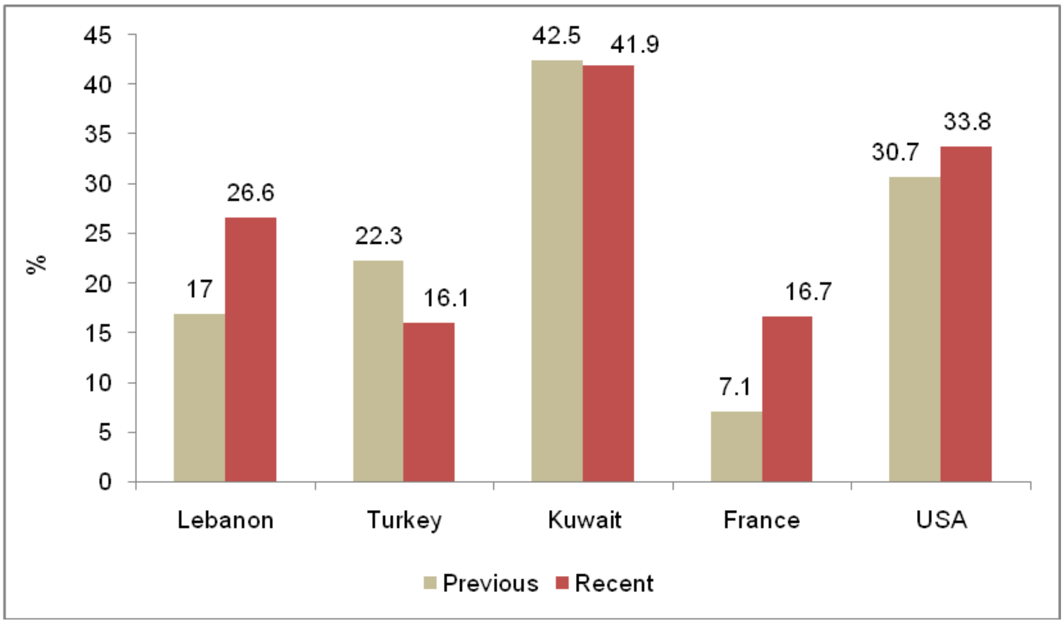


Figure 5.2 Obesity trend in selected countries of the MENA region, France and USA
*Compiled from the World Health Organization. (2012). *Global Database on Body Mass Index.* Retrieved on February 2012 from http://apps.who.int/bmi/index.jsp

Lebanon	■1997 ■2008 (≥20 years)	Turkey	■1997 ■2007 (20-85 years)
Kuwait	■1996 ■2006 (20-64 years)	France	■1997 ■2007 (18-74 years)

As all anthropometric indices should be considered in obesity prevention and intervention approaches (Poirier, 2008), data from this study reveal that at a rather early age of 30-39 years, 51.8% of males and 58.6 % of females have abdominal obesity and are at risk for metabolic related diseases later in life. The proportion of study participants of both genders with elevated percent body fat (≥ 25% BF in men, ≥ 32% in women) increased with increasing age; however, contrary to other studies (Sibai et al., 2003), it did not decrease in the older subjects greater than 60 years of age, but rather maintained a steady distribution across the older age groups. This could be attributed to the increase in the total number of older persons and in the percentage of the older population that is obese.

Overall, the prevalence of abdominal obesity among Lebanese adults is currently estimated at 61.9% in women and 52.2% in men. The fact that women are more likely than men to have a higher waist circumference is in accordance with data from countries in sub-Saharan Africa, South America, and the Middle East. Studies from these countries, also found high prevalence of abdominal obesity using corresponding population-specific cut offs, with 67% of women and 18% of men in urban Cameroon (WC ≥ 94cm men, ≥ 80cm women) (Fezeu at al., 2006), 64.4% in women and 31.5% in men in Oman (WC ≥ 102cm men, ≥ 88cm women) (Al-Lawati, 2003), and 46.2% and 10.6% in Iranian men and women, respectively (WC ≥ 102cm men, ≥ 88cm women) (Veghari et al., 2010).

5.3 Associations of Demographic, Socioeconomic, Dietary and Physical Activity factors with Obesity in Lebanese Adults

5.3.1 Associations of Demographic and Socioeconomic factors with obesity

According to the World Health Organization, the balance between energy intake and expenditure through food choices and physical activity is among the most important factors that would promote or protect from obesity (WHO, 2003). Yet, in turn, these lifestyle factors are probably affected by socioeconomic characteristics, both individual and environmental, including media and marketing of energy dense foods, not to forget the psychosocial and cultural factors (Haijan-Tilaki & Heidari, 2009; Sibai et al., 2010).

Individual demographic factors and socioeconomic characteristics, such as age, gender, marital status, educational attainment, occupation, income and place of residence, have been recurrently reported to be associated with obesity (Wang and Beydoun, 2007). Likewise, the current study showed significant associations of some key variables of socioeconomic level with obesity among Lebanese men and women, namely education, work status, as well as household wealth measured by ownership of assets and family crowding; however, gender differences were noted as far as the effects of these variables are concerned. Understanding the differences between the factors associated with excessive weight gain among men and women is crucial if intervention programs are to succeed in helping individuals of both genders consider healthful lifestyle plans that give them the best opportunity to achieve and maintain a healthy weight (Hajian-Tilaki & Heidari, 2009).

Age, Gender, and Marriage

Increase in weight with age has been documented among most of the population in developing countries including the Eastern Mediterranean Region (Musaiger et al., 2011; Janghorbani et al., 2007). The current study data showed a significant increase in obesity risk with age among women in the age strata 20-39 years and 40-64 years, but not in men. Several population-based cross-sectional studies reported higher prevalence of obesity with increasing age attributed to decreased energy requirements at rest in both genders, at least up to the age of 60 years (Nooyens et al., 2008; Hou et al., 2008; Hall et al., 2011; Sidik & Rampal, 2009). No significant association between age and obesity was observed in men and women ≥ 65 years. BMI does appear to have excellent validity as a measure of absolute fat mass adjusted for height in young and middle-aged adults, but not in the elderly due to age-related variation in lean mass (WHO, 2008; Buzzard, 1998)

Marriage, on the other hand, was significantly predictive of obesity for men of the age strata 20-39 years and greater or equal to 65 years. The marriage-obesity relationship may vary with age, gender and ethnicity, but the exact mechanism linking both variables is not fully understood (Tzotzas et al., 2010), and many plausible hypotheses were reported. At a young age, research attributed this relationship to entry into a relationship and sharing the same household environment that may in turn influence partners' food choices and eating habits (The & Gordon-Larsen, 2009). Actually, longitudinal findings suggest that both men and women who enter marriage are more likely to become obese, an incident recognized in young adults across diverse racial backgrounds (Averett et al., 2008). Furthermore, entry into marriage had been associated with decreased physical activity (Bell & Lee, 2005), paralleled with increased social obligations promoting increased food intake and energy consumption (Burke et al., 2004), and a decline in the desire to maintain weight for the purpose of attracting a partner (The & Gordon-Larsen, 2009).

The positive marriage–obesity relationship was also reported in studies carried out in various countries of the MENA region such as Syria (Fouad et al., 2006), Iran (Veghari et al., 2010), and Morocco (Batnitzky, 2008). Data from a national epidemiological survey in Greece, that includes a large sample of men and women 20-70 years of age, reported that married, divorced and widowed subjects had higher risks for being obese compared to unmarried ones in both genders (Tzotzas et al, 2010). Sobal and colleagues (2009) reported that white divorced men and black single men had lower odds of being obese compared with married men. However, marital status did not have any effect on white women's weight (Sobal et al., 2009), a finding that is comparable with the one reported by the current study. Another study examining gender differences in the marriage-obesity relationship reported that married women were less likely to be obese compared with married men, and in certain ethnic groups, women showed no association between marriage and body weight (Reynolds et al., 2008).

Among the elderly, changes in energy demands and expenditures related to changes in body composition as well as development of chronic diseases occur, and the mechanism linking marriage to obesity remains unclear (Tzotzas et al., 2010).

It has been frequently reported that obesity and its association with demographic factors such as marriage, gender, and age can be partly reduced by changes in lifestyle leading to the manipulation of energy intake away from positive energy balance (Zhang & Wang, 2004); however, there exist several socio-economic characteristics that influence an individual's access to resources, knowledge of nutrition and health, food choices, and physical activity (Zhang & Wang, 2004), allowing for the possibility of accomplishing a healthier existence.

Education, Work Status and Household Assets

Socioeconomic status, estimated in this study by educational attainment, work status, household material possession and crowding index, showed age and gender specific associations with obesity in Lebanese adults.

Educational attainment showed a significant negative trend with obesity (test for trend $p<0.05$) in women aged 40-64, but none was observed in men. These findings are in line with other studies carried out in developing countries where negative associations between educational status and obesity were observed in women; however, none were reported in men (Ackplakorn et al., 2007; Marques-Vidal et al., 2008; Madda et al., 2003; Haijan-Tilaki & Heidari, 2009; Tzotzas et al., 2010). Furthermore, studies carried out in developed countries such as Australia, Canada and England confirmed that the education-obesity gradient is stronger in women than in men (Sassi et al., 2009).

Of the other sociodemographic factors, availability of household assets and low family crowding significantly decreased the risk for obesity in women aged 20-39 and ≥ 65. In developed countries, obesity prevalence has been reported to fall steadily in women as household income rises. This same relationship has been observed in developing countries as the country's gross national product increases (WHO, 2004). Lebanon has been experiencing a rapid economic growth and as other developing countries, the burden of obesity might become noticeable in groups of lower socioeconomic status.

Whereas this study did not show any significant relation between work status and obesity in women, studies carried out in other countries of the Middle East region reported that working women were less likely to be obese than non-working women (Ahmad et al., 2006; Ainy & Azizi, 2007), and that unemployment aggravates other socioeconomic and daily life factors that are positively associated with obesity (Meshkani et al., 2006). Thus, the decreased risk for obesity among Lebanese women of higher socioeconomic status might be related to the existence of other psychosocial factors playing a role among these women regardless of work status. Women in general may face greater social pressures to conform to ideals of body image than men (Sanchez-Vaznaugh et al., 2009), and those in higher social classes may be more prone to media messages of pervasive pictures of the perfect model figure, or are better able to pursue methods of achieving ideal body weight (Sanchez-Vaznaugh et al., 2009).

In men, enhanced household assets, including owning a car and a mobile, but not work status, significantly increased the risk for obesity in those 20-39 years of age. This most probably reflects family status, mainly in the lower edge of the age stratum (20-29 years) rather than personal attributes (education, work, and income) (Seubsman et al., 2009). On the other hand, work status as being employed reflecting an income source, was the factor imposing a greater risk for obesity in men 40-64 years of age, and tripling in those who reported being "self-employed". All in all, men who were in the work task force exhibited increased odds for obesity as compared to their non-working counterparts. This could be explained by the symbolic value that a body size and shape holds for men, as they are traditional wage earners in families, where income and the pursuit of physical authority continue to interconnect (McLaren, 2007).

Comparing the effects of both income and education on obesity, it has been established that a better economic standing primarily affects obesity in terms of the resources available to buy food and to participate in leisure time physical activities; whereas education, associated with the acquisition of beliefs and knowledge enables people to integrate healthy behaviours into a coherent lifestyle and gives them a sense of control over their health (Yoon et al., 2006; Sassi et al., 2009). In general, higher education and income groups have been found to have healthier diets than those who are less educated or illiterate (Drewnowski et al., 2007). Educated people of both genders may have higher awareness regarding the consequences of obesity (Hajian-Tilaki & Heidari, 2009), and thus may more readily shift to a healthier physical activity pattern and a healthier diet characterized by greater consumption of fruits, vegetables and decreased intake of fats (McLaren, 2007). This in a way mirrors a person's income or economic capacity to buy these foods, which have been shown to be more expensive than less nutritious food items (Drewnowski & Specter, 2004; Drewnoski & Darmon, 2005). In fact, worldwide high and volatile food prices have been declared in a recent press release by the World Bank group (The World Bank, 2011). In many countries including Lebanon, the prices of vegetables, fruits, meats and quality cooking oils continue to rise with potentially adverse nutritional consequences for the poor (The World Bank, 2011; The Ministry of Social Affairs, 2011).

Body Weight Status: the Complex Interactions with Gender, Socioeconomic Status and Culture

In brief, among Lebanese men, a better socioeconomic standing was found to likely increase obesity risk; whereas among women, material wealth and higher levels of education were probably protective factors against obesity. These data in women are similar to results of other studies conducted in developed, developing countries or countries in transition such as Spain (Garcia Alvarez, 2007), Korea (Yoon et al., 2006), Iran (Hajian-Tilaki & Heidari, 2009) and the United States (Sanchez-Vaznaugh, 2009).

The observed gender difference in risk patterns to obesity development reflects the distinctive effect of health, cultural beliefs and body weight perceptions on body weight status. Women could have different attitudes toward body weight status than men and may give more value to practices for controlling body weight such as exercise, and more so to diet and food choices for better health outcomes (Yoon et al., 2006; Borders et al., 2006; Wardle et al., 2004; Giskes et al., 2007). Higher education as a form of increased cultural capital implying expectations for personal achievement (McLaren, 2007), may be associated with the magnitude by which a person may be adjusted to societal standards of weight and physical appearance, and consequently to health messages regarding diet and physical activity (McLaren, 2007). A thinner body may be socially valued and materially viable to a greater extent for highly educated women, for whom thinness continues to be promoted as an ideal of physical beauty (McLaren, 2007; Hajian-Tilaki & Heidari, 2009). Highly educated women may be on increased social pressure to be thin than highly educated men, and thus such women may have healthier lifestyles than their male counterparts (Hajian-Tilaki & Heidari, 2009).

In general, women are more likely to use their resources, whether economic, cultural or social in nature, to shift their diet and activity patterns in pursue of a healthier body

weight than are men, whereas the increase in earnings and purchasing power of men may not lead to a healthier lifestyle (Zhang & Wang, 2004).
These complex intertwined social factors may be the promoters of decreased likelihood of obesity among Lebanese women of high socioeconomic and educational level in the current study as compared with men.

Noteworthy is the cosmopolitan appeal of Lebanon, interwoven with Western influences through the multilingualism of most of the Lebanese population. This unique feature of Lebanon is in a way opening doors to interchange between individuals of various cultures with similar socioeconomic and demographic backgrounds. Educated generations are bound to be influenced by Western socio-cultural beliefs and behaviours, as well as attitudes towards thinness that are not necessarily the norm in the traditional Arab culture where strong positive cultural perceptions of body fatness as a beauty criterion in women still prevail despite urbanization and the reported growing conflict between western values and Arabic tradition especially among the females (Mousa et al., 2009; Rguibi & Belahsen, 2006). It is probable that the Lebanese adults share a common cultural preference for a dominant larger size among men, and a smaller physically attractive figure among women, especially by those at the younger age stratum.

5.3.2 Diet, Physical Activity and Obesity: The Energy Balance Equation

Broad social environmental changes could increase people's energy intake and decrease people's energy expenditure. The existing environments within a country (the built environment, transport systems, active recreation opportunities, cuisines and food culture, and culture of body size) can greatly moderate or modulate the effects of the global obesity drivers on a population weight (Swinburn et al., 2011). However, within a given environment, body weight differs among individuals, indicative of the role of individual mediators of energy balance (Swinburn et al., 2011). Food intake and physical activity are two of the factors that are a part of an individual's own choice of behaviour and lifestyle (Zhang & Wang, 2004). Undoubtedly, the final decision to consume a particular food item or beverage, or whether to exercise or not, is an individual choice. Nevertheless, one should not ignore the complexity of the variety-rich environment continuously creating the huge medleys of foods and technologies, rendering many of these individual decisions mechanical or unintentional (Swinburn et al., 2011), and with time habitual. Actually, studies have shown that abundance of an array of tastes and flavours can actually promote energy consumption (Epstein et al., 2009), accentuated by the widespread advertisements for energy dense foods, large portion sizes served in a variety of eateries, and most importantly, food preparation practices at home (Zhang & Wang, 2004).

Indeed, researchers have reported that the difference between the average daily energy intake and energy expenditure rate would lead to an energy balance gap that, even if small, underlies the development of obesity at a population level (Hall et al., 2011; Hill, 2009).

Despite the commonly known theory of energy balance, studies examining the association between total energy intake, physical activity, and obesity reported inconsistent results in adults. Results varied by gender and were a mixture of negative associations, positive associations, and no associations (Summerbell et al., 2009).

Lack of association between energy consumption and obesity has been frequently reported, partly attributed to the well-documented underreporting of food intake in dietary surveys (Garriguet D., 2008; Thompson & Subar, 2008; Summerbell et al., 2009). Similarly, most observational cohort as well as cross-sectional studies reported either non-significant or inversely significant associations (mainly in women) between physical activity and obesity (Macdonald et al., 2003; Ma et al., 2005; Schmitz et al.,2000; Tatiana et al., 2003; Luke et al., 2002). Over-reporting of physical activity has been noted in self-report methods including questionnaires and structured interviews. Objective tools for the measurement of physical activity may be better choices to capture total energy expenditure (Livingstone, 2003); however, these tools are costly especially if they were to be used in large surveys. Unfortunately, the optimum epidemiological tool for assessing physical activity and/or dietary intake is so far non-existent (Livingstone, 2003; Summerbell et al., 2009).

In addition to these possible inaccuracies in the measurement of the variables investigated (diet and physical activity), these reported diverse associations could be related to choice of analytical design (observational cohort and cross-sectional), and unmeasured probable covariates (Summerbell et al., 2009).

In Lebanon, studies investigating the relationship between diet, physical activity, and obesity are rare. In the earlier national study, obesity was found to be associated with age, low-education, non-smoking, and family history, but no significant associations were reported with energy consumption and/or physical activity (Sibai et al., 2003). In another study carried out among university students, obesity prevalence was higher among male students compared with females who showed healthier eating habits (Yahia et al., 2008).

In light of its limitations and strengths, this study provides further probable evidence of the importance of the prevention of obesity by balancing between energy intake and expenditure through food consumption and physical activity, with age and gender differences.

The findings of the current study have shown a positive relationship between energy consumption and obesity in a multivariate regression model, excluding the implausible reporters of energy intake, significantly in women aged 20-64 years. Thus, one can say that the current dietary intake of these women may be a contributing factor to the estimated high prevalence rates of obesity, where the odds of obesity incidence increased with the increase in energy consumption, significantly at an intake ≥8368KJ.

On the other hand, physical activity showed significantly negative associations with obesity, in females 20-39 years and ≥ 65 years, but not in those 40-64 years. It could be possible that the energy consumption of Lebanese middle-aged women surpasses their physical activity, and thus they are at the positive side of the energy balance equation.

No significant associations between diet, physical activity and obesity were observed in males.

It should be herewith considered that the relationships between physical activity and dietary exposures are complex and are surrounded by many other known or unknown socodemographic factors that when linked together may, or may not, lead to obesity in specific population groups. It appears that in Lebanese women, a better socioeconomic status is protective from obesity through manipulation of diet and/ or physical activity away from positive energy balance. In men, socioeconomic indicators may be predictors of obesity through mechanisms other than diet and / or physical activity.

Energy Intake of Lebanese Adults Compared with Recommendations and Guidelines

Compared with the 2010 dietary guidelines for Americans (United States Department of Agriculture, 2010), the energy consumption level increasing the risk of obesity among Lebanese adults (significantly in women) is at the higher limit of recommended intake at moderate activity levels for both genders .

Examining the diet composition of the adult Lebanese population, this study reports mean percent energy consumption from fat exceeding by far the 30% limit recommended by the WHO (WHO, 2003), as well as the 35% limit recommended by the institute of medicine (Dietary Reference Intakes, 2002) in both genders; intakes of carbohydrates and proteins were at the lower limit of the recommended intake. Evidence shows that in terms of energy balance and body weight maintenance, the critical issue is not the relative proportion of macronutrients in the diet but rather the total energy consumed per day. It has been reported that a relatively modest change in the overall energy density of the diet, for a person consuming a consistent weight of food, would significantly impact his or her daily energy consumption (Rolls, 2009). Because of its high energy content of 37.7 KJ per gram, fat influences energy density values of foods more than carbohydrate or protein (16.8 KJ per gram) (Rolls, 2009; Drewnowski, 2007). Generally, acceptable macronutrients distribution in the diet ought to be maintained to reduce metabolic complications and chronic disease risks, along with quality choices of unsaturated fats, unrefined cereals, and plant-based or animal-based high biological value proteins (Skidmore, 2007; Drewnowski, 2007; Hall et al., 2011; Dietary Guidelines for Americans, 2010).

Food Sources of Energy Intake among Lebanese Adults: the Obese versus the Non-obese

Among the study participants, obesity occurrence was linked to increased consumption of energy from fat (test for trend $p<0.05$) among middle aged females and males. Indeed, high intake of fats and oils (identified as mean percent of energy consumption from the food group (Table4.21) has been observed **among** obese participants compared with the non-obese. This type of intake may be playing a role in increased energy consumption in this group.

Knowledge of foods, their nutrient content and health properties is an important factor in attaining energy requirements. In a study carried out among Lebanese adolescents (aged 17-19) of two contrasting socioeconomic backgrounds, nutrition knowledge was found to be high in both groups. The intake of macronutrients differed significantly, with lower consumption of carbohydrates but higher of proteins and fats among participants of high socioeconomic status (Nabhani -Zeidan et al., 2011); however, the author did not report associations with obesity.

This study did not look at the food consumed per socioeconomic status, but it is well-recognized that environmental, social, and cultural factors do affect consumption of certain foods more than others. Although obese participants also reported higher intake of fruits, which if taken whole and within recommendations are a good source of vitamins as well as fibre, this intake may be in the form of 100 % fruit juice that if consumed in large amounts might readily lead to increases in energy consumption beyond requirements and/or expenditure. Bottled 100% fruit juice is available in the Lebanese market at all sizes and affordable prices, whereas whole fresh fruits have climaxed in prices.

The cereals food group, which in this study includes all breakfast cereals, bars, cakes as well as cereal breads, has shown a significantly higher mean percent contribution to the total energy intake of the non-obese (0.3±2.0) than the obese (0.1±0.9). This may imply that this segment of the population under study may be more educated and thus more aware of the benefits of snacking on a whole cereal bar of 90 Calories than on a full fat creamy dessert. Also, they may be of a better economic status since cereal bread for instance is more expensive than regular bread.

The major food group markedly showing an increased percent energy consumption in the obese as compared with the non-obese is the energy-dense fat group, which in this study comprised the following food items: added oil, butter, and margarine for cooking purposes or on the table, mayonnaise, avocado, olives, tahini (sesame paste), beef tallow, lard, ghee, creams for sauces, and cream added on puddings and desserts. Nutrient-dense foods would become energy-dense foods when significant amounts of the above-mentioned food items are added. The energy density will be doubled in foods that are already energy-dense, although in the eye of the consumer, the portion size may be almost identical. Examples are butter or mayonnaise in the sandwich, oil in the salad or for cooking, avocado in a cup of mixed juice, or sesame paste with chickpeas (hummus).

A snapshot on the abundant use of oil in the Lebanese cuisine may be useful in this context. Lebanon is a Mediterranean country famous for its produce of olives and olive oil. Olive trees are most abundant in the Northern and Southern Governates of Lebanon, and thus it is highly probable that the inhabitants of these areas who are the producers of olives and olive oil are in many instances possibly of the lower socioeconomic segment. These people would sell their produce, but most importantly, they preserve part of it within their homes. Olive oil is a main ingredient in many traditional composite dishes, and it is used in a varying degree among the different socioeconomic classes. Those of lower socioeconomic status would possibly use it on special occasions for dishes such as “taboule” which is a Sunday accompaniment salad dish, and substitute it with the cheaper commercial oils for cooking and food preparation. Generally, oils of all levels of qualities and price ranges are available in the market, and seemingly are a major contributor to the energy intake of the obese people. Among the poor, frying of foods and added oil may be commonly used as a means to induce satiety and provide extra energy when food is not abundant at home. For those farmers and herd raisers, animal tallow and lard may also be used as a replacement of oil. Olives are essential in the Lebanese diet, and in almost every household, one would observe the plateful of olives always available on the kitchen table. Olives is a food for the rich and the poor, although it was previously mostly labelled for the poor. A common traditional Lebanese saying goes: “living on bread and olives”; it is used to indicate cases when the underprivileged could not afford other food products.

A noteworthy finding of this study is the similar ranking of the major food groups in terms of their contribution to daily energy consumption for both the obese and the non-obese. The main contributor is bread, a staple food in Lebanon, followed by meat (all types whether red or white), fat and oil, pastries (comprising the reasonably-priced popular Lebanese pastries known as “Manaeesh” made of dough with added thyme mixed with oil, or cheese, or meat), full fat dairy, and composite traditional dishes. Lastly is the starch and starchy vegetables group, although the latter includes potatoes and rice that, besides bread, are known as the country’s staple foods. Speaking of Manaeesh, mixed thyme with oil is a very popular ingredient of sandwiches within the Lebanese households, mostly of the lower socioeconomic status, and among all age groups. Similarly, a dairy product known as “Labneh”, which in many households – especially among farmers- is homemade, is another popular breakfast/ dinner component eaten with bread and also, more often than not, with lots of added oil. In addition to oil, meat and full-fat dairy may also be major contributors to the increased mean consumption of total fat intake among Lebanese adults.

Nonetheless, the energy balance equation has two sides: energy intake is one side that should be matched with the other one, which is the energy expenditure.

Physical Activity Level among Lebanese Adults Compared with Recommendations

This study findings indicate that women were more engaged in moderate physical activity than men (34.0% versus 28.5%, respectively), but estimates of those engaged in high physical activity are nearly similar for both genders (23.5% of men and 22.6% of women) with variations by age group; highest prevalence was observed in males 20-29 years (31.0%) and in middle aged women 40-49 years (30.5%). Men however exhibited higher inactivity rate than women (48.0% versus 43.4%, respectively). These findings are in contrast with most of the surveys in developing countries reporting that women are generally more physically inactive than men (Misra & Khurana, 2008). This is mirrored by the increased prevalence of sitting time (≥10 hours/day), a proxy measure for sedentariness, among males (46.0%) compared with females (33.1%).

Prevalence of physical inactivity in both genders (45.5%) compared with countries of high income, approximates that of France (43.1%) and is higher than that of Denmark (22.3%) and Finland (23.8%) (Al Tannir et al., 2009). Compared with other MENA countries of low to middle income, inactivity rates among Lebanese adults was higher than those in Syria (31%) but lower than those in Sudan (86.6%) (Musaiger, 2011).

