DETERMINANTS AND CONSEQUENCES OF OBESITY IN ADULT KUWAITI FEMALES

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ABSTRACT

From the early fifties, the economic upheaval created by the oil boom brought rapid changes in the traditional life style of the Kuwaiti people that resulted in a more sedentary lifestyle with high food availability and overnutrition. This led to an increase in overweight and obesity, which has become a major public health problem. A representative random sample of 324 adult Kuwaiti females aged 20-60 years were selected in a cross-sectional study to assess the prevalence of obesity, its characteristics, determinants, contributing factors, and relation to other co-morbidity. The sample was drawn from health centre registration files between May 1996 to October 1997. Data was collected by using: a semi-structured questionnaire, anthropometric measurements, and biochemical analysis of blood samples.

Thirty-nine percent of the participants were in the 30-39 year age group, 73% were married, and 56% were at the medium level of education. Fifty-six percent of the participants had a BMI $\geq$ 30.0 and the lean BMI was 32.0. Of these, 56% had a medium level of education, 58% were working and 77% were married. The mean WHR and WC were 0.87 and 96 cm respectively and there was linear relationship between WC and age as well as maternal characteristics. Body fat was positively associated with age, BMI, waist circumference, and WHR. Eighty-five percent of those in 20-29, 87% of those in the 30-39 and 98% of the 40+ age group had more than 33% of their body weight as fat. Thirty-one percent of the participants had arthritis, 25% had hypertension, and 18% had diabetes mellitus. A quarter of the participants had borderline high, and 15% had high levels of serum cholesterol. Of these, over 60% had BMI $\geq$ 30.0. Twenty-three percent had high LDL, 9% had low HDL, and 3% high levels of serum triglycerides.

Multivariate analysis have shown that, after controlling for all the variables, that increase in age and returning to pre-pregnancy weight were the main independent contributing factors to the risk of obesity.

Almost half the participants underestimated their weight status, and only 28% considered their actual weight to be appropriate for them. Furthermore, 61% of the participants reported that they thought that their husbands would categorise their weight into categories less than their actual weight categories.

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

Table **Page**

Figures

Glossary

BMI	:	Body mass index
Uwt	:	Under weight
NormWt	:	Normal weight
OvWt	:	Overweight
ObI	:	Class I obesity
ObII	:	Class II obesity
ObIII	:	Class III obesity
WHR	:	Waist Hip Ratio
STR	:	Sub-scapular Triceps Ratio
WC	:	Waist circumference
HC	:	Hip circumference
SES	:	Socio-economic status
NIDDM	:	Non-insulin dependent diabetes mellitus
IDDM	:	Insulin dependent diabetes mellitus
CHD	:	Coronary heart disease
FBS	:	Fasting blood sugar
SC	:	Serum Cholesterol
ST	:	Serum triglycerides
LDL	:	Low-density lipoproteins
HDL	:	High density lipoproteins

CHAPTER I

INTRODUCTION

Obesity is a state associated with excess adipose tissue mass affecting children as well as adults. Obesity is now so common that it is replacing the more traditional public health concerns, including undernutrition and infectious diseases, as one of the most significant contributors to ill health (Flier, 1994; WHO, 1998).

Obesity has emerged as a world-wide phenomenon affecting wealthy and middle-income groups, as well as residents of countries previously considered to be poor (Barry, 1998). Furthermore, as standards of living continue to rise, weight gain and obesity are posing a growing threat to the health of inhabitants from countries all over the world.

The link between obesity and ill health are well established (Cowburn, 1997). Data from life insurance studies have suggested that obesity is a major risk factor in mortality especially from cardiovascular disease (CVD) and reported that the lowest relative mortality occurs at optimal or ideal weights in both men and women. As weight increases above optimal, mortality increases (Pi-Sunyer, 1991). Obesity is important as an independent long-term risk factor in producing morbidity and mortality from coronary heart disease (CHD). Hypertension, hyperlipidemia, and impaired glucose tolerance are also often associated with obesity (Pi-Sunyer, 1991) and there is growing consensus that reduction of even small amounts of weight may confer health benefits (Goldstein, 1992).