Moreover, adult Lebanese population exhibited a higher sitting time of 10 hours /d, as compared with their counterparts in the European Union countries such as Denmark, Austria, France and Great Britain where the median sitting time was 6 hours /day as determined in the Eurobarometer study that also applied the IPAQ protocol for assessing physical activity and sedentariness (Sjostrom et al., 2006).

Across the European countries, the prevalence of sitting was reported to be higher among women than men in only three countries; Austria, Denmark, and Great Britain (Sjostrom et al., 2006).

The higher prevalence rates of physical activity and/or lower sitting time among women could be explained by the observed associations between the levels of physical activity and certain socio-demographic characteristics among women (Table 2, Appendix S). Higher prevalence of physical activity was observed among non-working married women of low economic status This higher activity reported by these women, most probably those with lower socioeconomic backgrounds who are unable to afford a helper, or those who culturally believe in their full obligation to family care, may be related to household errands and commitments that might have been exaggerated in few cases in which the Interviewees may have confused the interviewer in this study for a family-aid non-governmental organization worker. Yet, the latter reason may have had a minimal effect on reporting since this study finding complies with the findings reported in many Middle Eastern countries regarding women's beliefs when it comes to family care. For example, a review of 10 studies investigating barriers to practicing physical activity and sports in six Arab countries (Egypt, Jordan, Bahrain, Qatar, Sudan and Iraq) indicated economic, social, psychological, cultural and environmental categories of obstacles. Nevertheless, the most prominent reported barriers were women's commitments to work at home and physiological conditions (pregnancy and lactation) (Musaiger et al., 2011; Musaiger et al., 2007).

For men, age, marital status, income, work status and household assets showed significant associations with the prevalence of the various categories of physical activities. The prevalence rate in the high level physical activity category was greater among students and single men of increased income (Tables 1 & 2, Appendix S).

In men, increased sitting time may be related to change in trend of occupation, where with advanced technology brought about with urbanization; most jobs can be carried out without any physical effort. Furthermore, a marked increase in the ownership of cars in most middle and high income countries has been noted. People are more likely to use their cars to drive to work, supermarket, church or mosque, than to walk even if it is a 10-minutes travel distance. This is a trend that is observed in Lebanon in both genders and among all young and adult age groups.

Generally, only 31.8% of Lebanese adults are meeting the WHO global recommendations for at least 150 minutes of moderate-intensity physical activity during the week; 22.7% are meeting the 75-minute recommendation of vigorous-intensity activity; and 45.5% are physically inactive (Table 4.8). In general, the prevalence of physical activity levels less than recommended for enhancing health was reported to be high in developing countries, ranging from 17 to 91% (Misra & Khurana, 2008).

The complex interactions between body weight, the psychosocial and cultural determinants of food choices, physical activity ,and body size perception are proposed to be largely moderated by gender (Hajian-Tilaki & Heidari, 2009, Swinburn et al., 2011), rendering modifications of lifestyles to achieve a more healthful weight rather delicate. In many communities, opportunities for different physical activities and sports recreation are available for males, whereas females may face barriers that limit their access to, and participation in, outdoor physical activity and sports (Hajian-Tilaki & Heidari, 2009). In most of the Gulf Cooperation Council Countries, and in certain communities and ethnic/religious backgrounds in Lebanon, segregation of men and women is favoured, and women-only exercise facilities are rare and highly expensive (Sibai et al., 2010). Furthermore, in certain areas across the Governates of Lebanon, mainly rural villages, it is also socially unacceptable for women to walk or exercise alone outside the house without the company of a family member (Sibai et al., 2010).

In order to tailor population specific health enhancing physical activities, socidemographic factors associated with the prevalence of physical activity at its various domains and intensities need to be investigated.

5.4 Current Stage of Nutrition Transition in Lebanon

Nutrition transition has been considered as a one-way frame with people shifting from one stage to another with urbanization and globalization, and characteristically, obesity in most Arab countries was reported to be more prevalent among women, the inactive, and high socio-economic classes (Musaiger et al., 2011). Although, as previously mentioned, Lebanon has been reported to be in the early stages of nutrition transition, there seems to be an increased awareness of the benefits of balanced diets and regular physical activity and behaviour change driven by individuals' desire to seek healthy lifestyles. This change seems to be occurring in some segments of the population, mainly in the higher socioeconomic class as this study has shown, and significantly among young adult women, accounting for stage 5 of nutrition transition framework.

The poorer segments of the population, although improving in country economic status valued by a higher Gross Development Product (GDP), continue to have low awareness of the benefits of diet and physical activity; additionally, they cannot afford healthier food choices (WHO, 2003). Thus, prevalent inequalities and household food insecurity among the poor may be one of the leading causes of the rise in obesity in Lebanon.

In a commentary analysis on tackling social determinants of health through community-based initiatives, Assai and colleagues (2006) indicate that, “Women are often the key to improving a population’s health, and this is especially true in the Eastern Mediterranean region. Projects that empower women and provide basic needs are transforming poor communities”.

5.5 Impact of Rising Obesity on Public Health in Lebanon

Substantial literature recognizes obesity as a major contributing factor to the development of some of the most widespread chronic diseases, namely type2 diabetes, cardiovascular diseases, skeletal-muscle disorders, and several types of cancer (WHO, 2003; Aranceta et al., 2009; Baldwin & Amato, 2012). These cause 3 million deaths per year worldwide (Field et al., 2001; Thorpe et al., 2004 Haslam & James, 2005; Finucane et al., 2011). In developing countries, four main behavioural risk factors shared by non-communicable diseases (NCD) have been reported to be escalating: tobacco use, misuse of alcohol, insufficient physical activity, and unhealthy diet/obesity. Indeed, in 2008, 80% of non-communicable diseases deaths were reported in developing countries, up from 40% in 1990 (Baldwin & Amato, 2012).

Although data on morbidity and causes of death in Lebanon are insufficient, available estimates on the main causes of adult deaths point towards non-communicable diseases; diabetes, cardiovascular diseases and cancer, of which lifestyle-related factors such as diet/obesity and physical inactivity are significant modifiable risk factors (Rudy, 2010).

Importantly, the prevalence of cardiovascular disease risk factors has been shown to be high and comparable to western countries. The prevalence rates of hypertension, diabetes, and hypercholesterolemia were estimated to be 23.1%, 13.8%, and 20.7%, respectively, in a national study conducted in 2004 (Tohme et al., 2005). Within a decade, hypertension prevalence has increased by 3 fold and hypercholesterolemia has reached a prevalence rate of 32.1% (Sibai et al., 2008).

Cardiovascular diseases remain a major health problem accounting for over 16% of prevalent health conditions and 60% of underlying causes of death in Lebanese adults (Lebanese society of cardiology and cardiac surgery, 2009). The risk of mortality from CVD has been reported to increase with higher BMI for both men and women. It is increased by 20-40% at BMI of 25.0kg/m2 and by 2 to 3 times at BMI greater than 30 kg/m^2 (Adams et al., 2006). Obesity may also increase cardiovascular risk through its co-morbidity with hypertension, diabetes and unfavourable blood lipids (Miller et al., 2005).

The obesity prevalence in Lebanese adults reported in this study has serious implications for the health sector as well as the society, and warrants national response to this growing problem. A few private obesity clinics, mostly within a hospital setting, have been established in the capital Beirut and the Governate of Mount Lebanon in the recent years. This phenomenon may be in itself an attestation, at the level of the private sector, to the importance of the obesity epidemic in the country. On the other hand, no obesity prevention initiatives and /or treatment centres have been established at the public health level. Recognition of the rise of obesity at the Governmental level is crucial to alleviate the health and economic burden of obesity on the population.

Chapter 6: Conclusions and Recommendations

6.1 Conclusions

This national cross-sectional study provided useful data on the prevalence of obesity in adults living in Lebanon in 2008. When compared with estimates from a previous national cross-sectional study conducted in 1997, it was found that the prevalence of obesity had increased, particularly in some sub-groups of the population. The findings of this thesis underscore the importance of social determinants of health in shaping obesity, and highlights how these are different compared with other countries and cultures.

Prevalence of Obesity in Lebanese Adults

- Currently, approximately one in four Lebanese adults is obese
- While men and women showed overall similar prevalence rates of obesity, gender disparities were noted across obesity classes and age groups.
- Abdominal obesity was observed in both genders indicating increased risk of metabolic abnormalities and associated non-comunicable diseases.

Demographic, Socioeconomic, Dietary and Physical Activity Associates of Obesity in Lebanese Adults

- The likelihood of obesity increased in women aged 20-64 years as their energy consumption increased, but not in men.
- Obesity risk decreased among physically active women aged 20-39 and ≥ 65 years, but not in men.
- For females aged 20-64 years, age was significantly positively associated with obesity.
- For females aged 20-39 years, crowding index was significantly negatively associated with obesity.
- For females aged ≥65 years, household assets were significantly negatively associated with obesity.
- For females in all age groups, family history of obesity was significantly positively associated with obesity.
- For males aged 20-39 years, marital status and household assets were significantly positively associated with obesity, but the other socio-demographic variables were not.

- For males aged 40-64 years, work status and family history of obesity were significantly positively associated with obesity, but the other socio-demographic variables were not.
- For males aged ≥65 years, marital status and family history of obesity were significantly positively associated with obesity, but the other socio-demographic variables were not.

Diet Characteristics and Physical Activity Patterns among Lebanese Adults

- Mean Energy consumption from fat exceeding the recommended cut-offs was observed among the Lebanese adult population at all age groups.
- A higher intake of fats and oils and a lower consumption of cereals were observed among the obese as compared with the non-obese.
- Men exhibited higher inactivity levels than women, as a result of increased sitting time.
- Almost one in two Lebanese adults is currently inactive.

Nutrition Transition Stage

- The significantly decreased risk of obesity among women of higher socioeconomic status, seemingly related to an increased awareness of the benefits of a healthy diet and regular physical activity, may be currently accounting for stage 5 of the nutrition transition framework in Lebanon.

6.2 Implications

These study findings underscore the importance of social determinants of obesity, and highlight gender-disparities in these associations in an adult population living in a country experiencing nutrition transition. These determinants are different from those which have been reported in other countries, and what's interesting is the fact that determinants of obesity vary by country and culture, and change over time. Obesity research is strongly entrenched in reality, and hopefully the new nationwide information provided by this thesis will contribute to a better understanding of the epidemiology of obesity in Lebanon.

The multifactorial complexity surrounding obesity prevalence in Lebanese adults means that a multidimensional approach is required to tackle obesity. Policy makers and commissioners of health services who are responsible for public health should tailor their efforts and resources to tackling obesity in light of the specific associations of obesity in their population.

Taking the high risk approach, culturally-appropriate, community-based interventions should be initiated to help increase nutrition awareness among specific population segments, especially women of low education and socioeconomic levels, and working men with higher socioeconomic status. Understanding the importance of a healthy balanced diet and physical activity in the prevention of lifestyle-related diseases, regardless of genetic susceptibility and environmental exposure, is crucial. Nevertheless, strategies to improve the environments within which individual behavioural decisions are made should be considered, mainly those related to food availability, cost of healthy foods, and access to physical activity opportunities. Most important is the delivery of a stable food security level for all the households in the six Governates of Lebanon.

Work-based weight management programmes which target men might be particularly useful in Lebanon, as might area-based initiatives which target women in poorer housing districts of Lebanon.

6.3 Future Perspective

Both governmental and non-governmental organizations, including academic institutions, should direct their efforts towards acknowledging the complexity of obesity determinants among Lebanese adults. Further epidemiological work investigating the determinants of obesity in nutrition transition countries would be useful, and can potentially help those countries which are yet to experience nutrition transition.

Qualitative studies in this area are sadly lacking, and could help illuminate the underlying reasons for the determinants of obesity in Lebanon. Work involving focus group discussions should be carried out in various districts of the six Governates of Lebanon, both rural and urban, to explore in-depth ethnicity and other differences, as well as culturally and economically sensitive issues regarding food behaviour and physical activity. Moreover, the findings of the current study have shed light on the prevalence of obesity among the elderly, showing the need for further in-depth research on the risk factors for obesity among older adults, taking into consideration diet and body composition changes, as well as social and health conditions.

The work that the researcher has presented in this thesis is a cross-sectional study, and longitudinal studies to confirm the findings and to assess the effects of higher BMI estimates over time on disease burden and quality of life among the Lebanese adult population are crucial. Sadly, it is unlikely that they will ever be funded in Lebanon.

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Appendix A

National Study Overview

The general study is the product of combined research proposals between the department of nutrition and food sciences lead by Professor Nahla Hwalla and the department of Health sciences lead by Professor Abla Sibai, at the American University of Beirut; both professors are the supervisors of this thesis researcher. The first proposal that focused on non-communicable diseases was primarily submitted for approval by Dr Sibai as the principal investigator; thus explaining as to why Dry Sibai was designated as the principal investigator in the ethics approval form (Appendix B) and Dr Nahla Hwalla as the co-investigator. Shortly thereafter, both Dr Sibai and Dr Hwalla solicited more funds to logistically support the Nutrition Component of the study and they have both become on equal grounds as the principal investigators of the national study.

The general study proposed a timely assessment of the prevalence of non-communicable diseases in Lebanon and their risk factors by concurrently conducting at the national level a household survey and a cell phone survey, whereby findings from both surveys will allow researchers to compare the data from both sources and adjust for potential bias and evaluate the effectiveness of conducting a national health survey with a sample drawn from banks of known cell phone telephone numbers.

Being an instructor at the nutrition and food sciences department at the American University of Beirut, the researcher of this thesis expressed interest in pursuing the PhD degree and thus the proposal of estimating obesity prevalence in Lebanon initiated by Dr Hwalla was taken on and developed into its final objectives that are stated in chapter two. Ethics approval was then also obtained for this thesis protocol that was entitled “socioeconomic and dietary determinants of obesity in Lebanon” and labeled as the nutrition subcomponent of the general study (comparison of estimates based on cell phone interviews with face to face interviews) (Appendix B). The researcher was designated as a co-investigator in the study protocol submitted for ethics approval.

The researcher of this thesis was involved in every step of the initial planning for the national study with its integrated nutritional component starting with the coordinated writing of the study proposal, as well as the assent and consent forms for ethics approval, construction and pilot testing of the national general study questionnaires (adult questionnaire, adolescent and child questionnaires), recruitment and training of the field interviewers, and field methodology testing prior to commencing the data collection that was carried out simultaneously, and by the same interviewers, for the general study and the nutrition component, the latter being represented in integrated modules within the questionnaire. The researcher of this thesis was responsible for data collection as well as for the coordination of the filed work that was carried out and completed through the period between May 2008 and April 2009.

Research assisstants were hired to help in the data entry of the 'Adult Questionnaire", under the supervision of this thesis researcher. However, to ensure data uniformity, data entry of food intake (24-hr recalls) and physical acyivity (IPAQ) data were solely carried out by the latter. The whole data set was then cleaned and processed by the thesis researcher and data analysis carried out with the help of Dr Adetayo Kasim (medical statistician at the Wolfson Research - Durham University), and under the supervision of Dr Abla Sibai (thesis co-advisor at the American University of Beirut).

The national cross-sectional study objectives were:

1- To determine the prevalence of non-communicable diseases and their risk factors in Lebanon using reported morbidity and biochemical measures
2- To identify covariates of obesity including socio-demographic, dietary, and physical activity patterns.
3- To Collect data on dietary trends and identify changes that occurred in diet composition over time in Lebanon.
4- To assess the validity of self-reported measures
5- To assess the feasibility of using cell phones in health interview surveys.
6- To compare the outcomes of cell phone interviews with face-to face interviews

Appendix B

Study Approval Letter

لجنة الأخلاقيات
كليـة الطب
INSTITUTIONAL REVIEW BOARD
FACULTY OF MEDICINE

AUB American University of Beirut
الجامعة الأميركية في بيروت

To: Dr. Abla Sibai
Dr. Nahla Hwalla
Date: February 18, 2008

Principal Investigator:	Dr. Abla Sibai
Co Investigator :	Dr. Nahla Hwalla American University of Beirut
Protocol Number:	FHS.AS.04
Protocol Name:	Comparison of Estimates based on cell phone interview with face to face interviews Nutrition Component: Socio-Economic and Dietary Determinants of Obesity in Lebanon

Thank you for submitting to the IRB your letter dated January 31, 2008 in response to the IRB's letter dated December 13, 2007 for review.

The IRB reviewed your reply, the revised study (version date December 2007), the three Arabic informed consent forms (version date December 2007; for questionnaire, for questionnaire and blood sample collection; and for parents of minors) and the Arabic assent forms (for children and for adolescents, version date December 2007) and the Arabic Telephone Script and the three Arabic questionnaires (for Family, for children and adolescents) and the English Food Frequency Survey in an expedited manner.

In addition, the IRB reviewed the nutritional sub-part of the study entitled "Socio-Economic and Dietary Determinants of Obesity in Lebanon" and the English consent forms (for parents of minors and for adults; version date December 2007) and the English assent forms (for children and adolescents; version date December 2007) and the three English questionnaires (Household and adult Questionnaire; Adult Questionnaire and Child Questionnaire by proxy).

This is to grant you approval to the study (version date December 2007), the three Arabic informed consent forms (version date December 2007; for questionnaire, for questionnaire and blood sample collection; and for parents of minors) and the Arabic assent forms (for children and for adolescents, version date December 2007) and the Arabic Telephone Script and the three Arabic questionnaires (for Family, for children and adolescents) and the English Food Frequency Survey and nutritional sub-part of the study entitled "Socio-Economic and Dietary Determinants of Obesity in Lebanon" for a period of one year from the above date, at which time a progress report is kindly requested from you.

The membership of this Institutional Review Board complies with the membership requirements defined in the US Code of Federal Regulation (21CFR56 and 45CFR46) of the Food and Drug Administration. In addition, the IRB operates in a manner consistent with Good Clinical Practices under the ICH guidelines, with FDA and applicable national/local regulations.

Sincerely,

Ibrahim Salti, MD
Chairperson of the IRB

cc. Dr. Ali Bazarbachi, Assistant Dean for Research, Faculty of Medicine

Appendix C

Interviewer Identification Letter

This is to certify that Ms/Mr. ____ is an interviewer in a : "Behavioral Risk Factors Surveillance Study "**carried out by researchers at the American University of Beirut to** investigate the prevalence of chronic diseases and their associated factor in the Lebanese population

Ms/Mr_____________ will ask you few questions covering socioeconomic status, health and lifestyle information. He/she, will also measure your weight, height, waist circumference, and skin thickness.

Thanking you for your cooperation,

Marie Claire Chamieh
Study Coordinator
American University of Beirut
Bliss Street
Beirut, Lebanon
Phone: (01) 350000 Ext: 4484

Appendix D

Adult Questionnaire

(English version)

Socioeconomic and Dietary Determinants of Obesity in Lebanon
Adult Questionnaire

Family Number	--------------------------
Governate	1. Beirut 2. Mount Lebanon 3. North 4. South 5. Bekaa 6. Nabatiyeh
Caza	
Region	
District	
Block Number	
Cluster Number	
Telephone Number	

	1st Visit	**2nd Visit**	**Last Visit**
Date:			
Result:			Total Number-----

Name of the interviewer:--- Signature:------------------

HOUSEHOLD INFORMATION:

a-Your House is:

1) Family's property
2) My property
3) Rented
4) A relative's/friend's property
5) I don't know
6) No answer

b- How many rooms are there in your house other than the kitchen, the bathroom, the parking, the open air balcony?

1) Number: -----------------------
2) No answer

c- Number of cars owned by the family:

0) don't own a car
1) 1 car
2) 2 cars
3) 3 cars
4) 4 cars
5) More than 4 cars
6) Don't Know
7) No answer

d- Is there a servant who sleeps in your house?

1) No
2) Yes
3) No answer

e- What is the family income /month? ___________ 77-Doesn't know/refused to answer

f-If refused to answer (e), then you might say that the income is in Lebanese Pounds:

1)<I million 2) 1-3 Million 3) 3-6 Million 4)6-8 Million 5)> 8 million

e- Does the family have?

	Yes	No	No answer
Refrigerator			
Washing Machine			
Oven			
Television			
AC			
Video			
Computer			

Family members

f- Who is the head of the family? ---

g- Total Family members number who usually sleep in this house (including married and those traveling): ------------------------------ (number)

	HR_NAM	HR_RELHH	HR_SEX	HR_AGE	HR_EDU	HR_OCC	HR_MS	Cell
	Name	**Relation with to head of family** 1. Head of family 2. Husband/Wife 3. Son/ daughter 4. Son's wife/ Daughter's husband 5. Grandson/ Granddaughter 6. Father/ Mother 7. father / mother in law 8. Brother/ Sister 9. Sister/ brother in law 10. Grandmother/ Grandfather 11. Nephew/ niece 12. Other relatives 13. Others/ Not relatives	**Gender** 1. Male 2. Female	**Age** Write 0 for children younger than 1 year old	**Level of education** 1. Illiterate 2. Reads & Writes 3. Elementary school 4. Middle School 5-.High School 6. Baccalaureat 7. Higher Education 8. Doesn't know 9. Refuses to answer	**Occupation** 0. Doesn't work 1. Governmental employee 2. Nongovernmental employee 3. Self-employed 4. Voluntary worker (no paycheck) 5. Student 6. Retired 7. Unemployed (able to work) 8. Unemployed (unable to work) 9. Refuses to answer	**Marital Status** 1. Single 2. Married 3. Divorced 4. Separated 5. Widowed 6. Refuses to answer	**Does he have a cell** 1. No 2. Yes
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								

This table is for choosing the person (s) involved in this study:

	Number of members in the family														
The first number of the family in thesample	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
0	1	1	1	1	3	3	2	8	3	9	3	11	12	3	5
1	1	1	2	1	4	2	1	2	5	1	8	4	1	14	7
2	1	1	3	4	1	1	4	5	5	3	6	1	2	9	11
3	1	2	2	2	2	5	7	3	7	5	9	2	3	7	15
4	1	1	1	3	1	6	1	6	1	10	8	9	7	11	1
5	1	1	2	2	4	5	1	1	9	6	6	1	5	1	4
6	1	1	2	4	2	4	4	7	9	2	8	6	4	10	13
7	1	1	2	4	2	1	1	5	6	6	5	12	9	5	11
8	1	2	2	4	1	4	4	6	7	6	9	4	8	2	12
9	1	2	3	2	1	3	4	8	7	10	3	6	4	6	7

For the interviewer:

In the first column, circle the number corresponding to the first number of the family; for example, if the number of the family is 5011, then circle the number 1.
In the first row, circle the number of family members, for example 7.
The point of intersection is the number of person asked for the research; for example7 and 5=>1. If the person is not present, you can choose the number that is below.

Name of the person involved in the study (18 +): --

ADULT QUESTIONNAIRE (18+)

Family Number---------------------------------

Individual Number------------------------------

1. PERSONAL INFORMATION

1.0- Name of the person: --

1.1- Sex: 1) Male
2) Female

1.2- Date of Birth (Day/Month/Year): -------------------------

1.3- Age in years: ---------------------

1.4- Educational Level; what is the highest educational level that you got?

1) Illiterate
2) Reads and Writes
3) Elementary School
4) Middle school
5) High School
6) Technical Diploma
7) Bachelor
8) Higher education (MSc., PhD)
9) don't know
10) Refused to answer

1.5- Marital Status:

1) Single
2) Married
3) Divorced
4) Separated
5) Widowed
6) Refused to answer

1.6- Occupation:

1) Not Working (housewife)
2) Governmental employee
3) Nongovernmental employee
4) Self- employed
5) Volunteer worker
6) Student
7) Retired
8) Unemployed (can work)
9) Unemployed (can't work)
10) Refuse to answer

1.7- How do you rank your living status?

1) Low
2) Medium
3) High

2. SMOKING:

2.1- Do you smoke or used to smoke cigarettes?

1) No, I never smoked
2) Yes, I currently do
3) I used to smoke and I stopped
4) Refuses to answer

If the answer to question 2.1 is:

- *"I used to smoke and I stopped", continue to the next question.*
- *"Yes, I currently do", go to question 2.4*
- *"No" or "no answer", go to question 2.9.*

2.2- When did you stop smoking? *(Write only one answer)*

1) Number of years: -----------------------------------
2) Number of month: ---------------------------------
3) Number of weeks: -----------------------------------

2.3- What is the reason that made you quit smoking? *(You can choose more than one answer)*

	Yes	No
Health reason/ disease		
Medical advice		
Family advice		
Financial reason		
Other reasons, please state		

2.4- How old were you when you started smoking?

1) Age in years:--------------------------
2) Don't remember
3) Refused to answer

2.5- How many cigarettes do you smoke/ used to smoke daily? Please specify

1) Number of cigarettes----------------------
2) I don't know
3) Refused to answer

2.6- <u>Have you ever thought of quitting smoking?</u>

1) Yes
2) No
3) Don't know
4) Refused to answer

2.7- Does any of your parents smoke?

1) Yes
2) No
3) Don't know/not sure
4) Refuse to answer

2.8- If the answer above is yes, who's the smoker?

1) The father
2) The mother
3) Both
4) I don't know
5) Refused to answer

SMOKING/ARGUILEH:

2.9- Do you currently smoke arguileh?

1) Yes
2) No
3) Refused to answer

If the answer is "Yes", continue to the next question *If the answer in "No", or "Refuse to answer", go to Part 3 page 7(Alcohol consumption)*

2.10- How often do you smoke arguileh?

1) Daily
2) Once or more per week
3) Once or more per month
4) Occasionally
5) Don't know
6) Refused to answer

2.11- How old were you when started smoking arguileh?

1) Age in years ------------------------
2) Don't know/don't recall
3) Refused to answer

2.12- How many "arguileh" did you smoke last month?

1) Number: -----------------------
2) Don't know/recall
3) Refuses to answer

2.13- Where do you usually smoke arguileh? *(You can choose more than one answer)*

	Yes	No
At home		
At a restaurant/ Coffee shop		
At a friend's place		
Other places	Specify	

3. ALCOHOL CONSUMPTION:

3.1- Have you ever had an alcoholic beverage such as Beer, wine, whisky, etc., in the past 12 months?

1) Yes
2) No
3) Don't recall/not sure
4) Refused to answer

- ❖ *If the answer is other than "Yes" continue to the next question*
- ❖ *If the answer is no, don't know or refused to answer go to section 4(Dietary Habits) page 8.*

3.2- In average, how many days per week do you drink alcoholic beverages?
1) Only in occasions
2) Less than once per week
3) 1-2 times/week
4) 3-4 times per week
5) 5-6 times per week
6) Daily
7) Don't know
8) Refused to answer

3.3- When you drink alcohol: In average, how many glasses will you drink?
1) Quantity at one time-------------
2) Don't know
3) Refused to answer

4. DIETARY HABITS AND PERCEPTIONS

4.1- Do you usually eat breakfast?
1) Never
2) Sometimes: times per week -------------------
3) Regularly every day

4.2- Do you eat lunch?
1) Never
2) Sometimes: times per weeks --------------------
3) Regularly every day

4.3- Do you eat dinner?
1) Never
2) Sometimes: times per weeks -----------------------
3) Regularly every day

4.4- Do you eat small snacks (chips, chocolate, fruits…) between main meals?
1) Never (go to question "f")
2) Sometimes: times per weeks ------------------------
3) Regularly every day

4.5- If the answer is "Yes", how many snacks do you eat daily?
1) 1
2) 2
3) 3
4) 4
5) More than 4 times, specify --------------------

4.6- Do you eat while watching Television?
1) I don't watch Television
2) Never
3) Sometimes, days per week______
4) Most of the times

4.7- In average, how many times per week will you eat outside your house?

1) Never
2) 1
3) 2
4) 3
5) More than 3 times, specify ---------------------

4.8- Do you use any kind of vitamins such as Vitamin A, B, D …?

1) Yes
2) No

4.9- Do you use any kind of minerals such as Calcium, Magnesium ...?

1) Yes
2) No

4.10- Do you use any kind of medication on regular basis?

1) Yes, specify ---
2) No

4.11- How would you describe your body?

1) Very thin
2) Thin
3) Normal/Average
4) Overweight
5) very fat

4.12- Concerning your weight, what is the approach you follow?

1) I try to lose weight
2) I try to gain weight
3) I try to maintain my weight
4) No specific approach

4.13- Over the last 7 days, what was the method you used to lose weight, maintain your weight or to gain weight?

1) Didn't try to lose ,maintain , or gain weight
2) Followed a diet
3) Exercised
4) Exercised & changed my eating habits
5) Used other ways than Dieting or Exercising , specify: --------------------------

4.15- In the past 7 days did you did you

1) Take medication to reduce your appetite or weight
2) Take medication to increase your appetite or weight
3) Didn't take any medication to change my weight

4.16- Did you do any surgical procedure to lose weight?

1) yes
2) No
3) Don't know
4) Refused to answer

5. <u>PHYSICAL ACTIVITY (IPAQ)</u>

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.
Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

5.1- During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

1) Number of days: -----------------------------
2) No vigorous activities

- *If your answer was "No Vigorous activities", then skip to question 5.3.*

5.2- How much time did you usually spend doing vigorous physical activities on one of those days?

1) Hours per day: -------------------------------
2) Minutes per day: ----------------------------
3) Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

5.3- During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

1) Days per week: ---------------------------
2) No moderate physical activities

- *If your answer was "No moderate physical activity", then skip to question 5.5.*

5.4- How much time did you usually spend doing moderate physical activities on one of those days?

1) Hours per day: ----------------------------
2) Minutes per day: -------------------------
3) Don't know/not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5.5- <u>During the last 7 days, on how many days did you walk for at least 10 minutes at a time?</u>

1) Days per week: ------------------------
2) No walking

❖ *If the answer of your questions was "No walking", the skip to* question *5.7.*

5.6- <u>How much time did you usually spend walking on one of those days?</u>

1) Hours per day: -------------------------
2) Minutes per day: --------------------------
3) Don't know/not sure

Think about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

5.7- <u>During the last 7 days, how much time did you spend sitting on a week day?</u>

1) Hours per day: ---------------------
2) Minutes per day: -----------------------
3) Don't know/ not sure

6. <u>HEALTH STATUS:</u>

6.1- Do you suffer from any health problem?

1) Yes, specify-------
2) No

6.2- In general, how would you evaluate your health now? Is it:

1) Excellent
2) Very good
3) Good
4) Acceptable
5) Weak
6) Do not know/not sure
7) Refused to answer

6.3- During the last month, how many days you were in a bad physical health status? (Ex; injuries)

1) Number of days: ----------------------------
2) Never
3) Don't know
4) Refused to answer

6.4- During the last month, how many days were you in a bad psychological status and that includes psychological pressures, depression and bad mood?

1) Number of days: ---------------------------
2) Never
3) Don't know
4) Refused to answer

- *If the answer of the questions 6.3 and 6.4 was "1 day and more…" then continue to the next question.*
- *If the answer of the questions 6.3 and 6.4 was "Never", "Don't know" or "Refuse to answer", then skip to sec7 "Changing Behavior"*

6.5- During the last 30 days, how many days did your bad health and psychological status prevented you from performing your regular activities? (House chores, studying, working…….)

1) Number of days: ----------------
2) Never
3) Don't Know
4) Refused to answer

7. FAMILY HISTORY OF CHRONIC DISEASES:

7.1-Does any of your family members or relatives suffer from cardiovascular problems?

1) Yes
2) No
3) Don't know
4) Refused to answer

7.2-Does any of your family members or relatives suffer from high blood pressure?

1) Yes
2) No
3) Don't know
4) Refused to answer

7.3-Does any of your family members or relatives have diabetes?

1) Yes
2) No
3) Don't know
4) Refused to answer

7.4-Is any of your family members or relatives overweight or obese?

1) Yes
2) No
3) Don't know
4) Refused to answer

7.5--Does any of your family members or relatives suffer from any other chronic diseases?

1) Yes, specify------------------
2) No
3) Don't know
4) Refused to answer

8- <u>24 HOUR DIETARY RECALL</u>

What are the foods that you have been eating for the last 24 hours? Mention the kind of the food, quantity, the place and the time that you ate at.

Place	Time	The food and the way it was prepared	Quantity

Is this an unusual example? -Yes: --------- -No: ----------

If "Yes", then how it is unusual? --

For the interviewer only: choose the answer that most fits with the quantity and quality of the food mentioned above.

1) Cup 2) Spoon 3) Food portions

4) Another way: ---

9. HEALTH SEEKING BEHAVIOR

9.1-Are you trying to start or increase your physical activity ?

1) yes
2) No
3) I don't know
4) Refused to answer

9.2-Are you trying to decrease your intake of fat?

1) yes
2) No
3) I don't know
4) Refused to answer

9.3-Are you trying to decrease salt intake?

1) yes
2) No
3) I don't know
4) Refused to answer

9.4-Are you trying to decrease sweets and sugars in your diet?

1) yes
2) No
3) I don't know
4) Refused to answer

9.5-Are you trying to increase your intake of fruits & vegetables?

1) yes
2) No
3) I don't know
4) Refused to answer

9.6-Are you trying to change your eating habits to improve your health?

1) yes
2) No
3) I don't know
4) Refused to answer

10- ANTHROPOMETRIC MEASUREMENTS:

MEASUREMENTS		
	No.1	**No.2**
Height (Cm)		
Weight (Kg)		
Hip Circumference (Cm)		
Waist Circumference (Cm)		
Triceps (mm		
Sub scapular (mm)		
Biceps (mm)		
Suprailiac (mm)		

Appendix E

Adult Participant Assent Form

Confidentiality

The investigators are committed to preserve the anonymity of the participant, to keep the results confidential and to give them only to the participant involved.
If you agree that your child participates in this research study, the information will be kept confidential. Unless required by law, only the study doctor and designee, the ethics committee and inspectors from governmental agencies will have direct access to your medical records.

Investigator's Statement:

I have reviewed, in detail, the informed consent document for this research study with -------------------------------- (name of parent/guardian) the purpose of the study and its risks and benefits. I have answered to all the parent's questions clearly. I will inform the participant in case of any changes to the research study.

____________________ ____________________

Name of Investigator or designee **Signature**

____

Date

Participant's agreement

I have read and understood all aspects of the research study and all my questions have been answered. I voluntarily agree to take part in this research study and I know that I can contact Dr. Abla Sibai or Dr. Nahla Hwalla at 01-350000 ext 4647/4400 or any of her designee involved in the study in case of any questions. If I felt that my questions have not been answered, I can contact the Institutional Review Board for human rights, Dr. Ibrahim Salti at 01-350000 ext 4911. I understand that I am free to withdraw this consent and discontinue participation in this project at any time, even after signing this form, and it will not affect my care. I know that I will receive a copy of this signed informed consent.

____________________ ____________________

Name of participant **Signature**

____

Date

____________________ ____________________ __________

Witness's Name **Witness's Signature** **Date**
(If parent does not read)

Institutional Review Board
Protocol # FHS.AS.04
Date December 2007

Institutional Review Board
Faculty of Medicine
American University of Beirut
18 FEB 2008
APPROVED

2/2

Appendix F

Distribution of Residents According To Age and Governate

Table 9a
Distribution of residents according to age and Governorates

جدول رقم (٩) أ
توزع المقيمين بحسب العمر والمحافظات

	Governorates						المحافظات	
Age	Beirut بيروت	Mount Lebanon جبل لبنان	Northern Lebanon لبنان الشمالي	Bekaa البقاع	Southern Lebanon لبنان الجنوبي	Nabatieh النبطية	Lebanon لبنان	العمر
0 - 4	19273	107527	85341	35625	32402	19074	299242	4 - 0
5 - 9	25541	122924	82020	43203	40366	23528	337582	9 - 5
10 - 14	29002	140183	90076	53479	46315	26985	386040	14 - 10
15 - 19	34522	137919	83767	52768	43733	20318	373027	19 - 15
20 - 24	41352	151503	73152	46768	39391	20579	372745	24 - 20
25 - 29	34429	127293	57091	35913	28783	14864	298373	29 - 25
30 - 34	30032	114335	53662	32674	28603	16616	275922	34 - 30
35 - 39	21705	112045	50502	29183	28062	15214	256711	39 - 35
40 - 44	25728	111218	45740	27474	26500	13133	249793	44 - 40
45 - 49	22547	85987	33567	22057	19121	10689	193968	49 - 45
50 - 54	21799	71961	29001	19229	15439	8317	165746	54 - 50
55 - 59	21424	56173	24107	15305	13528	7046	137583	59 - 55
60 - 64	18618	50465	20838	17276	12252	6603	126052	64 - 60
65 - 69	16934	44093	16949	19206	9717	6016	112915	69 - 65
70 - 74	13472	34306	10661	11806	8410	5154	83809	74 - 70
75 - 79	6830	19591	7166	4997	5850	4931	49365	79 - 75
80 -84	5707	10781	3394	2890	2108	1938	26818	84 - 80
85 and above	1590	3264	1675	1356	617	840	9342	85 وما فوق
Total	390505	1501568	768709	471209	401197	221845	3755033	المجموع

Appendix G

Procedures for Collecting 24-Hour Recalls

When taking a 24-hour recall, it is important for the interviewer to follow certain procedures to insure the following:

C That all foods and beverages consumed are listed.
C That amounts of foods are as accurate as possible.
C That homemaker is not influenced to say he/she ate foods that were not eaten.

It is recommended that staff and volunteers, who take recalls, **be thoroughly trained in standard techniques**. At the end of this section, please find **"A Method for Training EFNEP Staff and Volunteers On Collecting 24-hour Recalls.**" At a minimum, paraprofessionals and volunteers should practice taking food recalls on each other before using the method with homemakers.

Note: The following techniques are written specifically for individual interviews. At the end of this section, you will find a list of ways to alter these techniques for group settings in which homemakers record their own food recalls.

<u>Setting the stage for the interview</u>

The following steps will help in eliciting truthful and complete information:

1 Explain to homemaker that you need to know only what she/he actually ate. She/he should not feel embarrassed about any food, as there are no "good" or "bad" foods. No one eats just the right foods all the time.

2 Do not express in words or facial expressions either approval or disapproval of foods which homemaker mentions.

3 Do not ask leading questions that would lead homemaker to feel she/he “should” have had a certain item and, thus, say she/he did.

<u>During the food recall interview</u>

1. Use your FOOD RECALL KIT to determine the amounts of foods consumed. (Food Recall Kit described below under "24-Hour Food Recall Kit"). Homemakers may not be able to give amounts of ingredients in their portions of mixed dishes, salads and casseroles. If a home recipe was used, obtain a copy. If food was eaten in a restaurant, record the name or type of restaurant.
2. Start with the most recent meal or snack that the homemaker consumed. Work backwards to cover all foods and beverages eaten or drunk in the last 24 hours.
3. <u>First</u>, get a complete list of all foods eaten without trying to determine amounts. Use the following types of probes to find **what foods** were eaten:

A. The first type of probing is related to <u>time</u>. Examples: "At what time was this? Did you eat or drink anything before or after that?" "What did you have at that time?" "At what time did you go to bed?"

B. The second type of probe is related to the homemaker's activities. Examples: "What did you do this morning?" "While you were working around the house, did you take a break to have something to eat or drink?" "Did you watch TV last night? When you watched TV, did you eat anything?" "Did you have anything to drink with this?"

C. The third type of probe tries to get more complete information about foods already reported. Examples: "Do you remember anything else that you ate or drank with this food?" "What else did you have at this meal?" "Was the (bread, vegetable) eaten plain or did you put something on it?" "Did you have anything in your coffee?" "Did you have a second helping?"

4. Second, after all foods are named by the homemaker, go back over the lists to get additional descriptions and amounts of the food. Also determine if all of the food was eaten or if some was left on the plate.

To get more information on the type of food:

A. Encourage the homemaker to describe foods as clearly as possible. The interviewer may have to restate questions to get more information.

B. Describe combination dishes carefully. Mixtures such as sandwiches, soups, stew, pizza, casseroles, etc. can be prepared in many ways.

C. Ask to see packages, if available, on pre-packaged foods, and record brand name and other pertinent information.

To determine the amount of food eaten:

A. Amounts of a food may be given in

1 NUMBERS, such as eggs, donuts, apples

2 SHAPES, such as a pat of butter, stalk of celery, slice of pie (or the shapes included at the end of this section.)

3 DIMENSIONS, such as size of models in Recall Kit, or size of cornbread, cake, etc. using a ruler.

4 VOLUME, such as liquids, cooked vegetables, pudding, ice cream

5 WEIGHT, such as meat, cheese, candy bar, (3 oz. meat equals size of deck of cards, or palm of woman's hand)

B. In determining amounts, use food models, measuring cups, measuring spoons, ruler, raw rice, beans, etc. in Food Recall Kit. Have homemaker show you how much they had by pouring raw rice or dry beans on a plate or by identifying some item in your Recall Kit. A ruler can also be used to show size of certain items.

C. When appropriate, ask homemaker to bring in the serving container (bowl, cup, glass, etc.) that was used and determine the amount it holds by using rice and a standard measuring cup.

1 If nutrition questions are being asked by the homemaker during the time the recall is being taken, ask homemaker if you may answer them later when you have completed the recall.

2 After the homemaker has given a recall of foods and amounts for the entire 24 hours, read the list back to him/her and ask homemaker to tell you anything else that he/she may have forgotten before.

3 Thank the homemaker for his/her cooperation. Do not comment on the recall at this time, unless homemaker asks a specific question. **Wait and address deficiencies, excesses, etc. when lessons are taught** that deal with that area of the diet.

Ways to Alter Food Recall Techniques to Accommodate Group Settings

Large group settings present a special challenge when collecting food recalls. Unless volunteers or others are available to assist, it is usually necessary to have homemakers record their own food recalls. The following techniques are suggested:

1 Set the stage for obtaining the recalls similar to those listed above in section entitled "Setting the stage for the interview."

2 Distribute forms and explain that (**after you have finished the instructions**) you want each person to record everything he or she ate or drank between the time they came to this meeting and a specified time on the previous day, to cover 24 hours. Be sure group members understand the time frame to use in recording their food intake.

3 Explain that group members should do this task with as little talk as possible, except to ask questions of group leader. This will allow group members to concentrate and not be influenced by what others are saying.

4 Place the items in your Food Recall Kit in view of all, or display a large poster or hook & loop board showing the units of measurement and standard serving sizes to serve as a guide for listing amounts of foods and beverages.

Posters or hook & loop boards can be prepared using drawings or cardboard food models (from the National Dairy Council or other sources).

<u>Some items to display on Poster</u>: 8 oz. glass of milk or water 4 oz. glass of juice 1 serving (1/2 cup) cooked vegetable/fruit 1 cup of raw vegetable 3 oz. serving hamburger or other lean meat 1 cup cereal 1 slice bread or medium roll or biscuit 1 med. piece fruit

1 Go over the various serving sizes and how to record portions of servings.

2 Show on a large poster (or overhead transparency, if available) sections of food recall, with examples of how foods are to be recorded.

3 Allow group members to begin listing their food recall, while paraprofessional or volunteer circulates and answers questions.

4 After most group members appear to be finished, have them go back over the recall and look for meals/snacks where food items or descriptions may be incomplete. Some examples of such items are as follows:

C bread eaten at a meal, including type C fat, sugar, sweetener, or creamer added to foods or beverages C milk or sugar added to cereal C type of milk C type of cereal C all ingredients in a sandwich or salad (other than one included in
EFNEP Foods Dictionary) C mayonnaise or other spread on sandwiches C dressings added to salads

9. Collect recalls and thank group members for their cooperation.

24-Hour Food Recall Kit

Purpose of the FOOD RECALL KIT: To assist paraprofessional/interviewer in taking the food recall and estimating the amounts more accurately.

The Food Recall Kit should contain the following items:

Cup - One 8-oz. plastic measuring cup

Bowls - 2 different shapes - each holding 2 cups

Small sauce dish - about 1/2 cup

Standard measuring spoons:
1 tablespoon
1 teaspoon
1/2 teaspoon

-1/4 teaspoon *Plastic Container of 2 to 3 cups rice (with tight fitting lid) *Plastic

Container of 2 to 3 cups dried beans (with tight fitting lid)

*Rice will be used as an example for measuring more dense foods such as mashed potatoes and oatmeal. Beans may be used for foods that are loosely packed, such as cereal or vegetables.

* To reduce the weight of the Food Recall Kit, dry cereal may also be placed in tightly covered plastic container or plastic bag for use in determining size of servings.

Plastic ruler - 6" works well and may be less cumbersome than a 12" ruler.

10 Shapes on cardboard or plastic as described in the following chart.

Item Identification	Size	Example of Food To Be Measured
A	1" square	Cheese, fudge
B	2" square	Brownies, Cornbread
C	1/16 layer cake	Cake
D	1/12 layer cake	Cake
E	1/8 of a 9" pie	Pie, quiche
F	1/7 of a 9" pie	Pie, quiche
G	1/6 of a 9" pie	Pie, quiche
H	3" square	Sheet cake, Cornbread
I	4" circle	Danish, pancake
J	1/4 of 12" pizza	Pizza

Additional shapes of various cuts of meats, each about 3 ounces of cooked, edible portion (master copy provided).

Compiled by: Ruby H. Cox, Ph.D., R.D. (1/93)

Parts of these procedures are adapted from the Enhanced EEFNEP Record and Reporting Manual from the New York EFNEP Program, Cornell University.

A METHOD FOR TRAINING EFNEP STAFF AND VOLUNTEERS ON COLLECTING 24-HOUR FOOD RECALLS

Training of paraprofessionals, volunteers, and other interviewers is very important if food recalls are to be complete and accurate. The following method assumes that you will bring EFNEP paraprofessionals or other participants together for group training. The entire training session may take 5 to 6 hours and will require at least one or two other people to assist the workshop presenter throughout the workshop.

1. BEFORE the workshop the Workshop Presenter (possibly an EFNEP supervisor) should make the following preparations:

- Notify participants of date and time and instruct experienced paraprofessionals to bring with them any props they have previously used in taking food recalls. New paraprofessionals or other workshop participants would not be given this instruction.

- Assemble Food Recall Kits for each workshop participant, according to the guide in the previous section of Appendix III.

- Assemble two trays representing two 24-hour recalls: Recall 1 and Recall 2 (examples attached), using food models, actual foods, and pictures. Foods in the recalls should be different, but comparable in that they **require the same techniques to elicit information** from the respondent (such as from an EFNEP homemaker). Label one as Recall 1 and the other as Recall 2. Recall 1 will be used in a pre-training assessment and Recall 2 will be used in a post-training assessment of how well workshop participants have learned the techniques for collecting food recalls.

- Enlist co-workers (but not workshop participants) to serve as "assistants" in the workshop by serving as respondents (i.e."pretend" homemakers) and to help score recalls collected during interviewing practice sessions. There should be 1 respondent for every 2 or 3 workshop participants. Prior to the beginning of the workshops, those to serve as respondents should become thoroughly familiar with the foods on Recall 1 and Recall 2.

  Respondents should also be briefed on how EFNEP homemakers might or might not respond during food recall interviews.

- Using two copies of Form 1 (located at end of this section), list the foods for Recall 1 and Recall 2 on separate forms. Identify and list all the characteristics that should be elicited from a respondent about the foods on Recalls 1 and 2 and assign point values (1 point for each piece of information about a food). This will yield the total number of points an interviewer (i.e. workshop participant) could earn on each of the recalls, if he/she used the appropriate probes, props, and questions in taking a food recall. (See examples at end of this section).

2. Call together workshop participants and begin the workshop.

3. Explain briefly that the purpose of the training is to help each to improve their skill in eliciting and recording complete and truthful food recall information. At this time, <u>do not go into detail about how recalls should be collected</u>.

4. Assign each workshop participant to one of the respondents (i.e. "pretend" homemakers) with whom she/he will do a food recall interview later in the workshop. For times sake, there should be no more than three participants (interviewers) assigned to each respondent.

5. Situate respondents (i.e. "pretend homemakers) in private areas so recalls can be taken without other participants over-hearing the interview. Respondents should have, as a reference during interviews, a copy of Form 1 on which Recall 1 has been listed. They should later have, as a reference, the Form 1 on which Recall 2 has been listed.

6. Distribute blank copies of a 24-hour food recall form to be used in your state (<u>or use blank copies of Form 1 which will facilitate scoring at a later time</u>).

7. Explain to participants that each one will act as an "interviewer" and will take a 24 hour recall on an assigned "respondent" (i.e. "pretend" homemaker). Initially, interviewers should use whatever methods and props that they have previously used, if they are experienced paraprofessionals. If participants have never before taken a 24-hour recall, they should use their own judgement as to what techniques and probes to use.

Note: Put workshop participants at ease by emphasizing that you do not expect perfection, especially on the first recall, and that they will have a second chance to show what they have learned, after being trained on appropriate techniques.

8. Proceed to allow each workshop participant to interview, in private, a respondent ("pretend" homemaker) regarding food eaten on Recall 1. Responses should be recorded by each interviewer on a blank copy of Form 1 or on a 24-Hour Food Recall form. Interviewers should label the form they complete as RECALL #1.

9. Completed forms should be given immediately to workshop assistants who will do scoring. Scoring should be done immediately so feedback can be provided later in workshop on how participants performed as interviewers. Points will be assigned to recalls completed by each interviewer based on previously identified points (i.e. characteristics listed on the Form 1's which were completed on Recall 1 and Recall 2 before the workshop).

10. Proceed to train the participants on the food recall techniques discussed in the prior section "Procedures for Taking 24-Hour Recalls." Give each participant a Food Recall Kit and demonstrate all techniques and show how items in the kit can be used. Use as examples the foods in Recall 1 above and discuss the probes, props, and questions that could have been used to get complete information from the respondent ("pretend homemaker).

11. Repeat Steps 6 through 9, but interviews should be based on Recall 2. This 24 hour intake should be labeled by interviewers as RECALL #2. Workshop presenter and assistants should collect and score completed recall forms as soon as possible, so results can be shared with the group.
Note: When results are shared with group, DO NOT mention name of individual participants, as this may cause embarrassment.

12. Using the Form 1, completed before workshop on Recall 2, score each participant's completed recall, based on the points assigned food characteristics on Recall 2.
13. Hold a group discussion in which feedback is provided on how participants did (as a group) on Recall 1 and Recall 2. Discuss ways participants improved as interviewers between Recall 1 and Recall 2. Point out the areas where participants tended to do well and PRAISE PARTICIPANTS. Also point out food items on which interviewers did not elicit or record
14. complete information on Recall 1 and whether there were improvements on Recall 2, as a result of the training and the use of props and probes. Especially emphasize areas where complete information was not obtained by most participants on Recall 2. Discuss and demonstrate correct probing techniques again, if needed.
15. Encourage workshop participants to further practice using the food recall techniques with each other, or co-workers, during the next few days following the workshop.

16. During a subsequent training on some other topic (i.e. several weeks later), the EFNEP supervisor should re-assess how paraprofessionals are doing in taking recalls, after having used the techniques with actual homemakers in the field. This can be done by having paraprofessionals pair off and take recalls on each other, while the supervisor observes.

This method for training paraprofessionals on taking 24-Hour Recalls was developed and tested by Dr. Ruby H. Cox, in the Virginia EFNEP Program. Data is now being collected, in a controlled setting, for possible publication in a journal article. If you have questions, contact Dr. Cox at the following address and phone number:

Ruby H. Cox, Ph.D., R.D. Phone: 703-231-7156 Virginia Tech FAX: 703-231-7157 229 Wallace Hall Blacksburg, VA, 24061-0228

FORM 1 FOR USE IN FOOD RECALL TRAINING ACTIVITY

Use this form for assigning points to Recall Items prior to training, (OR as blank form for collecting Food Recalls during training)

Instructions for Trainer: (1) Set up trays with a typical day's intake of approximately 15 to 20 foods that are consumed locally. (2) List foods below and characteristics to be obtained by interviewer from the respondent. (3) Assign points to each characteristic and record under column “Points Possible Or Earned." This shows points which will be earned if interviewer (training participant) elicits complete information about foods eaten by respondent.

FOOD ITEM	CHARACTERISTICS	POINTS POSSIBLE OR EARNED

	TOTAL POINTS POSSIBLE OR POINTS EARNED	

RECALL 1 SAMPLE

FORM 1 FOR USE IN FOOD RECALL TRAINING ACTIVITY

Use this form for assigning points to Recall Items prior to training, (OR as blank form for collecting Food Recalls during training)

Instructions for Trainer: (1) Set up trays with a typical day's intake of approximately 15 to 20 foods that are consumed locally. (2) List foods below and characteristics to be obtained by interviewer from the respondent. (3) Assign points to each characteristic and record under column “Points Possible Or Earned." This shows points which will be earned if interviewer (training participant) elicits complete information about foods eaten by respondent.

FOOD ITEM	CHARACTERISTICS	POINTS POSSIBLE OR EARNED
BISCUIT	FOOD LISTED: YES	1
	KIND: HOMEMADE	1
	SIZE: LG 3" DIAMETER	1
	NUMBER: 2	1
GRAVY	FOOD LISTED: YES	1
	AMOUNT: 1/2 CUP	1
	TYPE FAT: FATBACK GREASE OR LARD	1
	TYPE LIQUID: WHOLE MILK	1
POTATOES	FOOD LISTED: YES	1
	HOW PREPARED: FRIED	1
	FAT ADDED: CRISCO (SHORTENING)	1
	AMOUNT: 1 CUP	1
TEA	FOOD LISTED: YES	1
	AMOUNT: 16 OZ	1
	SUGAR ADDED: 2 TBSP	1
CUPCAKE	FOOD LISTED: YES	1
	FLAVOR: CHOCOLATE	1
	ICING: YES - CHOCOLATE	1
	NUMBER EATEN: 2	1
CHEESEBURGER	FOOD LISTED: YES	1
	TYPE: HOMEMADE	1
	SPREAD: MAYONNAISE, MUSTARD	2
	CHEESE = 3/4 OZ CHEESEFOOD	1
	NUMBER & SIZE: 1 LARGE	1

SOFT DRINK	FOOD LISTED: YES	1
	TYPE: REGULAR	1
	AMOUNT: 12 OZ CAN	1
STEAK	FOOD LISTED: YES	1
	TYPE: CUBED ROUND STEAK	1
	HOW PREPARED: FLOURED - FRIED IN SHORTENING	1
	AMOUNT: 4 OUNCES	1
	LEAN OR LEAN & FAT: LEAN ONLY	1
GRAVY	FOOD LISTED: YES	1
	TYPE FAT: SHORTENING & MEAT DRIPPING	1
	TYPE LIQUID: WATER	1
	AMOUNT: 1/3 CUP	1
ONIONS	FOOD LISTED: YES	1
	HOW PREPARED: FRIED	1
	TYPE FAT: SHORTENING	1
	AMOUNT: 1/2 CUP	1
POTATOES	FOOD LISTED: YES	1
	HOW PREPARED: STEWED	1
	FAT ADDED: YES - MARGARINE 1 TSP	1
	AMOUNT: 1 CUP	1
GREENS	FOOD LISTED: YES	1
	TYPE: COLLARDS	1
	FAT ADDED: 1 TSP FATBACK GREASE	1
	AMOUNT: 1/2 CUP	1
BREAD	FOOD LISTED: YES	1
	TYPE: CORNBREAD	1
	AMOUNT: 2 PIECES - SIZE C	1
	SPREAD: YES - MARGARINE 2 TSP	1
MILK	FOOD LISTED: YES	1
	TYPE: WHOLE	1
	AMOUNT: 10 OZ (1 1/4 CUP)	1
	TOTAL POINTS POSSIBLE OR POINTS EARNED	56

RECALL 2 SAMPLE

FORM 1 FOR USE IN FOOD RECALL TRAINING ACTIVITY

Use this form for assigning points to Recall Items prior to training, (OR as blank form for collecting Food Recalls during training)

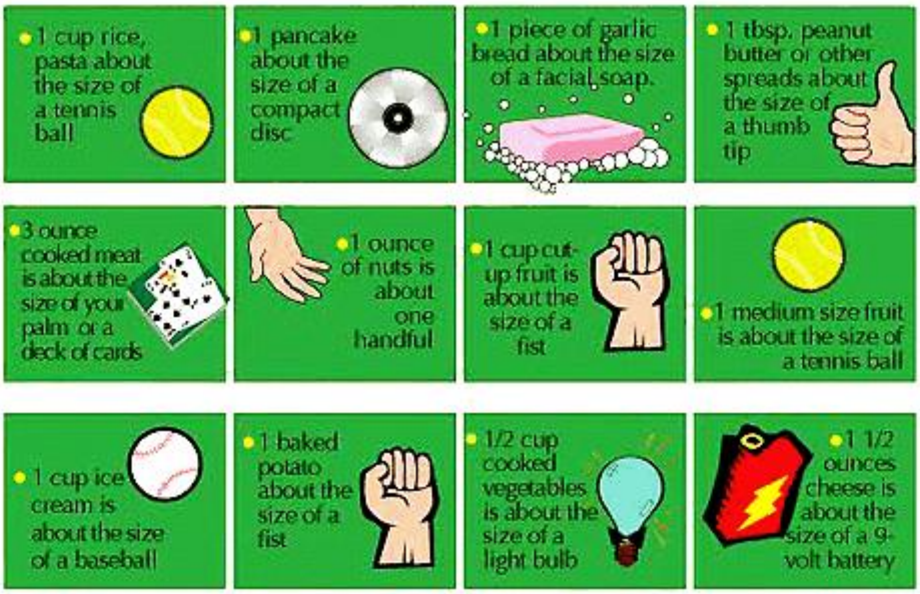
Instructions for Trainer: (1) Set up trays with a typical day's intake of approximately 15 to 20 foods that are consumed locally. (2) List foods below and characteristics to be obtained by interviewer from the respondent. (3) Assign points to each characteristic and record under column “Points Possible Or Earned." This shows points which will be earned if interviewer (training participant) elicits complete information about foods eaten by respondent.

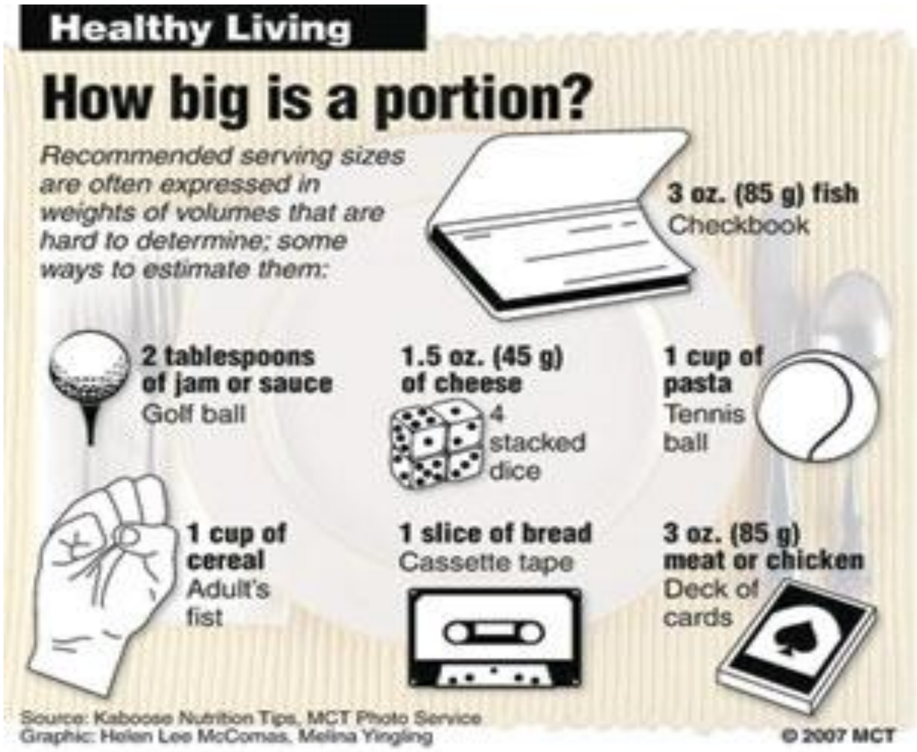
FOOD ITEM	CHARACTERISTICS	POINTS POSSIBLE OR EARNED
BREAD	FOOD LISTED: YES	1
	KIND: FRIED BATTER (FRITTER)	1
	FAT USED: SHORTENING	1
	SERVINGS: 2 FRITTERS	1
EGGS	FOOD LISTED: YES	1
	HOW PREPARED: SCRAMBLED	1
	FAT ADDED: LARD 1 TSP	1
	AMOUNT: 2 EGGS	1
POTATOES	FOOD LISTED: YES	1
	HOW PREPARED: FRIED	1
	FAT ADDED: LARD 2 TSP	1
	AMOUNT: 2/3 CUP	1
COFFEE	FOOD LISTED: YES	1
	AMOUNT: 2 CUPS (10 FLUID OZ.)	1
	ADDED SUGAR/CREAMER:	1
	SUGAR: 2 TSP.	1
	CREAMER: 2 TSP	1
POTATO CHIPS	FOOD LISTED: YES	1
	NUMBER CHIPS OR SIZE PK: 20 CHIPS	1
SANDWICH	FOOD LISTED: YES	1
	TYPE BREAD: WHITE LOAF BREAD	1
	TYPE FILLING: HAM - 2 OZ	1
	VELVEETA CHEESE - 3/4 OZ	1
	SPREAD: MAYONNAISE - 1 TBSP	1

PUNCH	FOOD LISTED: YES	1
	TYPE: ORANGE	1
	REAL JUICE: NO - KOOL AID TYPE	1
	AMOUNT: 2 CUPS (16 OUNCES)	1
BEEF	FOOD LISTED: YES	1
	TYPE: ROAST CHUCK	1
	HOW PREPARED: BAKED	1
	LEAN OR LEAN & FAT: LEAN ONLY	1
	AMOUNT: 2 OZ	1
BEANS	FOOD LISTED: YES	1
	TYPE: GREEN BEANS	1
	FAT ADDED: FATBACK ABOUT 1/2 TSP GREASE	1
	AMOUNT: 1 CUP	1
BREAD	FOOD LISTED: YES	1
	TYPE: CORN MUFFIN	1
	SERVINGS NUMBER/SIZE - 2 MUFFINS	1
	SPREAD ADDED: BUTTER 2 TSP	1
GRAVY	FOOD LISTED: YES	1
	FAT: DRIPPINGS FROM ROAST	1
	LIQUID: MEAT BROTH	1
	AMOUNT: 1/2 CUP	1
MILK	FOOD LISTED: YES	1
	TYPE: 1% FAT	1
	AMOUNT: 1 CUP (8 OZ)	1
ICE CREAM	FOOD LISTED: YES	1
	TYPE: CHOCOLATE ICE MILK	1
	AMOUNT: 1 1/2 CUPS	1
CAKE	FOOD LISTED: YES	1
	TYPE: CHOCOLATE LAYER	1
	WITH OR W/O ICING: WITH CHOCOLATE	1
	SIZE SLICE: 1 SIZE E	1
	TOTAL POINTS POSSIBLE OR POINTS EARNED	55

Appendix H

Handy Guide to Estimate Portion Size





Appendix I

Physical Activities Defined by Level of Intensity _Interviewers Guide for Culturally Related Examples

Using the Ainsworth et al. Compendium (Ainsworth et al., 2000), an average MET(metabolic equivalent) score was derived for each type of activity: vigorous, moderate, and walking. MET is defined as the ratio of work metabolic rate to a standard resting metabolic rate of 4.184 /KJ/Kg/hour, 1 MET is considered a resting metabolic rate obtained during quiet sitting. Activities are listed in the Compendium as multiples of the resting MET level and range from 0.9(sleeping) to 18 METs (running at 10.9mph).

I- **WALKING: Includes All types of walking included; average IPAQ MET score= 3.3 METs**

Walking at a moderate or brisk pace (3-4.5 mph)

- Walking to class, work, store, visiting neighbor
- Walking for prayer at church or mosque
- Walking for pleasure with friends
- Walking the dog

II- Moderate Activity: Average IPAQ MET score = 4.0 METs

Recreational

- Hiking
- Bicycling 5 to 9 mph- moderate effort
- Using stair climbing machine at moderate pace
- Aerobic dancing, low impact, general
- Weight training and bodybuilding using free weights
- Gymnastics, general
- Modern dancing
- Table tennis
- Basketball-shooting baskets
- Basketball, non game-general
- Volleyball, non game-general
- Swimming leisurely(not lap swimming)
- Hunting, small game
- Gardening general; digging, light shoveling, plowing, planting, trimming plants

Occupational

- Occupations that require extended periods of walking, pushing or pulling objects weighing les than 75 lbs
- Standing while lifting objects weighing less than 50 lbs, or carrying objects of less than 25 lbs up a flight of stairs
- Tasks frequently requiring moderate effort and considerable use of arms, legs, or occasional total body movements:
    - Briskly walking on a level surface while carrying a suitcase or load weighing up to 50 lbs
    - Waiting tables or institutional dishwashing
    - Driving or maneuvering heavy vehicles (e.g., semi-truck, school bus, tractor, or harvester)—not fully automated and requiring extensive use of arms and legs
    - Operating heavy power tools (e.g., drills and jackhammers)

    - Many homebuilding tasks (e.g. electrical work, plumbing, carpentry, dry wall, and painting)
    - Farming—feeding and grooming animals, milking cows, shoveling grain; picking fruit from trees, or picking vegetables
    - Packing boxes for shipping or moving
    - Assembly-line work—tasks requiring movement of the entire body, arms or legs with moderate effort
    - Patient care—bathing, dressing, and moving patients or physical therapy
    - Animal care: shoveling grain, feeding farm animals, or grooming animals
    - Playing with or training animals
    - Manually milking cows or hooking cows up to milking machines

- Home repair: cleaning gutters, refinishing furniture, laying or removing carpet or tiles
- General home construction work: roofing, painting inside or outside of the house, wall papering, scraping, plastering, or remodeling
- Child care: handling uncooperative young children (e.g., chasing, dressing, lifting into car seat), or handling several young children at one time
- Actively playing with children—walking, running, or climbing while playing with children
- Coaching children's or adults' sports

Housework

General household tasks requiring considerable effort:

- Scrubbing the floor or bathtub while on hands and knees
- Hanging laundry on a clothesline,
- Sweeping an outdoor area,
- Cleaning out the garage,
- Washing windows,
- Moving light furniture,
- Packing or unpacking boxes,
- Walking and putting household items away,
- Putting groceries away
- Walking and carrying especially large or heavy items less than 50 lbs.
- Walking while carrying a child weighing less than 50 lbs
- Walking while pushing or pulling a child in a stroller
- Carrying a child weighing less than 25 lbs up a flight of stairs
- Child care: handling uncooperative young children (e.g., chasing, dressing, lifting into car seat), or handling several young children at one time

III- Vigorous Activity: Average IPAQ MET score = 8.0 METs

Recreational

Bicycling more than 10mph or steep uphill
Aerobic dancing-high impact
Step aerobics
Jumping rope
Using stair climbing machine at fast pace
Circuit weight training
Football game
Basketball game

Squash
Swimming-steady paced laps
Running
*Gardening: heavy or rapid shoveling, felling trees, carrying heavy loads, hand-splitting logs, trimming trees.

Occupational

- Home repair or construction: very hard physical labor, standing or walking while carrying heavy loads of 50 lbs or more, taking loads of 25 lbs or more up a flight of stairs or ladder (e.g., carrying roofing materials onto the roof), or concrete or masonry work

- Occupations that require extensive periods of running, rapid movement, pushing or pulling objects weighing 75 lbs or more, standing while lifting heavy objects of 50 lbs or more, walking while carrying heavy objects of 25 lbs or more

- Tasks frequently requiring strenuous effort and extensive total body movements.
    - Running up a flight of stairs while carrying a suitcase or load weighing 25 lbs or more
    - Teaching a class or skill requiring active and strenuous participation, such as aerobics or physical education instructor
    - Firefighting
    - Diving
    - Masonry and heavy construction work
    - Using heavy manpowered tools
    - Farming—forking straw, baling hay, cleaning barn, or poultry work
    - Loading and unloading a truck
    - Animal care: forking bales of hay or straw, cleaning a barn or stables, or carrying animals weighing over 50 lbs
    - Handling or carrying heavy animal-related equipment or tack

Housework

- Heavy housework: moving or pushing heavy
- furniture (75 lbs or more), carrying household items weighing 25 lbs or more up a flight or stairs, or shoveling coal into a stove
- Standing, walking, or walking down a flight of stairs while carrying objects weighing 50 lbs or more
- Carrying several heavy bags (25 lbs or more) of groceries at one time up a flight of stairs
- Grocery shopping while carrying young children *and* pushing a full grocery cart, or pushing two full grocery carts at once
- Carrying an adult or a child weighing 25 lbs or more up a flight of stairs
- Standing or walking while carrying an adult or a child weighing 50 lbs or more
- Vigorously playing with children—running longer distances or playing strenuous games with children

Source: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition and Physical Activity. *Promoting physical activity: a guide for community action*. Champaign, IL: Human Kinetics, 1999. (Table adapted from Ainsworth BE, Haskell WL, Leon AS, et al. Compendium of physical activities: classification of energy costs of human physical activities. *Medicine and Science in Sports and Exercise* 1993; 25(1):71-80. Adapted with technical assistance from Dr. Barbara Ainsworth.)

***** The ratio of exercise metabolic rate. One MET is defined as the energy expenditure for sitting quietly, which, for the average adult, approximates 3.5 ml of oxygen uptake per kilogram of body weight per minute (1.2 kcal/min for a 70-kg individual). For example, a 2-MET activity requires two times the metabolic energy expenditure of sitting quietly.

+ For an average person, defined here as 70 kilograms or 154 pounds. The activity intensity levels portrayed in this chart are most applicable to men aged 30 to 50 years and women aged 20 to 40 years. For older individuals, the classification of activity intensity might be higher. For example, what is moderate intensity to a 40-year-old man might be vigorous for a man in his 70s. Intensity is a subjective classification

~Note: Almost every occupation requires some mix of light, moderate, or vigorous activities, depending on the task at hand. To categorize the activity level of your own position, ask yourself: How many minutes each working day do I spend doing the types of activities described as light, moderate, or vigorous? To arrive at a total workday caloric expenditure, multiply the minutes spent doing activities within each intensity level by the kilocalories corresponding to each level of intensity. Then, add together the total kilocalories spent doing light, moderate, and vigorous activities to arrive at your total energy expenditure in a typical day.

Appendix J

Anthropometric Measurement Handout

Regional Training Course on Anthropometry and Stable Isotope Preparation and Administration for Body Composition Assessment (RAS/6/050) 1-5 October 2007, Tokyo, Japan

Anthropometric measurement handout

Anthropometric Techniques

The majority of **measurement protocol** used in this training course was based on the protocol defined by Ross and Marfell-Jones (Ross et al., 1991) and as endorsed by the International Society for the Advancement of Kinanthropometry (ISAK) and the Australian Sports Commission Laboratory Standards Accreditation Scheme. These definitions are consistent with their manual *International Standards for Anthropometric Assessment (2006).*

Anthropometric Landmarks

Landmarks are identifiable skeletal points which generally lie close to the body's surface and act as the "markers" that identify the exact location of a measurement site, or from which a soft tissue site is located. (ISAK, 2006)

Technique for locating landmarks

- The landmark is located by the left thumb and index finger of the anthropometrist.
- Once located the landmark is marked with the right hand and then re-checked to ensure no displacement of the skin has occurred.
- The pad of the thumb is used for locating the landmark.
- An eyebrow pencil is recommended for marking the landmark on the participant.
- **Nails** of the anthropometrist must be clipped short to avoid scratching the participant.

The landmarks defined by Marfell-Jones et al. (2006) in "International Standards for Anthropometric Assessment (2006)" for the basic anthropometric assessment are as follows:

1. <u>Acromiale®</u> Definition: The point on the superior aspect of the most lateral part of the acromion border when the participant is in relaxed standing position with the arms hanging by the sides.

Location:

1. Stand behind the participant on the right hand side and apply a marking pen to the lateral border of the acromion process at a 45° angle.
2. With the left thumb and index finger palpate along the lateral border of the acromion process to locate the most superior point.
3. Mark the point and then re-check with the left thumb.

2. <u>Radiale®</u> Definition: The point at the proximal and lateral border of the head of the radius when the participant is in relaxed standing position with the arms hanging by the sides.

Location:

1. Using the left thumb or index finger palpate downward in the lower portion of the lateral dimple of the elbow.
2. By pronation and supination of the forearm movement of the head of the radius should be felt.
3. Mark and then re-check the landmark.

3. <u>Mid Acromiale-Radiale®</u> Definition: The mid-point of the straight line joining the acromiale® and the radiale® when the participant is in relaxed standing position with the arms hanging by the sides.

Location:

1. Measure the linear distance from the acromiale® and the radiale® with the arm relaxed and hanging by the side.
2. Place a horizontal mark at the mid-point.

4. <u>Triceps skinfold site®</u>

Definition: The point on the posterior surface of the arm, at the level of the Mid-acromiale-radiale® landmark. The participant's arm is in the mid-prone position.

5. **Biceps skinfold site® Definition:** The point on the anterior surface of the arm in the mid-line at the level of the Mid-acromiale-radiale® landmark.
6. **Subscapulare® Definition**: The undermost tip of the inferior angle of the scapula when the participant is in relaxed standing position with the arms hanging by the sides. **Location**:

一. Palpate the inferior angle of the scapula with the left thumb.
一. If there is a difficulty locating the angle of the scapula ask the participant to reach behind the back with the right arm.
一. Once located ask the participant to return their arm to the side of the body and mark the landmark.
一. A final check of this landmark should be made with the participant's hands by the side in the relaxed position.
一. **7. Subscapular skinfold site® Definition**: The site 2cm along a line running laterally and obliquely downward from the Subscapulare® landmark at a 45°angle.

8. **Iliocristale® Definition:** The point on the iliac crest where a line drawn from the mid-axilla (middle of the armpit), on the longitudinal axis of the body, meets the ilium. The participant assumes a relaxed position with the right arm folded across the chest.

Location:

1. Stabilize the participant's body by support left pelvis using the left hand. Palpate and locate the top of the iliac crest using palms of the fingers of the right hand.
2. Once located, find specific edge of the crest by horizontal palpation with the tips of the fingers.
3. Once identified, draw a horizontal line at the level of the iliac crest and draw an imaginary line from the mid-axilla down the mid-line of the body. The landmark is at the intersection of the two.

9. Iliac crest skinfold site® Definition: The site at the centre of the skinfold raised immediately above the marked Iliocristale®.

10.Iliospinale® Definition: The most inferior or undermost part of the tip of the anterior superior iliac spine. The participant is in a relaxed position with the right arm folded across the chest.

Location:

1. Palpate the superior aspect of the ilium and follow anteriorly until the anterior superior iliac spine is reached.
2. The landmark is the lower margin where the bone can just be felt.
3. Difficulty in appraising the landmark can be eased by asking participant to lift the heel and rotate the right femur outward as the Sartorius muscle originates at this landmark.

11.Supraspinale skinfold site® Definition: The point at the intersection of two lines: 1) the line from the marked Iliospinale® to the anterior axillary border; and 2) the horizontal line at the level of the marked Iliocristale®.

12.Abdominal skinfold site® Definition: The point 5cm horizontally to the right hand side of the omphalion (midpoint of the navel). The distance of 5cm assumes an adult height of about 170cm. Therefore if the height differs markedly from this, the distance should be scaled for height by calculating 5*Ht of participant/170.

13.Medial calf skinfold site® Definition: The point on the most medial aspect of the calf at the level of the maximal girth.

14.Front thigh skinfold site® Definition: The mid-point of the linear distance between the Inguinal point® and the Patellare®.

15.Patellare® Definition: The mid-point of the posterior superior border of the patella.

16.Inguinal fold® Definition: The crease at the junction of the gluteal region and posterior thigh.

17.Inguinal point® Definition: The point at the intersection of the Inguinal Fold® and the mid-line of the anterior thigh.

18.Orbitale® Definition: The lower bony margin of the eye socket.

19.Tragion® Definition: The notch superior to the tragus of the ear.

20.Vertex® Definition: The most superior point on the skull when the head is positioned in the Frankfort plane.

Skinfolds

Equipment

The Harpenden caliper (John Bull, British Indicators England) which is calibrated to 40mm and provides a constant pressure of $10g/mm^2$ is the caliper of choice. The Slimguide caliper which is calibrated to 80mm provides the same compression as the Harpenden caliper and produces almost identical results (Schmidt et al., 1990).

Technique

1 The right side of the body is always used irrespective of which is the dominant side.

2 The skinfold is raised at the marked or designated site and the caliper applied 1 cm away from the controlling thumb and index finger. The back of the hand will be facing the measurer.

3 The caliper is placed at a depth about the level of the mid-fingernail.

4 For inexperienced anthropometrists, the skinfold site should be marked. Inaccurate location of skinfold sites has been found to be the greatest source of error.

5 The fold is held at 90° to the surface of the skinfold *throughout the measurement* The reading is taken two seconds after the full pressure of the caliper is applied.

6 The reading is taken to the nearest 0.1 mm, except where the Slimguide caliper is used which is to the nearest 0.5 mm.

7 Skinfold sites are measured in the same order as on the data sheet. A complete set is obtained first before repeating a second or third set of measurements.

8 The reading is taken at eye level to avoid a parallax error.

Skinfold measurement sites

1. **Triceps®** The caliper is applied 1 cm distally from the left thumb and index finger, raising a vertical fold at the marked mid-acromiale-radiale site on the most posterior surface of the arm. The participant's arm should be relaxed in the anatomical position.
2. **Subscapular®** The thumb palpates the inferior angle of the scapula (subscapulare), which has been previously marked. A second mark for the taking of the skinfold, is made 2 cm along a line running laterally and obliquely downwards from the subscapulare landmark at an angle of approximately 45°. The caliper is applied at the skinfold marked site. The participant should be standing erect with their arms by the side.
3. **Supraspinale®** The caliper is applied 1 cm anteriorly from the left thumb and index finger, raising a fold at the point where the line from the iliospinale landmark to the anterior axillary border intersects with the horizontal line of the superior border of the ilium. The fold runs medially downward at about a 45° angle. This skinfold is used in the Heath-Carter Somatotype and was previously named the suprailiac skinfold.
4. **Abdominal®** The caliper is applied 1 cm inferiorly to the left thumb and index finger, raising a vertical fold 5 cm from the right hand side of the midpoint of the navel.
5. **Front thigh®** The skinfold site is marked parallel to the long axis of the femur at the mid-point of the distance between the inguinal fold and the superior border of the patella. The participant is seated or has the leg flexed at a 90° angle. The caliper is placed 1 cm distally to the left thumb and index finger, raising a fold at the designated site.
6. **Medial calf®** The caliper was applied 1 cm distally from the left thumb and index finger, raising a vertical fold on the relaxed medial right calf at the maximum circumference. The participant is standing with his right foot on a box with the knee at 90°. The maximum circumference is used for taking the calf girth and can be marked of the medial aspect of the calf at this time.

Girth measurements

Equipment

A Lufkin (W606PM) self-retracting metal tape is recommended. All measurements are taken to the nearest 0.1 cm. Fibreglass tapes can stretch and need to be checked regularly against a metal tape.

Technique

1 The tape is held at right angles to the long axis of the body segment being measured.
2 The cross hand technique is used for measuring all girths.
3 Constant tension is used throughout the measurements, making sure there is no indentation on the skin but the tape holds the place at the designated landmark.
4 The tape must be read at eye level to avoid a parallax error.

Girth measurement sites

1. **Arm (relaxed)®** The perimeter distance of the right arm perpendicular to the long axis of the humerus when the participant is standing erect and the relaxed arm is by the side of the body. The measurement is made at the level of the mid-acromiale radiale line.
2. **Arm (flexed and tensed)®** The perimeter of the arm perpendicular to the long axis of the arm at the level of the peak of the contracted Biceps brachii, when the arm is raised anteriorly to the horizontal.
3. **Waist (minimum)®**
   The perimeter at the level of the estimated minimum waist halfway between the costal border and the iliac crest.
4. **Waist (mid-way)** The perimeter at the level of the mid-point between the lower costal (10th rib) border and the iliac crest. This can be considered as the same measurement site for WHO recommendation that defined as "The midway between the inferior margin of the last rib and the crest of the ilium, in a horizontal plane." (WHO, 1995)
5. **Umbilicus**
   The perimeter at the level of navel.

6. <u>Gluteal (hip)®</u>

The perimeter at the level of the greatest posterior protuberance, approximately at the symphysis pubis level anteriorally. The participant stands with the **feet together** and without contracting the gluteal muscles. The measurer stands to the right hand side of the participant.

7. <u>Calf (maximum)®</u>

The maximum perimeter of the calf when the participant is standing with the weight equally distributed on both feet. The measurement is taken from the lateral aspect of the leg. The maximum circumference is found by using the middle fingers to manipulate the position of the tape moving up and down the leg until the maximum circumference is established.

Breadths

Techniques for measuring breadths (and lengths).

Both the small sliding (bone) calipers and the large sliding calipers are held in the same way. The calipers lie on the backs of the hands while the thumbs rest against the inside edge of the caliper arms, and the extended index fingers lie along the outside of the caliper arms. The measurements are made when the calipers are in place, with the pressure maintained along the index fingers.

Bone breadth measurement sites

1. <u>Biepicondylar humerus®</u>

The distance is measured between the medial and lateral epicondyles of the humerus when the arm is raised anteriorly to the horizontal and the forearm is flexed at right angles to the upper arm. With the small sliding calipers gripped correctly, use the middle fingers to palpate the epicondyles of the humerus beginning proximal to the sites. The bony points first felt are the epicondyles. Place the caliper faces on the epicondyles so that the arms of the calipers point upward at about a 45ø angle to the horizontal. Maintain firm pressure with the index fingers until the value is read.

2. <u>Biepicondylar femur®</u>

The distance is measured between the medial and lateral epicondyles of the femur when the participant is seated and the leg flexed at the knee to form a right angle with the thigh. With the participant seated and the calipers in place use the middle fingers to palpate the epicondyles of the femur beginning proximal to the sites. The bony points first felt are the epicondyles. Place the caliper faces on the epicondyles so that the arms of the calipers point downward at about a 45ø angle to the horizontal. Maintain firm pressure with the index fingers until the value is read.

Basic measurement sites

Stature

The standard method for measuring stature is the *stretch stature* technique defined as the maximum distance from the floor to the vertex of the head. Stature is recorded using a stadiometer mounted on a wall with a fixed head piece. If a stadiometer with a counter is used the calibration must be checked prior to each testing session against a known height. Altneratively at triangular head piece and a carpenter's retractable tape measure with a foot piece can be used to measure the length from the floor. Graph paper can be attached to the wall at a standard height for marking.

The participant stands barefoot with feet and heels together. The head is placed in the Frankfort plane. The Frankfort plane is achieved when the Orbitale® (lower edge of the eye socket) is in the same horizontal plane as the Tragion® (the notch superior to the tragus of the ear). When the two landmarks are aligned, the Vertex® is the highest point on the skull. The participant is instructed to take a deep breath, while the measurer applies gentle traction alongside the mastoid process. The head piece is bought down firmly on the vertex at the same time and the reading taken at this point. The reading is taken to the nearest 0.1 cm.

Body Mass

Body weight should be obtained on an accurately calibrated beam-type balance and recorded to the nearest tenth of a kilogram. Ideally the participant should be weighed in a known weight of clothing and a correction for the nude weight can be made. The most stable values for monitoring weight change are those obtained routinely in the morning and after voiding. For most purposes a calibrated spring scale with measurement made to the nearest half a kilogram is satisfactory.

References

1 Marfell-Jones et al. *International Standards for Anthropometric Assessment (2006)*. International Society for the Advancement of Kinanthropometry, 2006. ISBN: 0-620-36207-3.

2 Norton K, Whittingham N, Carter L, Kerr D, Gore C, Marfell-Jones M. Measurement techniques in anthropometry. In: Norton K, Olds T, editors. *Anthropometrica*. *1 ed.* Sydney: University of New South Wales Press; 1996. p. 25-75.

3 Ross WD, Marfell-Jones MJ. Kinanthropometry. In: MacDougall JD, Werger HA, Green HJ, editors. *Physiological testing of the high-performance athlete. 2 ed.* Champaign: Human Kinetics Books; 1991. p. 223-268.

4 Schmidt PK, Carter JE. Static and dynamic differences among five types of skinfold calipers. Hum Biol 1990;62(3):369-388.

5 World Health Organization. Recommended measurement protocols and derivation of indices. In: WHO, editor. *Physical status: The use and interpretation of anthropometry.* Geneva: WHO; 1995. p. 424-438.

Attachments

1. Major anatomical landmarks
2. Skinfold measurement sites
3. Girth measurement sites
4. Anthropometric proforma

Note: Attachments 1-3 were adopted from Marfell-Jones et al. (2006).

1. **Major anatomical landmarks**
2. **Skinfold measurement sites**
3. Girth measurement sites

International Standards for Anthropometric Assessment

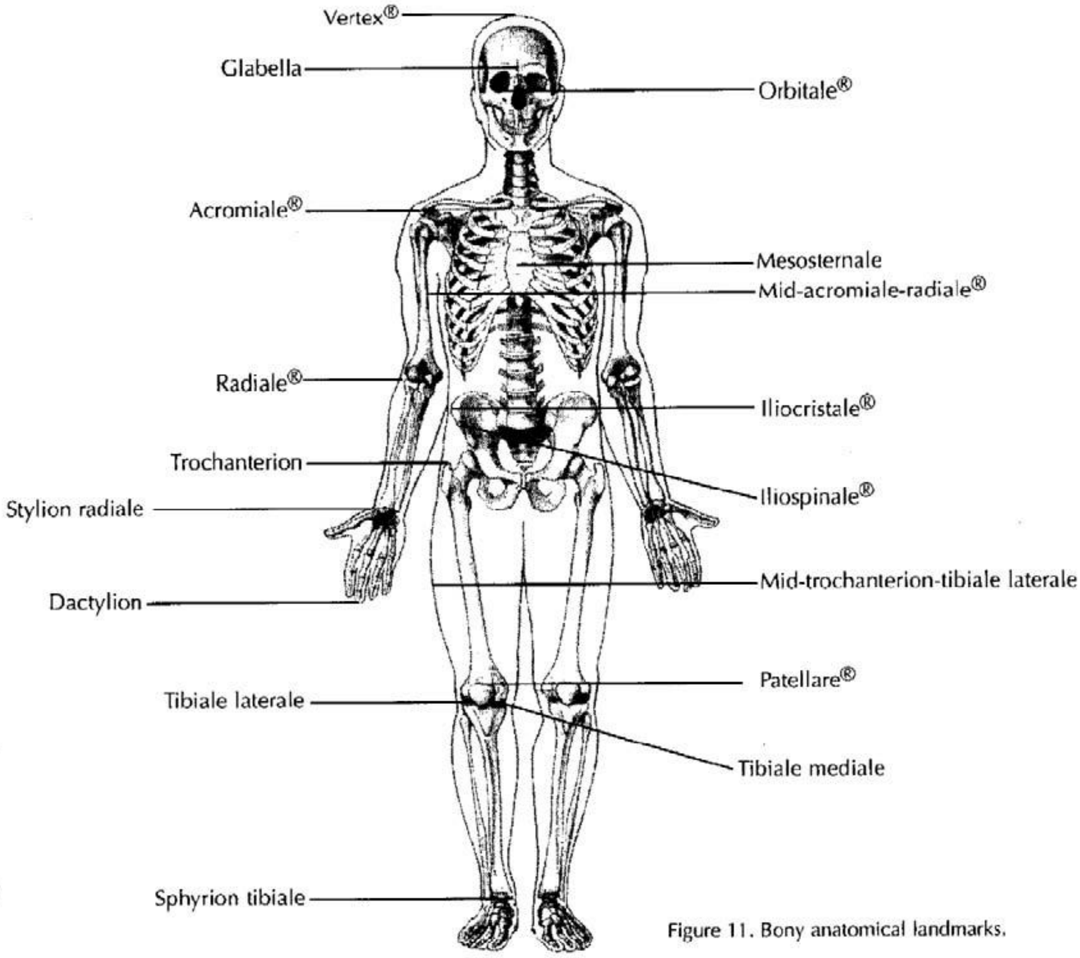


Figure 11. Bony anatomical landmarks.

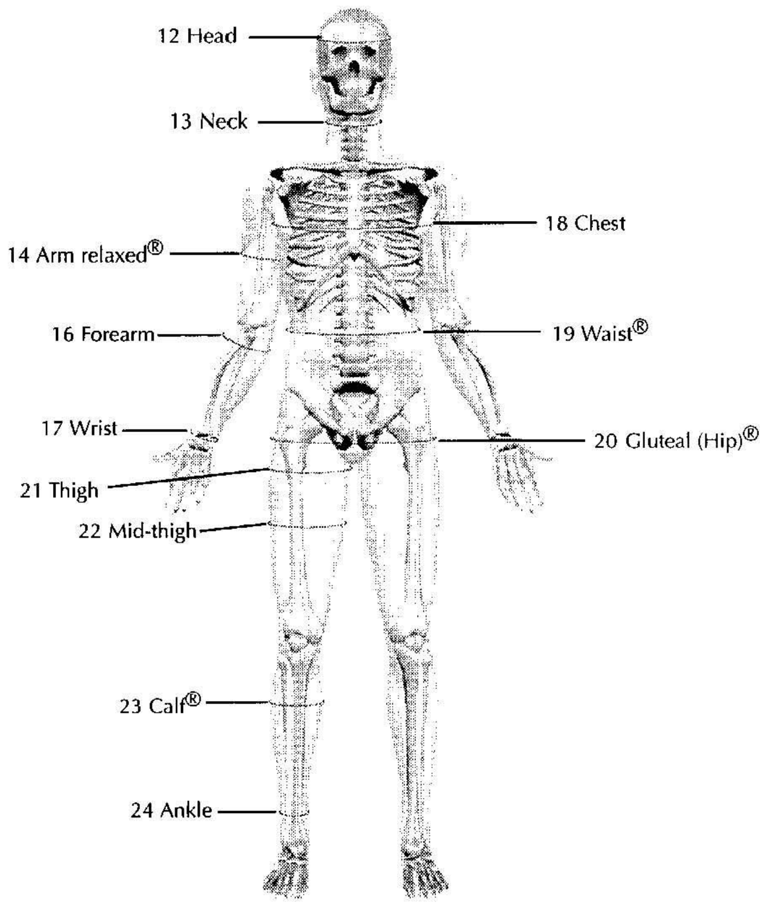


Figure 46. Location of girth measurements. Measurement 16 Arm flexed and tensed® is not shown.

Appendix K

Training Workshop Agenda

Socioeconomic and Dietary Determinants of Obesity in Lebanon

Training Workshop Agenda
Venue: Faculty of Agriculture and Food Sciences- Wing A .Room 201.

<u>Day 1: Monday April 7,2008</u>

9:30 -10:00	Introduction
11:00- 12:00	Procedure for Adult Questionnaire Administration
12:30 - 13:30	Lunch Break
13:30 - 15:30	Procedures for the International Physical Activity Questionnaire (IPAQ)-The Short Last 7 Days Format

<u>Day 2 Tuesday ,April 8,2008</u>

8:30-12:30	Procedures for the International Physical Activity Questionnaire (IPAQ)-The Short Last 7 Days Format (Practice with invited subjects evaluation)
12:30-14:00	Lunch Break
14:00 - 15:30	Procedures for collecting the 24-hour Food Recalls (what do I know session)

<u>Day 3 Wednesday April 9,2008</u>

8:30 - 12:30	Procedures for collecting the 24-hour Food Recalls (session 2 hands on- and practice with invited subjects)
12:30- 14:00	Lunch Break
14:00 - 15:30	Procedures for collecting the 24-hour Food Recalls (continued practice with invited subjects - evaluation)

Day 4 Thursday April 10, 2008

8:30 – 10:30	Anthropometry Techniques
11:00-13:00	Anthropometry: Practice and evaluation
13:00-14:00	Lunch Break
14:00 – 15:00	Anthropometry: practice and evaluation- invited subjects

Day 5 Friday April 11, 2008

8:30:00- 12:30 Field Methodologies:

- Logistics: preparation of each team's instruments, questionnaires, recall kit, attendance, non-response documentation
- Roles & Responsibilities
- Household selection and sample selection within each cluster

12:30-14:00 Lunch Break

14:00- 18:00 Overall Evaluation of interviewers and feedback
Wrap up

Appendix L

Summary of Good Interviewing Techniques

Summary: Good Interviewing Techniques

Before Beginning the Interview

Put the person at ease

- Thank them for welcoming you into their home and accepting to participate in the survey.
- Explain the purpose of the survey: Obtain informed consent
- Tell the person:
  - how long the survey will take; there are no right or wrong answers;
  - all responses are confidential;
  - at end of interview, some measurements will be taken.

Make a good first impression

- Smile; be prepared;

During the Interview

Interview the person alone or within the family context: Assure privacy

Ask the questions as written on the questionnaire

- Wording and sequence of questions must be maintained
- Do not rephrase the question

Stress confidentiality of responses when necessary

- No individual names will be used
- All information is combined for the report

Answer questions from the respondent frankly

- Be direct and pleasant when answering questions
- Be neutral with your expression and tone of voice
- Never approve or disapprove of an answer
- Probe in a neutral way: Can you explain a little more; I did not hear you, could you tell me again; There is no hurry, take a moment to think about it.
- Never suggest answers to the respondent

Do not hurry through the interview

- Ask questions slowly so the person understands
- After asking the question, pause and give the person time to think
- Feel free to say: "There is no hurry. Your answer is important."
- At the end of the interview:
- Thank the person for answering the questions in the survey
- Check survey for completeness
- Pass their questionnaire to the supervisor for the next phase of the survey

Appendix M

Non-Response Documentation Sheet

Socioeconomic & Dietary Determinants of Obesity in Lebanese Adults

Date: ______________________

Region: ____________________

Cluster: ____________________

Interviewer Presence

Name of interviewer	Attendance	Reason for Absence

Households Refusals / Non-Response:
Indicate the number of refusals and non-responses you have encountered during this field day.

Team	Refusals	Non-Response

Appendix N

List Of Food Groups

Group Number	Food Groups
1	Bread
2	Cereals (cereal/ granola bars, breakfast cereals, rice cake…)
3	Starch, starchy vegetables (flour, wheat, burgul, crepe, pasta, rice, potato, corn, pop corn, crackers, potato harra, couscous, yam, tortilla flour, pancake…)
4	Legumes (legume soup, lupin)
5	Fruits, fresh fruit juices, dried fruits, frozen/ice pops, canned fruit salad, fruit cocktail canned juice pack
6	Vegetables non-starchy
7	Meat/ poultry/ fish
8	Eggs
9	Milk & dairy full fat (yogurt, cheese, cheese spread, labneh, condensed milk, frozen yogurt fruit varieties)
10	Milk & dairy low fat/ skimmed
11	Sugars & sweets (jam, honey, molasses, sugar, sugar syrup, malt syrup, chocolate syrup)
12	Fats & oils (butter, margarine, mayo, mayo light, avocado, ashta, olives, tarator, tahini, beef tallow, lard, sauce blanche for pasta/bechamel, sauce cheese from dry mix milk/butter)
13	Nuts & seeds
14	Alcohol
15	Carbonated beverages
16	Other beverages (fruit drinks, energy drinks, Tang, iced tea, tea, instant coffee, cappuccino, café au lait, 3 in 1, lemonade, chocolate powder beverage, cocoa powder, milkshake, carob powder…)
17	Chocolates, nutella, chocolate coated fondant, chocolate mousse
18	Arabic sweets
19	Cakes, frostings and doughnuts, biscuit au chocolat, pies, tarts
20	Other desserts (puddings, sahlab, jello, meghli, halawa, custard, crème caramel, biscuits, cookies and cream, hard candy, raha al holkoum, lollipop, frozen pops chocolate/vanilla, candy toffee, licorice, nougat…)
21	Fried potato
22	Chips
23	Fast foods (pizza, chicken nuggets, taouk sandwich, hamburger, shawarma sandwich, fried potato sandwich, roast beef sandwich, falafel, ham and cheese sandwich/loaf/roll, tuna sandwich, submarine with cold cuts, coleslaw salad, chicken burger, cheese sticks, kabab meat sandwich, canned soups, chicken sandwich with pickles, chicken sandwich…)
24	Manakish & croissants (lahem baajin, fatayer, fatayer silk, fatayer potato, cheese rolls, spring rolls, kishek, brioche, chou pastries…)
25	Traditional composite dishes
26	Western composite dishes

27	Condiments, sauces ,& pickles (ketchup, mustard, soy sauce, coffeemate, makdous, cooking spray oil, tomato paste, sauce tartar)
28	Ice cream
29	Oral Supplements (shakes, formulas)

Hommos bi tahini = legumes + fat
Foul moudammas = legumes + oil
Msabbaha/ balila = legumes + fat
Baba ghannouj = vegetables + oil
French fried fish = meat + oil
Coleslaw + patty + burger bun = fast food
Tabbouleh, fattouch, cabbage salad, standard salad, eggplant salad = vegetables + oil
Kishek with potato and ghee = composite traditional
Kishek with ghee = traditional + fat
Chich taouk, kafta & kibbeh (akras, sayniyyeh, nayyeh) = meat
Egg fried with butter = eggs + oil
Mjaddara + sayadiyyeh (+ sayadiyyeh sauce) = composite traditional
Loubyeh bi zeit = composite traditional
Soup (chicken noodles) = starch + fat
Chicken fajita roasted = meat
Eggplant with tomato and onion (msa2a3it betenjen) = composite traditional
Soup (chicken broth, canned, prepared with water) = meat
Hamburger patty (broiled, lean beef) = meat
Coconut cream = fat
Rice cooked with ghee or butter = starch
Lemon juice (raw) = fruits
Kishek without meat = composite traditional
Burgul bi banadoura = composite traditional
Stuffed grape leaves with ghee = composite traditional
Okra in oil = composite traditional
Kishek without meat = composite traditional
Goat cheese 60-80% water, 17% or 28% BF = regular dairy
Krouch = composite traditional
Salad dressing, mayo type = fat
Cottage cheese, 4% fat = low fat dairy
Meat loaf with celery and onions = kafta (meat)
Cake mix, butter chocolate, super moist = cake
Tomato sauce for pasta without meat = sauces (condiments)
Tomato sauce for pasta with meat = sauces + meat (0.8 ratio from total Kcal)
Almond butter = fat
Egg fried in butter = egg + fat
Burgul bi dfin = composite traditional
Coconut shredded = condiment
Fish sardine, fish eggs (caviar) & tuna canned in oil = meat
Fassoulia with butter/ fassoulia c meat (no meat) = composite traditional
Fried chicory = vegetables + oil
Chicken gizzard = meat
Adas bi hamod = composite traditional
Mfataka = Arabic sweets
Potato harra = starch
Fassoulia in oil = composite traditional
Cream, half and half milk and cream fluid = fat

Fattet hommos = composite traditional
Fruit bar (oat bran) = cereals
Whey protein concentrate = N/A
Adas soup = legumes
Cottage cheese 1% BF = low fat dairy
Potato mehshi = composite traditional
Mc Donald's fries = fast food
Fajita meat roasted = meat
Loubieh with meat (no meat) = composite traditional
Hrisseh = composite traditional
Kafta in oven with potato and tomato sauce = composite traditional
Chicken curry = composite western
Salmon raw + sushi (rice, vinegar, salt, sugar) = meat
Malt beverage-near beer = alcohol
Salade de pates with tuna and dressing = starch + fat
Soufflé potato = starch + meat
Frankfurter, no bun, beef & pork = meat
Salade chef with ham & cheese = vegetables + meat
Rosto with vegetables = meat + vegetables
Sfouf = Arabic sweets
Tortilla corn = bread
Kabseh = composite traditional
pumpkin kebbeh = vegetables
tomato juice = vegetables
soufle potato = starch (from CHO only, x4) and the rest from meat (protein and fat)
salad chef with ham and cheese = vegetables from CHO only and meat from fat and protein
salad de pate with tuna and dressing = starch from CHO only and fat from protein and fat
salade de pate without dressing = starch
rosto with vegetables = vegetables from CHO only (x4) and the rest from meat (protein + fat)
Eggplant mehshi = composite traditional
Frikeh = composite traditional
Soup-beef broth dehydrated, cubed = condiment
Chicken pieces with fried rice = composite western
Beef ragout & rice pilaf-right course = composite western
Candy/caramel-plain/chocolate = chocolate
Candy-cadbury caramello = chocolate
Sahlab = Arabic sweets
Vegetable-3 cheese-kraft-pasta & cheese = composite western
Makloubit batenjen = composite traditional
Rolls & buns – plain hotdog/hamburger = bread
Samkeh harra = meat
Wendys sea food salad = fast food
Salad R3 = vegetables + fat
Fish eggs = meat
Dip-guacamole Kraft = fat
Beef stew with vegetables = composite traditional
Vegetable stew = composite traditional
Soup mushroom dehydrated = vegetables + fat
Chich barak – laban/pastry = composite traditional
Breadcrumbs + cheese gruyere + eggs + flour = fast food
Potato puree = starch + fat
Salad – chicken = fast food
Candy – Cadbury caramello = chocolate

Snail = meat
Russian salad = western composite
Chicory roots = vegetables
Spaghetti, meat balls, tomato sauce = western composite
Vegetable soup with chicken = composite traditional
Cottage cheese 4% fat = low fat milk
Goat = meat
Frikeh = composite traditional
Pear tart = cake
Potato salad = starch + fat
Noodles egg cooked = starch
Koussa in oil = vegetables + oil
Cheese tortellini Alfredo Stouffers = composite western
Tajen = composite traditional
Frozen pops chocolate/vanilla = ice cream
Foust'ieh = Arabic sweets
Pasta, macaroni, vegetables, cooked = composite western
Adas bi zeit = composite traditional
Quiche Lorraine – frozen dinner – Mrs Smith = composite western
Milk chocolate cocoa homemade = beverages
Shish barak laban only = milk
Fish oven fried = meat
Snoubrieh = Arabic sweets
Candy chocolate coated peanuts = chocolate
Chicken burger patty = meat
Beef stew with vegetables = composite traditional
Falafel grilled = composite traditional
Tomato juice = vegetables
Lebanese yakhneit (loubieh w riz,etc..) = stew only as composite traditional, rice as starch and beef as meat
Salade de pates without dressing = starch
Potato kebbeh = composite traditional
Chicken cordon bleu – Le Menu = fast food
Beef frankfurter = meat
Soup (rice + meat + carrot) = composite traditional
Candy – fudge – chocolate plain = other desserts
Sandwich – chicken with French bread = fast food
Pummelo = fruits
Pasta – noodles – egg – enriched – cooked = starch
Shawarma = meat
Salad dressing (Italian) = fat
Candy – raisainettes – chocolate coated = other desserts
Candy – chocolate coated peanuts = other desserts
Koussa omelette = composite traditional
Ravioli beef in red sauce = western composite
Crab salad = meat + vegetables
Baby food – chicken stew – strained (like canned soups) = fast food
Pasta – carbonara – Stouffers = composite western
Garlic dip – Kraft = fat
Chicken cordon bleu = meat + fat
Salade panache = vegetables + fat

Appendix O

Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (Ipaq)

– Short and Long Forms

November 2005

Contents

1. Introduction

This document describes recommended methods of scoring the data derived from the telephone / interview administered and self-administered IPAQ short and long form instruments. The methods outlined provide a revision to earlier scoring protocols for the IPAQ short form and provide for the first time a comparable scoring method for IPAQ long form. Latest versions of IPAQ instruments are available from www.ipaq.ki.se.

Although there are many different ways to analyse physical activity data, to date there is no formal consensus on a 'correct' method for defining or describing levels of physical activity based on self–report population surveys. The use of different scoring protocols makes it very difficult to compare within and between countries, even when the same instrument has been used. Use of these scoring methods will enhance the comparability between surveys, provided identical sampling and survey methods have been used.

2. Uses of IPAQ Instruments

IPAQ short form is an instrument designed primarily for population surveillance of physical activity among adults. It has been developed and tested for use in adults (age range of 15-69 years) and until further development and testing is undertaken the use of IPAQ with older and younger age groups is not recommended.

IPAQ short and long forms are sometimes being used as an evaluation tool in intervention studies, but this was not the intended purpose of IPAQ. Users should carefully note the range of domains and types of activities included in IPAQ before using it in this context. Use as an outcome measure in small scale intervention studies is not recommended.

3. Summary Characteristics of IPAQ Short and Long Forms

1. IPAQ assesses physical activity undertaken across a comprehensive set of domains including:
   a. leisure time physical activity
   b. domestic and gardening (yard) activities
   c. work-related physical activity
   d. transport-related physical activity;

2. The IPAQ **short** form asks about three specific types of activity undertaken in the four domains introduced above. The specific types of activity that are assessed are walking, moderate-intensity activities and vigorous-intensity activities.
3. The items in the **short** IPAQ form were structured to provide separate scores on walking, moderate-intensity and vigorous-intensity activity. Computation of the total score for the short form requires summation of the duration (in minutes) and frequency (days) of walking, moderate-intensity and vigorous-intensity activities. Domain specific estimates cannot be estimated.
4. The IPAQ **long** form asks details about the specific types of activities undertaken within each of the four domains. Examples include walking for transportation and moderate-intensity leisure-time activity.
5. The items in the **long** IPAQ form were structured to provide separate domain

specific scores for walking, moderate-intensity and vigorous-intensity activity within each of the work, transportation, domestic chores and gardening (yard) and leisure-time domains. Computation of the total scores for the long form requires summation of the duration (in minutes) and frequency (days) for all the types of activities in all domains. Domain specific scores or activity specific sub-scores may be calculated. Domain specific scores require summation of the scores for walking, moderate-intensity and vigorous-intensity activities within the specific domain, whereas activity-specific scores require summation of the scores for the specific type of activity across domains.

4. Overview of Continuous and Categorical Analyses of IPAQ

Both categorical and continuous indicators of physical activity are possible from both IPAQ forms. However, given the non-normal distribution of energy expenditure in many populations, it is suggested that the continuous indicator be presented as median minutes/week or median MET–minutes/week rather than means (such as mean minutes/week or mean MET-minutes/week).

4.1 Continuous Variables

Data collected with IPAQ can be reported as a continuous measure. One measure of the volume of activity can be computed by weighting each type of activity by its energy requirements defined in METs to yield a score in MET–minutes. METs are multiples of the resting metabolic rate and a MET-minute is computed by multiplying the MET score of an activity by the minutes performed. MET-minute scores are equivalent to kilocalories for a 60 kilogram person. Kilocalories may be computed from MET-minutes using the following equation: MET-min x (weight in kilograms/60 kilograms). MET-minutes/day or MET-minutes/week can be presented although the latter is more frequently used and is thus suggested.

Details for the computation for summary variables from IPAQ short and long forms are detailed below. As there are no established thresholds for presenting MET-minutes, the IPAQ Research Committee propose that these data are reported as comparisons of median values and interquartile ranges for different populations.

4.2 Categorical Variable: Rationale for Cut Point Values

There are three levels of physical activity proposed to classify populations:
1. Low
2. Moderate
3. High

The algorithms for the short and long forms are defined in more detail in Sections 5.3 and 6.3, respectively. Rules for data cleaning and processing prior to computing the algorithms appear in Section 7.

Regular participation is a key concept included in current public health guidelines for physical activity.[1] Therefore, both the total volume and the number of days/sessions are included in the IPAQ analysis algorithms.

The criteria for these levels have been set taking into account that IPAQ asks questions in all domains of daily life, resulting in higher median MET-minutes estimates than would have been estimated from leisure-time participation alone. The criteria for these three levels are shown below.

Given that measures such as IPAQ assess total physical activity in all domains, the "leisure time physical activity" based public health recommendation of 30 minutes on most days will be achieved by most adults in a population. Although widely accepted as a goal, in absolute terms 30 minutes of moderate-intensity activity is low and broadly equivalent to the background or basal levels of activity adult individuals would accumulate in a day. Therefore a new, higher cutpoint is needed to describe the levels of physical activity associated with health benefits for measures such as IPAQ, which report on a broad range of domains of physical activity.

'High'

This category was developed to describe higher levels of participation. Although it is known that greater health benefits are associated with increased levels of activity there is no consensus on the exact amount of activity for maximal benefit. In the absence of any established criteria, the IPAQ Research Committee proposes a measure which equates to approximately at least one hour per day or more, of at least moderate-intensity activity above the basal level of physical activity Considering that basal activity may be considered to be equivalent to approximately 5000 steps per day, it is proposed that "high active" category be considered as those who move at least 12,500 steps per day, or the equivalent in moderate and vigorous activities. This represents at least an hour more moderate-intensity activity over and above the basal level of activity, or half an hour of vigorous-intensity activity over and above basal levels daily. These calculations were based on emerging results of pedometers studies.[2]

This category provides a higher threshold of measures of total physical activity and is a useful mechanism to distinguish variation in population groups. Also it could be used to set population targets for health-enhancing physical activity when multi-domain instruments, such as IPAQ are used.

[1] Pate RR, Pratt M, Blair SN, Haskell WL , Macera CA, Bouchard C et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of American Medical Association* 1995; 273(5):402-7. and U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General.* Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, The Presidents' Council on Physical Fitness and Sports: Atlanta, GA:USA. 1996. [2] Tudor-Locke C, Bassett DR Jr. How many steps/day are enough? Preliminary pedometer indices for public health. Sports Med. 2004;34(1):1-8.

'Moderate'

This category is defined as doing some activity, more than the low active category. It is proposed that it is a level of activity equivalent to "half an hour of at least moderate-intensity PA on most days", the former leisure time-based physical activity population health recommendation.

'Low'

This category is simply defined as not meeting any of the criteria for either of the previous categories.

5. Protocol for IPAQ Short Form

5.1 Continuous Scores

Median values and interquartile ranges can be computed for walking (W), moderate-intensity activities (M), vigorous-intensity activities (V) and a combined total physical activity score. All continuous scores are expressed in MET-minutes/week as defined below.

5.2 MET Values and Formula for Computation of MET-minutes/week

The selected MET values were derived from work undertaken during the IPAQ Reliability Study undertaken in 2000-2001[3]. Using the Ainsworth et al. Compendium (*Med Sci Sports Med* 2000) an average MET score was derived for each type of activity. For example; all types of walking were included and an average MET value for walking was created. The same procedure was undertaken for moderate-intensity activities and vigorous-intensity activities. The following values continue to be used for the analysis of IPAQ data: Walking = 3.3 METs, Moderate PA = 4.0 METs and Vigorous PA = 8.0 METs. Using these values, four continuous scores are defined:

Walking MET-minutes/week = 3.3 * walking minutes * walking days Moderate MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate days Vigorous MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days Total physical activity MET-minutes/week = sum of Walking + Moderate + Vigorous METminutes/week scores.

5.3 Categorical Score

Category 1 Low

This is the lowest level of physical activity. Those individuals who not meet criteria for Categories 2 or 3 are considered to have a 'low' physical activity level.

[3] Craig CL,Marshall A , Sjostrom M et al. International Physical Activity Questionnaire: 12 country reliability and validity *Med Sci Sports Exerc* 2003;August

Category 2 Moderate

The pattern of activity to be classified as ‘moderate’ is either of the following criteria: a) 3 or more days of vigorous-intensity activity of at least 20 minutes per day

OR

b) 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day

OR

c) 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum Total physical activity of at least 600 MET-minutes/week.

Individuals meeting at least one of the above criteria would be defined as accumulating a minimum level of activity and therefore be classified as ‘moderate’. See Section 7.5 for information about combining days across categories.

Category 3 High

A separate category labelled ‘high’ can be computed to describe higher levels of participation. The two criteria for classification as ‘high’ are:

a) vigorous-intensity activity on at least 3 days achieving a minimum Total physical activity of at least 1500 MET-minutes/week

OR

b) 7 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum Total physical activity of at least 3000 MET-minutes/week.

See Section 7.5 for information about combining days across categories.

5.4 Sitting Question in IPAQ Short Form

The IPAQ sitting question is an additional indicator variable of time spent in sedentary activity and is not included as part of any summary score of physical activity. Data on sitting should be reported as median values and interquartile ranges. To-date there are few data on sedentary (sitting) behaviours and no well-accepted thresholds for data presented as categorical levels.

6. Protocol for IPAQ Long Form

The long form of IPAQ asks in detail about walking, moderate-intensity and vigorous-intensity physical activity in each of the four domains. Note: asking more detailed questions regarding physical activity within domains is likely to produce higher prevalence estimates than the more generic IPAQ short form.

6.1 Continuous Score

Data collected with the IPAQ long form can be reported as a continuous measure and reported as median MET-minutes. Median values and interquartile ranges can be computed for walking (W), moderate-intensity activities (M), and vigorous-intensity activities (V) within each domain using the formulas below. Total scores may also be calculated for walking (W), moderate-intensity activities (M), and vigorous-intensity activities (V); for each domain (work, transport, domestic and garden, and leisure) and for an overall grand total.

6.2 MET Values and Formula for Computation of MET-minutes

Work Domain

Walking MET-minutes/week at work = 3.3 * walking minutes * walking days at work
Moderate MET-minutes/week at work= 4.0 * moderate-intensity activity minutes * moderate-intensity days at work
Vigorous MET-minutes/week at work= 8.0 * vigorous-intensity activity minutes * vigorous-intensity days at work
Total Work MET-minutes/week =sum of Walking + Moderate + Vigorous MET-minutes/week scores at work.

Active Transportation Domain

Walking MET-minutes/week for transport = 3.3 * walking minutes * walking days for transportation
Cycle MET-minutes/week for transport= 6.0 * cycling minutes * cycle days for transportation
Total Transport MET-minutes/week = sum of Walking + Cycling MET-minutes/week scores for transportation.

Domestic and Garden [Yard Work] Domain

Vigorous MET-minutes/week yard chores= 5.5 * vigorous-intensity activity minutes * vigorous-intensity days doing yard work (**Note**: the MET value of 5.5 indicates that vigorous garden/yard work should be considered a moderate-intensity activity for scoring and computing total moderate intensity activities.)
Moderate MET-minutes/week yard chores= 4.0 * moderate-intensity activity minutes * moderate-intensity days doing yard work
Moderate MET-minutes/week inside chores= 3.0* moderate-intensity activity minutes * moderate-intensity days doing inside chores.
Total Domestic and Garden MET-minutes/week =sum of Vigorous yard + Moderate yard + Moderate inside chores MET-minutes/week scores.

Leisure-Time Domain

Walking MET-minutes/week leisure = 3.3 * walking minutes * walking days in leisure
Moderate MET-minutes/week leisure = 4.0 * moderate-intensity activity minutes * moderate-intensity days in leisure
Vigorous MET-minutes/week leisure = 8.0 * vigorous-intensity activity minutes * vigorous-intensity days in leisure
Total Leisure-Time MET-minutes/week = sum of Walking + Moderate + Vigorous MET-minutes/week scores in leisure.

Total Scores for all Walking, Moderate and Vigorous Physical Activities

Total Walking MET-minutes/week = Walking MET-minutes/week (at Work + for Transport + in Leisure) Total Moderate MET-minutes/week total = Moderate MET-minutes/week (at Work + Yard chores + inside chores + in Leisure time) + Cycling Met-minutes/week for Transport + Vigorous Yard chores MET-minutes/week Total Vigorous MET-minutes/week = Vigorous MET-minutes/week (at Work + in Leisure)

Note: Cycling MET value and Vigorous garden/yard work MET value fall within the coding range of moderate-intensity activities.

Total Physical Activity Scores

An overall total physical activity MET-minutes/week score can be computed as: Total physical activity MET-minutes/week = sum of Total (Walking + Moderate + Vigorous) MET minutes/week scores. This is equivalent to computing: Total physical activity MET-minutes/week = sum of Total Work + Total Transport + Total Domestic and Garden + Total Leisure-Time MET-minutes/week scores.

As there are no established thresholds for presenting MET-minutes, the IPAQ Research Committee proposes that these data are reported as comparisons of median values and interquartile ranges for different populations.

6.3 Categorical Score

As noted earlier, regular participation is a key concept included in current public health guidelines for physical activity.[4] Therefore, both the total volume and the number of day/sessions are included in the IPAQ analysis algorithms. There are three levels of physical activity proposed to classify populations – 'low', 'moderate', and 'high'. The criteria for these levels are the same as for the IPAQ short [described earlier in Section 4.2]

Category 1 Low

This is the lowest level of physical activity. Those individuals who not meet criteria for Categories 2 or 3 are considered 'low'.

Category 2 Moderate

The pattern of activity to be classified as 'moderate' is either of the following criteria: d) 3 or more days of vigorous-intensity activity of at least 20 minutes per day

OR

e) 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day

OR

[4] Pate RR, Pratt M, Blair SN, Haskell WL , Macera CA, Bouchard C et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of American Medical Association* 1995; 273(5):402-7. and U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General.* Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, The Presidents' Council on Physical Fitness and Sports: Atlanta, GA:USA. 1996.

f) 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum Total physical activity of at least 600 MET-minutes/week.

Individuals meeting at least one of the above criteria would be defined as accumulating a moderate level of activity. See Section 7.5 for information about combining days across categories.

Category 3 High

A separate category labelled 'high' can be computed to describe higher levels of participation. The two criteria for classification as 'high' are:

a) vigorous-intensity activity on at least 3 days achieving a minimum Total physical activity of at least 1500 MET-minutes/week

OR

b) 7 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum Total physical activity of at least 3000 MET-minutes/week.

See Section 7.5 for information about combining days across categories.

6.4 IPAQ Sitting Question IPAQ Long Form

The IPAQ sitting question is an additional indicator variable and is not included as part of any summary score of physical activity. To-date there are few data on sedentary (sitting) behaviours and no well-accepted thresholds for data presented as categorical levels. For the sitting question 'Minutes' is used as the indicator to reflect time spent in sitting rather than MET-minutes which would suggest an estimate of energy expenditure.

IPAQ long assesses an estimate of sitting on a typical weekday, weekend day and time spent sitting during travel (see transport domain questions).

Summary sitting variables include

Sitting Total Minutes/week = weekday sitting minutes* 5 weekdays + weekend day sitting minutes* 2 weekend days

Average Sitting Total Minutes/day = (weekday sitting minutes* 5 weekdays + weekend day sitting minutes* 2 weekend days) / 7

Note: The above calculation of 'Sitting Total' excludes time spent sitting during travel because the introduction in IPAQ long directs the responder to NOT include this component as it would have already been captured under the Transport section. If a summary sitting variable including time spent sitting for transport is required, it should be calculated by adding the time reported (travelling in a motor vehicle) under transport to the above formula. Care should be taken in reporting these alternate data to clearly distinguish the 'total sitting' variable from a 'total sitting – including transport' variable.

7. Data Processing Rules

In addition to a standardized approach to computing categorical and continuous measures of physical activity, it is necessary to undertake standard methods for the cleaning and treatment of IPAQ datasets. The use of different approaches and rules would introduce variability and reduce the comparability of data.

There are no established rules for data cleaning and processing on physical activity. Thus, to allow more accurate comparisons across studies IPAQ Research Committee has established and recommends the following guidelines:

7.1 Data Cleaning

I. Any responses to duration (time) provided in the hours and minutes response option should be converted from hours and minutes into minutes.

II. To ensure that responses in 'minutes' were not entered in the 'hours' column by mistake during self-completion or during data entry process, values of '15', '30', '45', '60' and '90' in the 'hours' column should be converted to '15', '30', '45', '60' and '90' minutes, respectively, in the minutes column.

III. In some cases duration (time) will be reported as weekly (not daily) e.g., VWHRS, VWMINS. These data should be converted into an average daily time by dividing by 7.

IV. If 'don't know' or 'refused ' or data are missing for time or days then that case is removed from analysis.

Note: Both the number of days *and* daily time are required for the creation of categorical and continuous summary variables

7.2 Maximum Values for Excluding Outliers

This rule is to exclude data which are unreasonably high; these data are to be considered outliers and thus are excluded from analysis. All cases in which the sum total of all Walking, Moderate and Vigorous time variables is greater than 960 minutes (16 hours) should be excluded from the analysis. This assumes that on average an individual of 8 hours per day is spent sleeping.

The 'days' variables can take the range 0-7 days, or 8, 9 (don't know or refused); values greater than 9 should not be allowed and those cases excluded from analysis.

7.3 Minimum Values for Duration of Activity

Only values of 10 or more minutes of activity should be included in the calculation of summary scores. The rationale being that the scientific evidence indicates that episodes or bouts of at least 10 minutes are required to achieve health benefits. Responses of less than 10 minutes [and their associated days] should be re-coded to 'zero'.

7.4 Truncation of Data Rules

This rule attempts to normalize the distribution of levels of activity which are usually skewed in national or large population data sets.

In IPAQ short - it is recommended that all Walking, Moderate and Vigorous time variables exceeding ‘ 3 hours’ or ‘180 minutes’ are truncated (that is re-coded) to be equal to ‘180 minutes’ in a new variable. This rule permits a maximum of 21 hours of activity in a week to be reported for each category (3 hours * 7 days).

In IPAQ long – the truncation process is more complicated, but to be consistent with the approach for IPAQ short requires that the variables total Walking, total Moderate-intensity and total Vigorous-intensity activity are calculated and then, for each of these summed behaviours, the total value should be truncated to 3 hours (180 minutes).

When analysing the data as categorical variable or presenting median and interquartile ranges of the MET-minute scores, the application of the truncation rule will not affect the results. This rule does have the important effect of preventing misclassification in the ‘high’ category. For example, an individual who reports walking for 10 minutes on 6 days and 12 hours of moderate activity on one day could be coded as ‘high’ because this pattern meets the ‘7 day” and “3000 MET-min” criteria for ‘high’. However, this uncommon pattern of activity is unlikely to yield the health benefits that the ‘high’ category is intended to represent.

Although using median is recommended due to the skewed distribution of scores, if IPAQ data are analysed and presented as a continuous variable using mean values, the application of the truncation rule will produce slightly lower mean values than would otherwise be obtained.

7.5 Calculating MET-minute/week Scores

Data processing rules 7.2, 7.3, and 7.4 deals first with excluding outlier data, then secondly, with recoding minimum values and then finally dealing with high values. These rules will ensure that highly active people remain classified as ‘high’, while decreasing the chances that less active individuals are misclassified and coded as ‘high’.

Using the resulting variables, convert time and days to MET-minute/week scores [see above Sections 5.2 and 6.2; METS x days x daily time].

7.6 Calculating Total Days for Presenting Categorical Data on Moderate and High Levels

Presenting IPAQ data using categorical variables requires the total number of ‘days’ on which all physical activity was undertaken to be assessed. This is difficult because frequency in ‘days’ is asked separately for walking, moderate-intensity and vigorous-intensity activities, thus allowing the total number of ‘days’ to range from a minimum of 0 to a maximum of 21’days’ per week in IPAQ short and higher in IPAQ long. The IPAQ instrument does not record if different types of activity are undertaken on the same day.

In calculating 'moderately active', the primary requirement is to identify those individuals who undertake activity on at least '5 days'/week [see Sections 4.2 and 5.3]. Individuals who meet this criterion should be coded in a new variable called "*at least five days"* and this variable should be used to identify those meeting criterion b) at least 30 minutes of moderate-intensity activity and/or walking; and those meeting criterion c) any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of 600 MET-minutes/week.

Below are two examples showing this coding in practice: i) an individual who reports '2 days of moderate-intensity' and '3 days of walking' should be coded as a value indicating "*at least five days"*;

ii) an individual reporting '2 days of vigorous-intensity', '2 days of moderate-intensity' and '2 days of walking should be coded as a value to indicate "*at least five days"* [even though the actual total is 6].

The original frequency of 'days' for each type of activity should remain in the data file for use in the other calculations.

The same approach as described above is used to calculate total days for computing the 'high' category. The primary requirement according to the stated criteria is to identify those individuals who undertake a combination of walking, moderate-intensity and or vigorous-intensity activity on at least 7 days/week [See section 4.2]. Individuals who meet this criterion should be coded as a value in a new variable to reflect *"at least 7 days*".

Below are two examples showing this coding in practice: i) an individual who reports '4 days of moderate-intensity' and '3 days of walking' should be coded as the new variable *"at least 7 days*".

ii) an individual reporting '3 days of vigorous-intensity', '3 days moderate-intensity' and '3 days walking' should be coded as *"at least 7 days*" [even though the total adds to 9] .

8. Summary algorithms

The algorithms in Appendix 1 and Appendix 2 to this document show how these rules work in an analysis plan, to develop the categories 1 [Low], 2 [Moderate], and 3 [High] levels of activity.

IPAQ Research Committee November 2005

Appendix 1

At A Glance Ipaq Scoring Protocol (Short Forms)

Continuous Score

Expressed as MET-min per week: MET level x minutes of activity/day x days per week

MET levels
Walking = 3.3 METs Moderate Intensity = 4.0 METs Vigorous Intensity = 8.0 METs
Sample Calculation

MET-minutes/week for 30 min/day, 5 days
3.3*30*5 = 495 MET-minutes/week 4.0*30*5 = 600 MET-minutes/week
8.0*30*5 = 1,200 MET-minutes/week
____________________________ TOTAL = 2,295 MET-minutes/week

Total MET-minutes/week = Walk (METs*min*days) + Mod (METs*min*days)
+ Vig (METs*min*days)

Categorical Score- three levels of physical activity are proposed

1. <u>Low</u>

- No activity is reported **OR**
- Some activity is reported but not enough to meet Categories 2 or 3.

2. <u>Moderate</u>

Either of the following 3 criteria

- 3 or more days of vigorous activity of at least 20 minutes per day **OR**
- 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day **OR**
- 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes/week.

3. <u>High</u>

Any one of the following 2 criteria

- Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week **OR**
- 7 or more days of any combination of walking, moderate- or vigorous-intensity activities accumulating at least 3000 MET-minutes/week

Please review the full document "Guidelines for the data processing and analysis of the International Physical Activity Questionnaire" for more detailed description of IPAQ analysis and recommendations for data cleaning and processing [www.ipaq.ki.se].

Appendix 2

At A Glance Ipaq Scoring Protocol (Long Forms)

Continuous Score

Expressed as MET-minutes per week: MET level x minutes of activity/day x days per week

Sample Calculation

MET levels MET-minutes/week for 30 min/day, 5 days
Walking at work= 3.3 METs 3.3*30*5 = 495 MET-minutes/week Cycling for transportation= 6.0 METs 6.0*30*5 = 900 MET-minutes/week Moderate yard work= 4.0 METs 4.0*30*5 = 600 MET-minutes/week Vigorous intensity in leisure= 8.0 METs 8.0*30*5 = 1,200 MET-minutes/week

TOTAL = 3,195 MET-minutes/week

Domain Sub Scores Total MET-minutes/week at **work** = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days) at work

Total MET-minutes/week for **transportation** = Walk (METs*min*days) + Cycle (METs*min*days) for transportation

Total MET-minutes/week from **domestic and garden** = Vig (METs*min*days) yard work + Mod (METs*min*days) yard work + Mod (METs*min*days) inside chores

Total MET-minutes/week in **leisure-time** = Walk (METs*min*days) + Mod (METs*min*days)
+ Vig (METs*min*days) in leisure-time

Walking, Moderate-Intensity and Vigorous-Intensity Sub Scores

Total **Walking** MET-minutes/week = Walk MET-minutes/week (at Work + for Transport + in Leisure)

Total **Moderate** MET-minutes/week = Cycle MET-minutes/week for Transport + Mod METminutes/week (Work + Yard chores + Inside chores + Leisure) + Vigorous Yard chores MET-minutes

Note: The above is a total moderate activities only score. If you require a total of all moderate-intensity physical activities you would sum Total Walking and Total Moderate

Total **Vigorous** MET-minutes/week = Vig MET-minutes/week (at Work + in Leisure)

Total Physical Activity Score **Total** Physical Activity MET-minutes/week = **Walking** MET-minutes/week + **Moderate** METminutes/week + Total **Vigorous** MET-minutes/week

Continued………..

Also

Total Physical Activity MET-minutes/week = Total MET-minutes/week (at Work + for Transport + in Chores + in Leisure)

Categorical Score- three levels of physical activity are proposed

1. <u>Low</u>

No activity is reported **OR**
a. Some activity is reported but not enough to meet Categories 2 or 3.

2. <u>Moderate</u>

Either of the following 3 criteria
a. 3 or more days of vigorous-intensity activity of at least 20 minutes per day **OR**
b. 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day **OR**
c. 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-min/week.

3. <u>High</u>

Any one of the following 2 criteria

- Vigorous-intensity activity on at least 3 days and accumulating at least 1500 MET-minutes/week **OR**
- 7 or more days of any combination of walking, moderate- or vigorous- intensity activities accumulating at least 3000 MET-minutes/week

Please review the full document "Guidelines for the data processing and analysis of the International Physical Activity Questionnaire" for more detailed description of IPAQ analysis and recommendations for data cleaning and processing [www.ipaq.ki.se].

Appendix P

Description of Variables Used in the Study and their Coding

Table 1 Description of Anthropometric[1] Variables used in the study analysis (n=2608)

Variable Name	Questionnaire "Anthropometry Measurement Data"	Computation	Variable Recoding
Body Mass Index	• Weight(kg) • Height(cm)	• weight (Kg)/height (m^2)	• Ideal 18.5-24.9 • Overweight 18.25-24.9 • Obese ≥30 (Classified according to WHO cutoffs)*
Percent Body Fat	Skinfold Thickness(mm): • Biceps • Triceps • Subscapular • Suprailiac	Computed according to Siri equation * • *% body fat =(495÷body density[@])-450* Age and gender specific body density determined using Durnin & Womersley[@] equations using log∑ of skinfold thicknesses	• Don't have elevated % BF (M<25%, W<32%) • Have elevated % BF (M≥25%, W≥32%) Missing cases=47
Waist Circumference	Waist circumference(cm)	NA	• Don't have elevated Waist Circumference (M≤94,W≤80cm) • Have elevated Waist Circumference (M≥94,W≥80cm) Missing cases=9

[1] Anthropometric variables were measured by the interviewer at the time of interview in the household
[@]Durnin, J. V., & Womersley, J. (1974); *Lee, R. D., & Nieman, D. C. (2007).
*(World Health Organization, 2004)

Table 2. Description of Socio-demographic Variables[1] used in the study

Variable Name	Questionnaire Codes	Variable recoding
Sex	• Male • Female	• Male • Female
Age	• Birth date or • Age in years at the date of household visit	-Coded into 10 year age groups for descriptive analysis: 20-29, 30-39, 40-49, 50-59, 60-69 and 70+ year -Coded into 3 age strata for regression analysis: • Young adults: 20- 39 years • Midlife adulthood: 40-49 years • Older adults≥65 years
Marital Status	• Single, • Married • Divorced • Separated • Widowed • Refused to answer	-Coded into 3 categories for descriptive analysis: • Single • Married • Divorced/Separated/ Widowed -Coded into 2 categories for regression analysis: • Single (Never Married) • Married (includes those who reported being married, divorced, separated, widowed) Missing cases=2
Education	Educational Level • Illiterate • Reads and Write • Elementary School • Middle School • High School • Technical Diploma • Bachelor • Higher education(MSc, PhD) • Don't know\Refused to Answer*	-Coded into 4 categories for descriptive analysis: • Preliminary or less(includes illiterate, reads & writes, elementary) • Complimentary(Middle School) • High School/Diploma(High school and Technical Diploma) • University(Bachelor and higher education) -Coded into 3 categories for regression analysis (young and midlife adults) • Primary and lower (illiterate, reads and writes, elementary) • Intermediate/Secondary/Tech(Middle & High School, Technical) • University(Bachelor, higher education) -Coded into 2 categories for regression analysis (Older adults) • Primary and lower(illiterate, reads and writes, elementary) • Intermediate and higher (Middle & High School,Technical, Bachelor, higher education) Refused to answer as missing cases=0

Table 2 Cont'd: Description of Socio-demographic Variables used in the study

Variable Name	Codes	Variable recoding
Work Status	Occupation • Not working(housewife) • Governmental employee • Nongovernmental employee • Self-employed • Volunteer work • Student • Retired • Unemployed(can work) • Unemployed(Can't work) • Refused to answer*	-Coded into 5 categories for descriptive analysis: • Does not work+ retired (includes housewife, retired, unemployed-can work-,unemployed-can't work) • Government employee • Private sector employee(Nongovernmental employee) • Self-employed • Student/volunteer work -Coded into 3 categories for regression analysis: • Does not work(housewife, retired, unemployed-can work, unemployed-can't work, student, volunteer work) • Employee(Government and nongovernmental employee) • Self-employed Refused to answer as missing cases=1
Income per month (in Lebanese Pounds)	• < 1 million • 1-3 Million • 3.1 Million-6 Million • 6.1 Million-8 Million • >8 Million • Don't Know • Refused to answer	-Coded into 3 categories according to the study population Mean Income • <1 Million • 1-3 Million • >3 Million Don't know & refused to answer considered as missing cases=233
Self-perceived socio-economic status (SES_self)	• Low • Medium • High • Don't know • Refused to answer	-Coded into 3 categories • Low • Medium • High (don't know & refused to answer were not reported by participants)
House ownership Your house is:	• Family's property • My property • Rented • Relative's/friend's property • Don't know • Refused to answer	-Coded into two variables: • Owns house(family's or own property) • Rents house(rented or relative's / friend's house) (don't know & refused to answer were not reported by participants)
Assets in the house: Does the family have:	• Fridge • washing machine • oven, television • air-condition • DVD player • computer	-Coded into : • Has all 7 items of household assets • Does not have all household assets(<7 items) Refused to answer and don't know considered as missing cases= 7

Table 2 Cont'd: Description of Socio-demographic Variables used in the study

Variable Name	**Codes**	**Variable recoding**
Car ownership	Doesn't own a car • Owns 1 car • Owns 2 cars • Owns 3 cars • Owns 4 cars • Owns more than 4 cars • Don't know / Refused to answer •	-Coded into : • Does not have a car • Have 1 or more cars (don't know & refused to answer as missing cases= 10)
Mobile phone ownership	• Yes • No • Refused to answer	• Yes • No (Refused to answer treated as missing cases=8)
Household Assets (as an indicator of wealth status)	Assets in the house + car ownership +Mobile phone ownership	-Recoded for descriptive and regression analysis (young midlife adulthood strata): • <7 items (Don't have all HH essentials) • 7-8 items (Have all essentials +car or mobile) • ≥9 items (Have all essentials +car + mobile) -Recoded into two categories for regression analysis(≥65 years age stratum) according to frequency: • <7 items (Don't have all HH essentials) • ≥7items(have all HH essentials)
Number of persons living in the house(excluding servants) **Number of rooms in the house (excluding kitchen, bathroom, open balcony and garage)**	----------persons Don't know, refused to answer ----------Rooms Don't know, refused to answer	**Both variables coded into the Crowding index calculated as the number of persons in the household divided by the number of rooms CI (crowding index)** • <1 person/room • ≥ 1 person/room (Don't know and reused to answer treated as missing cases=16)

[1]**Sociodemographic variables were self reported at interview**

Table 3 Description of lifestyle and dietary variables[1] used in the study

Variable Name	Codes	Variable recoding
Smoking Cigarettes: Smokes or used to smoke cigarettes	• No, never smoked • Yes, currently smokes • Used to smoke and stopped • Refuses to answer	-Coded into • Never smoker • Current or past smoker (refuses to answer as Never smoker)
Smoking water pipe(hooka): currently smokes	• No, never smoked • Yes, currently smokes • Refuses to answer	-Coded into • Never smoker • Current or past smoker (refuses to answer as Never smoker)
Smoking (cigarettes and /or hooka)	Both previous smoking variables combined **Smoking Cigarettes + Smoking hooka**	• No (Never smoker of cigarettes or hooka) • Yes (current or past smoker of cigarettes or hooka)
Alcohol Consumption; Had an alcoholic beverage in the past 12 months	• Yes • No • Don't recall, not sure • Refuses to answer	-Coded to : • Yes • No don't recall+ refused to answer as No
Alcohol frequency: Number of days per week participant consumed alcoholic beverages	• Only in occasions • Less than once per week • 1-2 times per week • 3-4 times per week • 5-6 times per week • Daily • Don't know • Refused to answer	-Coded to: • No alcohol (Includes all those who replied No to alcohol consumption variable) • <once per week(Only in occasions + less than once per week) • ≥ 1-2 times per week (Variable used only in univariate regression)
Alcohol amount : drinks /time	• Quantity at one time----------- • Don't know • Refused to answer	**According to Mean drinks/time coded to:** • No alcohol(Includes all those who replied No to alcohol consumption variable) • 1-2 drinks/time • 3 or more drinks /time (Variable used only in univariate regression)

Table 3 (Cont'd): Description of lifestyle and dietary variables used in the study

Variable Name	Codes	Variable recoding
Physical Activity	• IPAQ short form (Appendix N)	-Computed and coded according to IPAQ scoring protocol: • **Low:** No activity or not enough to meet next categories • **Moderate:** Minimal activity(activities achieving at least 600 MET$^{@}$ min/week • **High**: health enhancing physical activity; activities accumulating at least 1500-3000 MET min/week Missing cases=60
Siting hours	• IPAQ short form	**-**Coded to two categories according to Median value: • <10 hours sitting/d • ≥10 hours/day Missing cases=60
Energy Consumption(KJ) **(all participants excluding underweight subjects and those with missing BMI_)** **Energy Consumption(KJ)** **(Plausible repororters of energy intake)**	• Computed from participants' collected Single 24 hour recall Subjects who reported that their 24 hour recall is not representative of their intake due to sickness, dieting, busy days, etc., were considered as missing cases	-Coded into tertiles (by gender) for all reporters **Females** • Low (<5000) • Moderate (5000-7500) • High (>7500) **Males** • Low(<7000) • Moderate(7000-10500) • High(>10500) **Missing cases =68** -Coded into tertiles (by gender) for plausible reporters **Females** • Low (<6267) • Moderate (6267-8368) • High (>8368) **Males** • Low(<8368) • Moderate(8368-11297) • High(>11297)

Table 3 (Cont'd): Description of lifestyle and dietary variables used in the study

Variable Name	Codes	Variable recoding
Energy Consumption form fat	Computed as % of total energy(KJ)	-Coded into tertiles (both genders) • Low (<32) • Moderate (32-42) • High (>42)
Energy Consumption form Carbohydrates	Computed as % of total energy(KJ)	-Coded into tertiles (both genders) • Low (<45) • Moderate (45-65) • High (>65)
Energy Consumption form Proteins	Computed as % of total energy(KJ)	-Coded into tertiles (both genders) • Low (<12) • Moderate (12-15) • High (>15)
Consumption of regular meals Do you usually eat Breakfast Do you usually eat Lunch Do you usually eat Dinner	Derived by **combining questions on consumption of breakfast, lunch and dinner per day:** • Never • Sometimes • Regularly everyday	**-**Coded combining all three meals into: • Yes (regularly every day) • No (Never, Sometimes) **(Those who replied "regularly every day" to all meals were coded as YES consuming regular meals)** **(Those who skipped one or more meal were coded as No)** Missing cases=5
Frequent snacking: Do you eat small snacks?	• Never • Sometimes:------times /week • Regularly every day	-Coded to: • No: None or infrequent day to day snacking (Never+ sometimes) • Yes**:** Regular Daily Snacking(regularly everyday)
Number of Snacks/day: How many snacks do you eat daily?	• 1 • 2 • 3 • 4 • More than 4, specify	-Coded to: • 1-3 snacks/day • >3 snacks /d

Table 3 (Cont'd): Description of lifestyle and dietary variables used in the study

Variable Name	Codes	Variable recoding
Eating at TV: Do you eat while watching TV?	• I don't watch TV • Never • Sometimes • Most of the times	-Coded to: • Yes **:** sometimes, most of the times • No **:** I don't watch TV, never
Trying to increase PA: Are you trying to start or increase your physical activity?	• Yes • No • I don't know • Refused to answer	-Coded to • Yes • No • I don't know, refused to answer as missing cases=1
Trying to decrease fat consumption: Are you trying to decrease your fat intake?	• Yes • No • I don't know • Refused to answer	-Coded to • Yes • No • I don't know, refused to answer as missing cases=0
Trying to decrease sugar consumption	• Yes • No • I don't know • Refused to answer	-Coded to • Yes • No • I don't know, refused to answer as missing cases=2
Trying to increase fruits & vegetable consumption	• Yes • No • I don't know • Refused to answer	-Coded to • Yes • No • I don't know, refused to answer as No
Family history of obesity: **Is any of your family members or relatives overweight or obese?** Family includes closest of kin: mother, father, sister, brother, grandparents, uncles & aunts	• Yes • No • Don't know • Refused to answer	-Coded to • Yes • No • I don't know, refused to answer as missing cases=8

[1]Lifestyle Variables were self reported by the participant. Dietary Variables were computed from the collected 24 hour recall
@MET=Metabolic equivalents, Met minutes expresses the intensity of an activity compared with resting energy expenditure.

Appendix Q

Anthropometric Characteristics of Study Participants

Table 1: Anthropometric characteristics of male participants by 10 year age group (n=1222)

	Variables					
	BMI(Kg/m^2)		**Waist Circumference(cm)**		**Percent Body Fat(%BF)**	
Age groups	**Median**	**Interquartile range (p25-p75)**	**Median**	**Interquartile range (p25-p75)**	**Median**	**Interquartile range (p25-p75)**
20-29	25.3	(22.7-25.3)	56.5	(78.7-95.5)	21.3	(17.9-24.6)
30-39	26.9	(24.4-29.7)	94.6	(86.4-101.9)	25.3	(22.4-27.7)
40-49	28.1	(25.6-30.9)	97.1	(90.5-104.6)	29.8	(26.2-32.8)
50-59	28.2	(25.9-31.3)	100.5	(93.0-108.5)	32.9	(28.2-36.7)
60-69	28.3	(25.4-31.6)	99.0	(90.7-107.0)	31.4	(26.7-35.4)
≥70	28.4	(25.1-31.1)	100.2	(92.4-108.2)	29.6	(26.9-34.1)

Table 2: Anthropometric characteristics of female participants by 10 year age group (n=1386)

	Variables					
	BMI(Kg/m^2)		**Waist Circumference(cm)**		**Percent Body Fat(%BF)**	
Age groups	**Median**	**Interquartile range (p25-p75)**	**Median**	**Interquartile range (p25-p75)**	**Median**	**Interquartile range (p25-p75)**
20-29	22.8	20.6-25.7	76.3	71.0-83.0	30.8	27.5-34.1
30-39	24.9	22.8-29.2	82.1	74.6-90.8	33.4	30.8-36.8
40-49	27.3	24.1-30.8	85.2	79.5-94.9	37.6	34.3-40.4
50-59	29.8	26.1-34.5	93.6	85.5-106.8	42.5	39.9-44.9
60-69	29.8	26.2-33.9	96.0	86.1-107.5	40.6	38.3-43.9
≥70	30.3	26.8-35.3	102.0	90.0-111.0	41.8	38.6-44.5

Appendix R

Relationship between Body Mass Index[1] and Socio Demographic Characteristics in Lebanese Adult Participants

Table 1- Relationship between body mass index[1] and socio demographic characteristics of Lebanese adult **males** ≥ 20 years (n=1222).

	Body Mass Index(Kg/m^2) 18.5- 24.9 %(n)	25.0-29.9 %(n)	≥30 %(n)		
Total sample	31.1(379)	42.4(518)	26.6(325)		
Variables				Chi Square	P value*
Age(years)				**63.227**	**0.000**
20-39	67.8 (257)	49.0 (254)	39.1 (127)		
40-64	23.0 (87)	39.2 (203)	44.3 (144)		
>=65	9.2 (35)	11.8 (61)	16.6 (54)		
Marital Status				**100.473**	**0.000**
Single(never married)	57.7 (218)	34.4 (178)	23.1 (75)		
Married	38.3 (145)	62.7 (324)	73.8 (240)		
widowed /divorced/separated	04.2 (16)	02.9 (15)	03.1 (10)		
Education				**14.006**	**0.030**
Preliminary or less	21.6 (82)	19.9 (103)	25.8 (84)		
Complimentary	24.0 (91)	25.5 (132)	26.5 (86)		
High school or diploma	23.2 (88)	23.2 (120)	26.8 (87)		
University	31.1 (118)	31.5 (163)	20.9 (68)		
Smoking				**0.105**	**0.949**
Never smoker	30.9 (117)	31.9 (165)	31.7 (103)		
Current or past Smoker	69.1 (262)	68.1 (353)	68.3 (222)		
Alcohol				**6.668**	**0.036**
No(last 12 months)	45.9 (174)	43.2 (224)	52.3 (170)		
Yes(last 12 months)	54.1 (205)	56.8 (294)	47.7 (155)		
PA(METs)				**11.232**	**0.024**
Low intensity	46.9 (172)	46.7 (235)	51.4 (163)		
Moderate intensity	25.1 (92)	29.4 (148)	30.9 (98)		
High intensity	28.1 (103)	23.9 (120)	17.7 (56)		
Income(Lebanese Pounds)				**6.99**	**0.136**
Less than 1 million	31.9 (114)	26.4 (125)	32.1 (94)		
1-3 million	54.1 (193)	54.2 (257)	52.6 (154)		
>3 million	14.0 (50)	19.4 (92)	15.4 (45)		
Total Household Assets				**9.800**	**0.044**
<7 items	51.5 (195)	41.6 (214)	42.2 (135)		
7-8 items	23.7 (90)	29.0 (149)	28.1 (90)		
9 or more items	24.8 (94)	29.4 (151)	29.7 (95)		
House Ownership				**6. 398**	**0.041**
Owns house	68.2 (257)	74.5 (382)	75.9 (243)		
Rents House	31.8 (120)	25.5 (131)	24.1 (77)		
#Crowding Index				**4.750**	**0.093**
>= 1 person/room	65.0 (245)	58.0 (300)	59.1 (191)		
<1 person/room	35.0 (132)	42.0 (217)	40.9 (132)		
SES self				**2.447**	**0.654**
Low	21.7 (82)	25.3 (130)	25.8 (83)		
Middle	72.5 (274)	70.0 (359)	69.3 (223)		
High	05.8 (22)	04.7 (24)	05.0 (16)		
Work Status				**54.257**	**0.000**
does not work + retired	15.3 (58)	17.2 (89)	18.2 (59)		
GOV employee	07.7 (29)	10.6 (55)	11.1 (36)		
private sector employee	25.9 (98)	27.4 (142)	19.8 (64)		
owner business-self employed	37.5 (142)	39.6 (205)	49.1 (159)		
student/volunteer work	13.7 (52)	05.2 (27)	01.9 (6)		

Table 2 Relationship between body mass index[1] and socio-demographic characteristics of **female** participants (n=1386).

	Body Mass Index(Kg/m^2) 18.5- 24.9 % (n)	25.0-29.9 % (n)	≥30 % (n)		
Total sample	**42.1 (583)**	**31.4 (435)**	**26.5 (368)**		
Variables				Chi Square	P value*
Age(years)				**249.157**	**0.000**
20-39	77.0 (449)	42.3 (184)	26.9 (109)		
40-64	19.9 (116)	47.4 (206)	51.4 (189)		
>=65	03.1 (18)	10.3 (45)	19.0 (70)		
Marital Status				**177.540**	**0.000**
Single(never married)	41.6 (242)	17.0 (74)	09.5 (35)		
Married	51.9 (302)	72.2 (314)	67.7 (249)		
widowed /divorced/separated	06.5 (38)	10.8 (47)	22.8 (84)		
Education				**164.402**	**0.000**
Preliminary or less	11.1 (65)	20.9 (91)	35.3 (130)		
Complimentary	17.3 (101)	31.7 (138)	26.4 (97)		
High school or diploma	27.8 (162)	25.7 (112)	23.4 (86)		
University	43.7 (255)	21.6 (94)	14.9 (55)		
Smoking				**4.602**	**0.100**
Never smoker	52.5 (306)	50.3 (219)	45.4 (167)		
Current or past Smoker	47.5 (277)	49.7 (216)	54.6 (201)		
Alcohol				**13.428**	**0.001**
No(last 12 months)	64.7 (377)	71.3 (310)	75.5 (278)		
Yes(last 12 months)	35.3 (206)	28.7 (125)	24.5 (90)		
PA(METs)				**14.895**	**0.005**
Low intensity	46.3 (265)	36.6 (156)	46.8 (170)		
Moderate intensity	34.3 (196)	37.3 (159)	29.8 (108)		
High intensity	19.4 (111)	26.1 (111)	23.4 (85)		
Income(Lebanese Pounds)				**65.543**	**0.000**
Less than 1 million	28.9 (155)	43.4 (172)	50.8 (169)		
1-3 million	51.8 (279)	48.7 (193)	41.7 (139)		
>3 million	19.4 (104)	07.8 (31)	07.5 (25)		
Total Household Assets				**77.348**	**0.000**
<7 items	46.8 (272)	61.9 (267)	69.3 (253)		
7-8 items	25.5 (148)	25.5 (110)	21.6 (79)		
9 or more items	27.7 (161)	12.5 (54)	09.0 (33)		
House Ownership				**3.998**	**0.135**
Owns house	72.3 (416)	70.0 (303)	66.2 (241)		
Rents House	27.7 (159)	30.0 (130)	33.8 (123)		
#Crowding Index				**0.372**	**0.830**
>= 1 person/room	63.6 (370)	65.4 (282)	64.3 (236)		
<1 person/room	36.4 (212)	34.6 (149)	35.7 (131)		
SES self				**52.2621**	**0.00**
Low	12.7 (73)	27.5 (119)	29.2 (107)		
Middle	81.4 (469)	69.5 (301)	68.1 (250)		
High	05.9 (34)	03.0 (13)	02.7 (10)		
Work Status				**156.234**	**0.00**
does not work + retired	47.9 (279)	74.0 (322)	80.2 (295)		
GOV employee	05.0 (29)	03.9 (17)	04.3 (16)		
private sector employee	26.1(152)	11.5 (50)	09.2 (34)		
owner business-self employed	07.5 (44)	07.1 (31)	04.9 (18)		
student/volunteer work	13.6 (79)	03.4 (15)	01.4 (5)		

[1] BMI classification according to the WHO cut offs (WHO, 2004).*Significant at P<0.05. P-values were derived from chi-square test for all the socio demographic characteristics distributions. #Crowding Index = number of persons in the household divided by the number of rooms, excluding kitchen & bathrooms

Apppendix S

Unadjusted Association between Socio-Demographic Variables and the Various Levels of Physical Activity for Adult Participants

Table 1 Relationship between the various physical activity levels[1] and certain socio demographic characteristics of Lebanese adult males≥20years (n= 1187).

	Physical Activity Level				
	Low	Moderate	High		
Variables				Chi square	P value*
Age (years) % (n)				**33.740**	**0.000**
20-39	49.8 (307)	22.2 (137)	27.9 (172)		
40-64	47.0 (199)	32.9 (139)	20.1 (85)		
≥65	43.2 (64)	41.9 (62)	14.9 (22)		
Marital Status % (n)				**11.898**	**0.018**
Single(never married)	47.5 (215)	24.5 (111)	28.0 (127)		
Married	48.6 (336)	30.5 (211)	21.0 (145)		
widowed /divorced/separated	43.9 (18)	39.0 (16)	17.1 (7)		
Income(Lebanese Pounds) % (n)				**21.422**	**0.002**
<1 million	40.4 (132)	32.4 (106)	27.2 (89)		
1-3 million	48.8 (285)	28.8 (168)	22.4 (131)		
3-6 million	58.9 (76)	24.0 (31)	17.0 (22)		
> 6 million	44.2 (23)	17.3 (9)	38.5 (20)		
Education% (n)				**11.390**	**0.077**
Preliminary or less	45.1 (120)	33.1 (88)	21.8 (58)		
complimentary	44.1 (134)	27.0 (82)	28.9 (88)		
High school or diploma	49.1 (136)	28.5 (79)	22.4 (62)		
University	52.9 (180)	26.2 (89)	20.9 (71)		
Work status% (n)				**25.010**	**0.002**
Does not work/retired	43.5 (87)	40.0 (80)	16.5 (33)		
GOV employee	39.7 (46)	31.0 (36)	29.3 (34)		
Private sector employee	48.1 (141)	27.3 (80)	24.6 (72)		
Owner business/self employed	52.5 (260)	24.2 (120)	23.2 (115)		
Student/volunteer work	43.9 (36)	26.8 (22)	29.3 (24)		
Total Household Assets%(n)				**13.783**	**0.008**
<7 items	43.2 (232)	31.8 (171)	25.0 (134)		
7-8 items	47.9 (151)	27.0 (85)	25.1 (79)		
9 or more items	55.8 (182)	24.5 (80)	19.6 (64)		

[1] Physical activity levels classification according to IPAQ scoring protocol
*Significant at P<0.05. P-values were derived from chi-square test for all the socio - demographic characteristics distributions.

Table 2 Relationship between the various physical activity levels[1] and certain socio demographic characteristics of Lebanese adult females≥20 years (n= 1361).

	Physical Activity Level				
	Low	Moderate	High		
Variables				Chi square	P value*
Age (years) %(n)				42.978	0.000
20-39	47.7 (346)	32.6 (237)	19.7 (143)		
40-64	33.1 (166)	38.4 (193)	28.5 (143)		
≥65	59.4 (79)	24.8 (33)	15.8 (21)		
Marital Status %(n)				**28.876**	**0.000**
Single(never married)	51.7 (178)	32.6 (112)	15.7 (54)		
Married	38.2 (324)	35.8 (304)	25.9 (220)		
widowed /divorced/separated	52.4 (88)	28.0 (47)	19.6 (33)		
Income(Lebanese Pounds) %(n)				**30.592**	**0.000**
<1 million	36.0 (176)	37.4 (183)	26.6 (130)		
1-3 million	43.6 (262)	33.4 (201)	23.0 (138)		
3-6 million	62.9 (66)	26.7 (28)	10.5 (11)		
> 6 million	52.9 (27)	27.5 (14)	19.6 (10)		
Education %(n)				**12.079**	**0.060**
Preliminary or less	42.4 (120)	34.6 (98)	23.0 (65)		
Complimentary	38.3 (126)	38.3 (126)	23.4 (77)		
High school or diploma	42.5 (151)	31.8 (113)	25.6 (91)		
University	49.2 (194)	32.0 (126)	18.8 (74)		
Work status %(n)				**45.778**	**0.000**
Does not work/retired	37.9 (333)	36.1 (317)	26.0 (228)		
GOV employee	48.3 (29)	36.7 (22)	15.0 (9)		
Private sector employee	59.1 (139)	26.4 (62)	14.5 (34)		
Owner business/self employed	51.6 (48)	24.7 (23)	23.7 (22)		
Student/volunteer work	44.2 (42)	41.1 (39)	14.7 (14)		
Total Household Assets %(n)				**42.740**	**0.000**
<7 items	38.6 (301)	34.1 (266)	27.2 (212)		
7-8 items	44.9 (149)	39.5 (131)	15.7 (52)		
9 or more items	58.1 (140)	25.3 (61)	16.6 (40)		

[1]Physical activity levels classification according to IPAQ scoring protocol
*Significant at P<0.05. P-values were derived from chi-square test for all the socio - demographic characteristics distributions.

Appendix T

Prevalence and Covariates of Obesity in Lebanon: Findings from the First Epidemiological Study

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Abstract

SIBAI, ABLA MEHIO, NAHLA HWALLA, NADA ADRA, AND BOUSHRA RAHAL. Prevalence and covariates of obesity in Lebanon: findings from the first epidemiological study. *Obes Res.* 2003;11:1353–1361.

Objective: To estimate the prevalence of overweight and obesity and examine associated covariates in the Lebanese population.

Research Methods and Procedures: A cross-sectional survey of a representative sample of 2104 individuals, 3 years of age and older. Anthropometric measurements and dietary assessments were conducted following standard methods and techniques. Overweight and obesity (classes I to III) were defined according to internationally standardized criteria for classification of BMI.

Results: For children 3 to 19 years of age, prevalence rates of overweight and obesity were higher overall for boys than girls (22.5% vs. 16.1% and 7.5% vs. 3.2%, respectively). For adult men and women (age ≥ 20 years), the prevalence of overweight was 57.7% and 49.4%, respectively. In contrast, obesity (BMI ≥ 30 kg/m^2) was higher overall among women (18.8%) than men (14.3%), a trend that became more evident with increasing obesity class. BMI, percentage of body fat, and waist circumference increased to middle age and declined thereafter. Whereas lack of exercise associated significantly with obesity among children, obesity in older adults was more prevalent among the least educated, nonsmokers, and those reporting a family history of obesity.

Discussion: The results from this national population-based study in Lebanon show high prevalence rates of overweight and obesity comparable with those observed in developed countries such as the United States. While further studies are needed to examine the underlying social and cultural factors associated with lifestyle and nutritional habits, now is the time to institute multicomponent interventions promoting physical activity and weight control nationwide.

Key words: overweight, BMI, percentage of body fat, nutrition survey, Lebanon

Introduction

The prevalence of overweight and obesity is increasing rapidly worldwide and is emerging as a major risk factor for several chronic diseases of public health significance. Evidence from several studies indicates that obesity substantially increases the risk of diabetes, hypertension, heart disease, and breast cancer (1–3) and impairs quality of life (4).

Current prevalence rates for obesity among adults in most developed countries vary between 11% and 20% (5). In the United States, recent findings from the Behavioral Risk Factor Surveillance System in 2000 revealed that most adults 18 years of age or older are overweight (>56%), and approximately one in five is obese (6), representing an increase of ~1.7-fold in less than a decade (7). Evidence suggests that the worldwide obesity epidemic is likely to continue its rise in the years ahead (6,8–11). In countries of the Eastern Mediterranean Region (EMR),[1] health professionals similarly caution against a major surge in obesity rates (12). For example, the prevalence of obesity among women in Kuwait is ~40%, which places the country among the highest rates in the world (13).

There are no studies on overweight and obesity in Lebanon, a small middle-income country in the EMR. Lebanon has diverse characteristics: a high urbanization rate (81%),

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[1] Nonstandard abbreviations: EMR, Eastern Mediterranean Region; PHS, Population and Housing Survey; WHO, World Health Organization; OR, odds ratio; CI, confidence interval.

a high literacy rate (75%), and life expectancy approaching 67 years among men and 70.5 years among women (14,15), coupled with westernization and changes in lifestyle in the past several years. Therefore, noncommunicable diseases have already emerged as the leading causes of morbidity and mortality (16). Cardiovascular diseases (16%) and diabetes (13%) are the most prevalent health conditions among individuals 50 years of age and older (17) and account, respectively, for ~60% and 4% of underlying causes of death in older adults (16). The lack of basic indicators of major chronic disease risk factors such as the distribution of BMI in the population hampers public health planning for intervention and control of these diseases.

We report in this paper, from the first national study in Lebanon, the prevalence and covariates of obesity and overweight in both sexes and in all age groups. We also compared our data with findings from the United States and with other data from selected countries in the region.

Research Methods and Procedures

Study Design

Our study sample is based on the sampling frame of the Population and Housing Survey (PHS) carried out between 1995 and 1996 by the Ministry of Social Affairs in Lebanon in collaboration with United Nations Fund for Population Activities. The design and conduct of the PHS have been described in detail elsewhere (18). Briefly, the PHS was a national representative survey targeting households in each of the country's 6 governorates and 26 districts and included ~10% of the total Lebanese population of 3.4 million. Using a three-stage stratified cluster design, the sample (n = 65,000 households) was self-weighted and was selected based on a probability sample proportional to population size. For the present study, a random subsample of 1% of the PHS household sampling frame (n = 650 households) was selected. Informed consent was obtained from head of household, and all individuals of both genders 3 years of age and older, excluding pregnant women, were invited to participate in the study. The questionnaire covered information on sociodemographic characteristics and behavioral factors, including smoking, exercise, and sleeping patterns. A brief medical history and family history of obesity were also recorded. Refusals at the household level did not exceed 10% (57 households), and anthropometric measures were available for almost all individuals within the household (96%). Fieldwork was carried out between April and September 1997, and the final sample consisted of a total of 2104 individuals (900 men and 1204 women) living in 593 households and covering the six administrative governorates in Lebanon. The University Research Board approved the study protocol.

Anthropometric and Dietary Assessment

Anthropometric measurements were taken using standardized techniques and calibrated equipment (19). Subjects were weighed to the nearest 0.1 kg in light indoor clothing and with bare feet or stockings. Height was measured without shoes and recorded to the nearest 0.5 cm using a stadiometer. BMI was calculated as weight (kilograms) divided by height (meters) squared. Dietary intake was assessed using 24-hour dietary recall from the study subject and by proxy, mostly from the mother, for children <10 years of age. Food consumption data were converted to energy intake per day using the Nutritionist IV program (20), and the Middle East Food Composition Tables were used to analyze local dishes (21).

For individuals older than 20 years of age, skinfold thickness of body fat was measured over four sites (biceps, triceps, subscapular, and suprailiac) using a skinfold caliper. Two measurements were taken at each site, and the average value was taken as the skinfold score. Percentage of body fat was computed from the sum of the four measured skinfolds according to the Durnin and Womersley formula (22). A calibrated plastic measuring tape was used to measure circumference of the waist at the level of the umbilicus and of the hip at the level of maximum extension of the buttocks to the nearest 0.5 cm, with the subject standing and after normal expiration. Waist and hip circumferences were measured twice, and the average of the two values was taken.

Definitions of Overweight and Obesity

For comparability purposes, the classification criteria for overweight and obesity were defined according to World Health Organization (WHO) standardized criteria. In children up to 10 years of age, weight-for-height with the cut-point greater than 1 and 2 SD from the reference median value was used to define overweight and obesity, respectively (23,24). For adolescents (10 to 19 years old), the definitions of overweight and obesity were based on sex- and age-specific 85th and 95th BMI percentiles, respectively, derived from the U.S. First National Health and Nutrition Examination Survey (24). For adults who were 20 years of age and older, the following WHO-recommended criteria were used (25). Individuals with a BMI ≥25 kg/m^2 were considered overweight, and obesity was defined as follows: preobesity (BMI = 25.0 to 29.9 kg/m^2); class I obesity (BMI = 30.0 to 34.9 kg/m^2); class II obesity (BMI = 35.0 to 39.9 kg/m^2); and class III obesity (BMI ≥ 40.0 kg/m^2). Furthermore, the 25% and 32% sex-specific cut-points for body fat were used to indicate obesity among men and women, respectively (26), and subjects with waist circumference ≥102 and ≥88 cm, respectively, were considered at higher risk for metabolic diseases than their counterparts (27).

Table 1. BMI (mean ± SD and percentiles) by age and gender among study population, Lebanon 1997

	Age groups								
	6 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70^{+}	Total
	Men								
	n = 142	n = 257	n = 97	n = 101	n = 103	n = 80	n = 73	n = 47	n = 900
Mean ± SD	16.1 ± 2.4	20.5 ± 4.3	24.5 ± 3.9	25.9 ± 4.0	26.8 ± 3.8	27.2 ± 3.9	26.2 ± 4.1	25.5 ± 4.5	25.5 ± 4.3
5th percentile	13.4	14.9	18.7	18.7	20.5	20.5	19.3	18.0	18.5
15th percentile	14.2	16.1	20.3	21.9	22.3	23.3	21.6	21.0	20.9
50th percentile	15.7	20.5	24.1	25.6	26.8	27.3	26.1	25.8	25.5
85th percentile	19.3	25.3	27.5	30.3	30.6	30.7	29.7	30.2	29.7
95th percentile	21.4	31.7	32.0	33.2	34.0	34.8	33.3	33.6	33.0
	Women								
	n = 153	n = 336	n = 177	n = 193	n = 143	n = 100	n = 63	n = 39	n = 1204
Mean ± SD	16.0 ± 3.1	20.5 ± 3.5	22.9 ± 3.6	25.0 ± 4.1	27.2 ± 4.6	28.8 ± 5.0	29.7 ± 5.9	27.6 ± 4.6	25.5 ± 5.2
5th percentile	13.1	15.6	18.2	19.5	21.2	20.8	22.5	19.5	18.2
15th percentile	14.1	17.1	19.5	21.1	22.7	23.9	24.4	22.2	20.5
50th percentile	15.3	20.4	22.5	24.5	26.5	28.0	29.3	27.5	24.7
85th percentile	18.3	23.9	25.8	29.3	31.8	34.0	33.4	32.7	31.0
95th percentile	23.8	27.3	30.9	33.7	35.5	37.2	39.4	34.7	34.8

Statistical Methods

Descriptive statistics were calculated for BMI, and results are expressed as means, SDs, and percentiles. Data are presented for men and women separately in 10-year age groups, with the last age category including all those ≥70 years. To account for sampling effect, prevalence rates for overweight and obesity were estimated using weighted data. Multivariate logistic regression analysis was carried out, with percent obese (BMI ≥ 30kg/m^2) compared with normal as the dependent variable and a number of baseline characteristics as independent variables. These included age, gender, education, marital status, smoking, physical exercise, family history of obesity, crowding index, and dietary intake. The father's education was used as measure of socioeconomic status for children, and crowding index was calculated as number of persons within the household divided by the number of rooms, excluding kitchen and bathrooms. Engaging in physical exercise was assessed for subjects older than 6 years of age and was considered present if the individual was involved in any leisure-time activity for ≥3 d/wk preceding the survey. Total energy consumption and proportion of energy consumption from fat were divided into tertiles and included in the model as dummy variables with three categories (28). The regression analysis was conducted stratified by three age strata: children (6 to 19 years), adults (20 to 59 years), and older individuals (≥60 years). Prevalence odds ratios (ORs) and their 95% confidence intervals (CIs) were calculated. The Statistical Package for the Social Sciences (29) was used for all computations.

Results

Table 1 presents the mean BMI (±SD) of the study sample, with values corresponding to the 5th, 15th, 50th, 85th, and 95th percentiles by 10-year age groups and gender. Mean and median values for BMI increased fairly steadily with increasing age until the 50- to 59-year age group for men and the 60- to 69-year age group for women, and they decreased thereafter. Compared with women, men showed slightly higher estimates overall before the 40- to 49-year age group, with a reverse in the trend in the older categories.

The prevalence of overweight and obesity is presented for children (≤19 years) and adults (≥20 years) in Table 2. Overall, boys, particularly those older than 10 years of age, presented a higher prevalence of overweight and obesity than girls (22.5% vs. 16.1% and 7.5% vs. 3.2%, respectively). For both genders, overweight increased substantially with age until early adolescence, with a decrease thereafter (data not shown).

Among adults, the prevalence of preobesity (BMI = 25.0 to 29.9 kg/m^2) was estimated at 36.0%, with higher proportions for men than women across almost all age groups

Table 2. Prevalence of overweight and obesity among study population, Lebanon 1997

	Age groups			Age groups						
	3 to 9	10 to 19	Total	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70+	Total
	Overweight*			Overweight (BMI ≥ 25 kg/m^2)						
Men	14.2	26.9	22.5	40.2	62.4	68.7	75.1	60.9	57.2	57.7
Women	17.9	14.7	16.1	19.1	42.6	67.7	77.2	76.3	71.9	49.4
Both genders	16.7	20.0	18.6	28.3	50.6	68.2	76.3	69.5	65.7	53.0
	Obese*			Obese (BMI ≥ 30.0 kg/m^2)						
Men	7.1	7.7	7.5	8.0	15.9	19.4	19.7	13.8	16.1	14.3
Women	3.6	2.9	3.2	5.1	11.0	20.4	39.3	41.2	33.4	18.8
Both genders	4.8	5.0	4.8	6.4	12.9	19.9	30.8	29.5	26.1	17.0
				Preobese (BMI 25.0 to 29.9 kg/m^2)						
Men				32.2	46.5	49.3	55.4	47.1	41.1	43.4
Women				14.0	31.6	47.3	37.9	35.1	38.5	30.6
Both genders				21.9	37.7	48.3	45.5	40.0	39.6	36.0
				Class I obesity (BMI 30.0 to 34.9 kg/m^2)						
Men				6.1	13.9	17.2	16.1	11.5	14.3	12.1
Women				3.9	7.9	13.4	29.3	28.1	30.8	13.8
Both genders				4.9	10.3	15.0	23.3	21.0	23.9	13.1
				Class II obesity (BMI 35.0 to 39.9 kg/m^2)						
Men				1.9	2.0	2.2	2.7	2.3	0.0	2.0
Women				1.2	3.1	5.4	7.1	9.6	2.6	4.0
Both genders				1.5	2.6	4.0	5.1	6.5	1.5	3.2
				Class III Obesity (BMI ≥ 40.0 kg/m^2)						
Men				0.0	0.0	0.0	0.9	0.0	1.8	0.2
Women				0.0	0.0	1.6	2.9	3.5	0.0	1.0
Both genders				0.0	0.0	0.9	2.4	2.0	0.7	0.7

* Overweight and obesity for children (3 to 9 years): W-H > +1 and > +2 SD, respectively, from the reference median value. Overweight and obesity for adolescents (10 to 19 years): BMI ≥ 85th and BMI ≥ 95th percentile, respectively, derived from data from the NHANES I.

(Table 2). Preobesity peaked in the 50- to 59-year age group among men and a decade earlier in women. In contrast, obesity rates were, in general, greater in women than men, a trend that became more evident with increasing age and increasing obesity class. Overall, 57.7% of men and 49.4% of women were overweight (BMI ≥ 25 kg/m^2), yielding an estimated total of 53.0% in both genders. The corresponding estimates for obesity (BMI ≥ 30 kg/m^2) were 14.3% vs. 18.8%, respectively (both genders, 17.0%).

Figure 1 presents percent distribution of obesity among the adult study sample according to percentage of body fat, and Figure 2 shows percent distribution of the population at risk of metabolic disease using waist circumference, by age and gender. Compared with men, women showed rising trends in both characteristics with increasing age. They also presented with a significantly higher overall proportion of obesity (61.0% vs. 29.9%, respectively; $p < 0.001$) and percent at risk (38.4% vs. 25.0%, respectively; $p < 0.001$).

Results of the regression analysis showed variations in associations with obesity by age groups (Table 3). Among children, boys and those who did not exercise were significantly more likely to be obese than their counterparts. For adults (20 to 59 years old), obesity increased with age and was significantly more prevalent among subjects with low

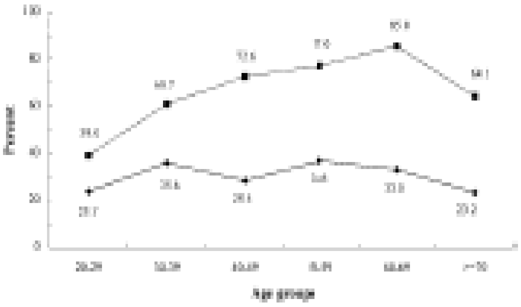

Figure 1: Percent distribution of obesity using percentage of body fat, by age and gender (Lebanon, 1997). ♦, men (percentage of body fat: ≥25%); ■, women (percentage of body fat: ≥32%).

education, nonsmokers, and those reporting family history of obesity. In the elderly (≥60 years), women were significantly more likely to be obese than men, and obesity was more prevalent among those with low educational levels, although this did not reach statistical significance.

Discussion

The findings of this study indicate that most Lebanese adults, 20 years of age and older, are overweight (53.0%, BMI ≥ 25 kg/m^2), and 17% are obese (BMI ≥ 30 kg/m^2). These results are slightly lower than those reported in the United States using the National Health and Nutrition Examination Survey (10) (54.5% and 22.5%, respectively) and the Behavioral Risk Factor Surveillance System data (56% and 19.8%, respectively) (6). The respective estimates for overweight and obese children (≤19 years) were also high, reaching 22.5% and 7.5% in boys and 16.1% and 3.2% in girls. Obesity was found to be greater in women than men. Gender differentials were greatest in class III obesity and among the elderly, with women older than 60 years having ~3.5 times the risk of being obese than men, after controlling for fat intake and other covariates. Whereas lack of exercise associated significantly with obesity among children, obesity in older adults was more prevalent among the least educated, nonsmokers, and those reporting family history of obesity.

Consistent with findings in other studies, trends in BMI, percentage of body fat, and waist circumference with age showed higher estimates up to middle age and a decline thereafter. The lower estimates in older age groups are likely because of weight loss occurring in old age, or alternatively, because of higher risk of mortality for the obese (30). The significance of waist circumference, as an index of central obesity, is its association with increased risk of metabolic diseases such as cardiovascular diseases, diabetes, and hypertension (31).

Obesity and high BMI values are major risk factors for several diseases, most notably diabetes. Studies have shown that for every 1-kg increase in weight, the prevalence of diabetes rises by 9% (32). The WHO specifies a BMI value of 21 kg/m^2 as optimal for the adult population mean, allowing almost all individuals to fall within the healthy weight range of 18.5 to 24.9 kg/m^2 (33). The corresponding value for adults older than 20 years in our survey data was estimated at 25.9 kg/m^2, approaching those values reported from neighboring countries (range, 25.9 to 30.2 kg/m^2) (34–38) and from the United States (26.6 kg/m^2) (39) and the United Kingdom (26.3 kg/m^2) (40). In the absence of published data on BMI in Lebanon, it is difficult to examine changes in recent years. Nevertheless, the comparability of our current estimates with those from developed countries witnessing the continuing "epidemic" of obesity (6,41) foreshadows an alarming signal, which, if not attended to, might reach even more severe levels than some neighboring countries of the EMR. Regional WHO reports have identified obesity as the most pressing health concern, with existing information showing levels of adult obesity exceeding 25% in some countries (12).

Table 4 reproduces available data for obesity in selected countries of the region (34–38) and compares them with those obtained in this study. Whereas Lebanon presented with the lowest rates in both men and women, obesity does not seem to be a characteristic of solely affluent societies. Modernization and adoption of the Western lifestyle for countries in transition are key factors affecting nutritional habits and obesity levels. Moreover, sociocultural norms in some Arab countries, where rich high-fat food plays an important role in the daily diet and where "plumpness" is considered healthy and a sign of beauty and affluence, have been suggested as underlying factors in the alarmingly high prevalence of obesity in the region (13,42–45). Current studies on food consumption patterns of the Lebanese young and adult population show a shift in the food consumption toward increased intake of fat, milk, and animal

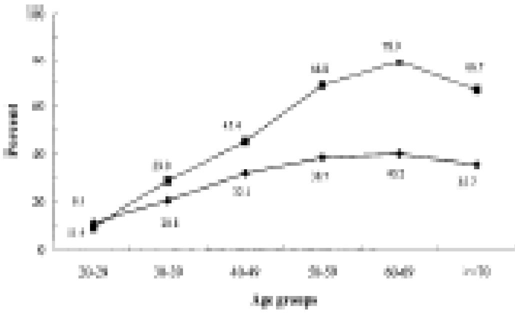

Figure 2: Percent distribution of subjects at risk for metabolic diseases using waist circumference, by age and gender (Lebanon, 1997). ♦, men (waist circumference: ≥102 cm); ■, women (waist circumference: ≥88 cm).

Table 3. Associations of obesity with baseline covariates stratified by age: prevalence ORs and their 95% CIs

	Age groups		
Variable (reference category)	6 to 19 years OR (95% CI)	20 to 59 years OR (95% CI)	≥60 years OR (95% CI)
Age (years)			
6 to 9	1.0		
10 to 19	0.49* (0.25 to 0.97)		
Age (years)			
20 to 29		1.00	
30 to 39		2.12* (1.06 to 4.25)	
40 to 49		5.12* (2.53 to 10.4)	
50 to 59		8.82* (4.24 to 18.4)	
Age (years)			
60 to 69			1.00
≥70+			0.65 (0.28 to 1.51)
Gender			
Male	1.00	1.00	1.00
Female	0.47* (0.23 to 0.92)	0.62 (0.37 to 1.02)	3.42* (1.26 to 9.30)
Education			
High	1.00	1.00	1.00
Low	1.92 (0.64 to 5.77)	2.41* (1.52 to 3.83)	2.09 (0.9 to 9.80)
Marital status			
Married		1.00	1.00
Unmarried		1.75 (0.99 to 3.08)	1.09 (0.40 to 2.98)
Smoking			
Yes		1.00	1.00
No		2.04* (1.30 to 3.20)	1.61 (0.65 to 3.95)
Exercise			
Yes	1.00	1.00	1.00
No	2.45* (1.16 to 5.20)	1.37 (0.88 to 2.11)	0.78 (0.32 to 1.93)
Family history of obesity			
No	1.00	1.00	1.00
Yes	0.81 (0.43 to 1.51)	2.16* (1.41 to 3.30)	1.51 (0.65 to 3.53)
Crowding index			
<1 person/room	1.00	1.00	1.00
≥1 person/room	2.16* (1.04 to 4.50)	0.89 (0.55 to 1.43)	0.88 (0.38 to 2.02)
Energy consumption (kcal)			
Low (<1400)	1.00	1.00	1.00
Moderate (1400 to 2000)	0.89 (0.40 to 2.02)	1.05 (0.62 to 1.76)	0.49 (0.19 to 1.27)
High (≥2000)	0.92 (0.40 to 2.10)	1.18 (0.68 to 2.07)	1.39 (0.48 to 4.06)
Energy consumption from fat (%)			
Low (<32)	1.00	1.00	1.00
Moderate (32 to 40)	1.65 (0.79 to 3.46)	1.55 (0.93 to 2.60)	2.73 (0.97 to 7.70)
High (≥40)	1.49 (0.62 to 3.55)	1.44 (0.85 to 2.44)	1.09 (0.40 to 2.98)

* $p < 0.05$.

Table 4. Prevalence of obesity (BMI ≥ 30 kg/m^2) among adults by age and gender in selected neighboring countries of the Eastern Mediterranean Region compared with the Lebanese data

	Age groups (years)						Mean
	20 to 29	30 to 39	40 to 49	50 to 59	≥60	Total	BMI
Men (%)							
Lebanon	8.4	15.8	19.4	19.6	15.3	14.5	25.8
Kuwait	32.1	35.8	40.1	35.3	15.2	32.3	27.9
Saudi Arabia	12.0	20.0	27.0	23.0	18.0	16.0	26.1
Jordan*	17.8	27.9	36.3	47.5	33.7	32.7	
UAE†	21.4		20.8		6.8	17.8	25.9
Urban Palestinian‡		28.8	43.6	44.4			27.4
Women (%)							
Lebanon	5.1	11.0	20.4	39.3	38.0	18.8	25.9
Kuwait	29.2	45.3	54.8	57.1	43.8	40.6	29.6
Saudi Arabia	20.0	33.0	41.0	38.0	26.0	24.0	27.5
Jordan*	25.9	56.0	76.1	73.8	65.8	59.8	
UAE†	25.0		36.8		17.4	27.5	27.3
Urban Palestinian‡		48.2	53.8	61.6			30.2

Age categories differed among these countries: * Starting age, 25 years; † age groups: 20 to 39, 40 to 59, and ≥60 years; ‡ age groups: 35 to 44, 45 to 54, and 55 to 65 years. UAE, United Arab Emirates.

protein, and a decrease in the intake of complex carbohydrates, in particular, bread and cereal. The contribution of carbohydrates to daily energy intake decreased from 64.8% in 1963 to 52.9% in 1998, whereas the contribution of fat increased from 24% to 34.3% during the same period (46).

In recent years, more concern has been directed toward childhood obesity (41). Studies indicate that the higher the childhood BMI percentile, the greater the risk of becoming an overweight adult (47), and that obesity in adults can now be predicted from earlier childhood and adolescent weight (48,49). As adult obesity is difficult to treat, identification at an early age of individuals who are at a high risk of obesity becomes especially important because it allows for introduction of early preventive strategies (50). In our survey data, boys were at greater risk of overweight and obesity than girls, particularly among those 10 years of age and older.

Of particular concern is our finding that obesity in children was significantly more prevalent in those who do not exercise, even after controlling for potential confounders including fat intake and family history of obesity. Whereas it is now well established that regular physical exercise is a key factor in successful weight loss and weight maintenance (51,52), baseline data from this study revealed elevated levels of physical inactivity among adults (52.1%). These rates are much higher than those reported in the United States (27%) (6) or several other member states of the European Union (range, 8% to 40%; mean, 32%) (53). Furthermore, in a recent study conducted among adolescents in Lebanon, physical activity as a method of losing weight was least common among overweight subjects and the lower socioeconomic status, based on parents' education (45). In Lebanon, only a small number of schools include physical education in their curricula, and parks, public beaches, and walking/bicycle lanes are totally lacking, with the result that leisure-time physical activity remains inaccessible to a vast segment of the population.

The findings of this study should be considered in light of the following limitations. The study lacked sufficient power to detect significant associations of obesity with baseline characteristics as reflected by the wide CIs around the estimated ORs in the regression analysis. Furthermore, the dietary assessment using 24-hour recall is known to underestimate food intake, particularly fat intake (54), and the lack of association of obesity with physical activity in adults may have been because of limitations in measurement of physical exercise based on leisure-time activities.

Despite these factors, this epidemiological study provides the first national data addressing overweight and obesity and associated covariates in the Lebanese population. The study used standardized international guidelines for definition of overweight and classes of obesity (25), which allowed comparisons with similar reports from other countries. Moreover, the study focused attention on obesity in children, an often neglected subpopulation in research and policy in the region.

Obesity is preventable, and the extent of our understanding of disparities in prevalence rates across various geographic districts and sociodemographic subpopulations is key to our efforts in planning culturally appropriate and relevant health promotion activities. Further analysis of the data at hand revealed regional variation in the prevalence of obesity ranging from 12% in the capital city to as high as 26% in the south, an underprivileged area in Lebanon. Whereas further studies are needed for examination of the sociocultural, economic, and behavioral factors associated with BMI and weight gain in Lebanon, now is the time to start implementing multicomponent interventions, at the societal and individual level, for weight control. Health professionals may play a key role in promoting regular physical activity. Other means of interventions may use mass media to influence nutritional norms, practices, and personal choices. Such interventions aimed at better health awareness and more physical activity should be monitored for their effectiveness over the years.

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Appendix U

Comparison between the two national cross sectional surveys, 1997 and 2009

	1997 survey	Current survey
Sampling Method	Random selection of households covering the 6 Governates of Lebanon, based on stratified cluster sampling	
Study population	Adults ≥ 20 years excluding pregnant women, with age and sex distribution proportional to baseline population	Adults ≥ 20 years excluding pregnant and lactating women and persons with mental disabilities. Age and sex distribution proportional to baseline population
Sample size	Males, n = 501 Females, n = 715	Males, n= 1244 Females, n=1453
Instrument	Questionnaire: face to face interviews	
Anthropometric Assessment	Measured weight, height, waist circumference, skinfold thicknesses following standardized procedures	
Dietary Assessment	Single 24 hour recall	
Physical Activity Assessment	Leisure physical activies for 3 or more days per week	International Physical Activity Questionnaire
Outcome Variable	Body Mass Index, WHO standardized criteria	
Independent Variables	Baseline characteristics: Socio-demographic, dietary and physical activity	
Findings	Obesity Prevalence rates of 14.3% in men and 18.8% in women Associations were presented for both genders combined and obesity was found to be associated with age, low education, non-smoking and family history for both genders	Obesity Prevalence rates of 26.6 % in men and 26.6% in women Associations are presented separately for men and for women. Obesity was found to be inversely associated with socioeconomic status in women, and positively associated with work in men. Obesity was positively associated with energy consumption, and negatively associated with physical activity in women.

Appendix V

Height data for adult participants aged ≥ 70 years

Table 1 Mean height for male and female participants aged ≥ 70 years (n= 386).

	Age Groups		
	70-74	**>75**	**>70**
Men			
n	**52**	**58**	**110**
Mean ±SD	167.2 ± 7.3	165.4±6.8	166.2±7.0
Women			
n	**43**	**40**	**83**
Mean ±SD	154.6 ± 6.3	153.6±6.8	154.2±6.5