A recent technical report by the World Health Organization (WHO) has suggested the use of body mass index {BMI = weight (kg) / height $(m)^2$} in the diagnosis of obesity with a cut-off of BMI > 30.0 being considered diagnostic of obesity. Based on epidemiological data, the lowest prevalence of health problems is usually found in people with BMI values between 20.0 and 25.0 kg/m^2, whereas complications are found more often in those with BMI 25.0-27.0 kg/m^2 and a greater prevalence of chronic disease is found in those with BMI > 27.0 kg/m^2 (Ledoux, 1997). Overall, the higher the BMI above 27.0 kg/m^2, the more important are the risks of developing such health problems as hypertension, non-insulin dependent diabetes mellitus (NIDDM), CHD, certain cancers and arthritis (Canadian guidelines for healthy weights, 1988). Furthermore, epidemiological data (Bjorntrop, 1985) has also provided evidence of an association between central obesity (apple pattern) and risk of CVD, stroke, hypertension, NIDDM, and some forms of cancer (Lapidus, 1984; Larsson, 1984; Reeder, 1992; Bjorntrop, 1992; Folsom, 1993) independent of the concomitant variation in total body fat mass. Recent clinical and epidemiological data confirms the strength of this association with central obesity (Peiris, 1989; Seidell, 1990; Reeder, 1992; Bjorntrop, 1992; Folsom, 1993; Dowling, 1993). Hence, the ratio of waist to hip circumference (WHR) has been used as a crude estimate of body fat distribution.

Obesity is increasing at an alarming rate both in developed and developing countries, and the problem appears to be increasing at a remarkable rate in children as well as in adults. Obesity may be relatively uncommon in African and Asian countries but is more prevalent in urban than rural populations and is steadily rising in developing countries with high incomes and increasingly rich economies. Some countries of the Arabian Gulf region classify as high income, and Kuwait is one of the countries that is considered as one. The prevalence of obesity is high in Kuwait and is increasing especially among women. A recent study has shown that obesity (BMI $\geq$ 30.0) is, at present, estimated to be about 40.6% in adult women and 32.3% in adult males (Al-Isa, 1995).

The precise pathogenesis of obesity is difficult to establish, however, the basic problem is an imbalance in energy metabolism such that energy input exceeds expenditure. In Kuwait, lifestyle has been profoundly influenced by the improved standard of living, high income, and free health care since the early 1960's. Food is plentiful and affordable, most homes are equipped with house-hold appliances that provide efficiency as well as comfort, cars are now used as means of transport for even the shortest of distances, house maids are affordable, and long hot summers restrict outdoor activities. In addition, tradition and customs in relation to dress, food habits and marriage, as well as, perceptions of weight status probably contribute to the risk of becoming obese.

The present study is concerned with examining the problem of obesity in Kuwait. More specifically, the problem under investigation is to determine the prevalence of obesity among adult Kuwaiti females, to identify the characteristics of this obesity, to identify the contributing factors to the obesity, and to determine the association of obesity to metabolic abnormalities as well as chronic non-communicable diseases.

CHAPTER II

THE BACKGROUND TO THE STUDY

2.1 The Global Problem of Obesity

Throughout the history of mankind, increase in weight has been viewed as an indication of health and well being. During times of food shortage, ensuring adequate energy intake to meet requirements has been a major nutritional concern. Today, however, obesity threatens to become the 21st century's leading health problem (Grundy, 1998). The cause of this increasing prevalence of obesity is two folds: 1) food is more readily available to everyone, and 2) the physical activity of people is reduced with increasing urbanisation and economic development. When energy intake exceeds energy expenditure, the excess energy is stored as fat, in the form of triglycerides, in the body. This is an efficient way of storing energy so that it is available in times of need. However, when the energy being stored exceeds the energy exerted for a considerable period of time, obesity supervenes bringing with it increasing risk of obesity. Not only that, but the pattern of obesity, central obesity (abdominal accumulation of adipose tissue), bears an added risk to some of the chronic non-communicable diseases.

Table-2.1 The prevalence of obesity in selected developed countries

		Prevalence of obesity (BMI in kg/m^2)				
		Men		Women		
Country	Year	%	cut-off	%	cut-off	Reference
USA	1994	33.3	27.8	34.9	27.3	Anon, 1988-94
England	1994	15	> 30.0	16	> 30.0	Seidell, 1995
Sweden	1988/89	5.3	> 30.0	9.1	> 19.3	Kuskowska, 1993
Germany	1990	17.2	> 30.0	19.3	> 30.0	Hoffmeiser, 1994
Australia	1989	11.5	> 30.0	13.2	> 30.0	Bennett, 1994
Italy	1994	46.1	≥ 25.0	31.3	≥ 25.0	Pagano, 1997

1. Adapted from Barry et al, Nutrition Reviews, 1998.

The problem of obesity is worldwide although its prevalence varies from one place to another. Nonetheless, it is increasing at an alarming rate affecting both developed and developing countries. A special article by Popkin and Doak (1997) reviewed the obesity epidemic as a worldwide phenomenon. The authors used data from several sources including publications from Chinese and Russian surveys. The main focus was on larger and more representative samples of adults. They used BMI (kg/m^2) as the standard population-based measure of overweight and obesity status. The cut-offs used to delineate obesity were: 18.5 for thinness, 18.5-24.99 for normal, 25.0-29.99 for overweight grade I, 30.0-39.99 for overweight grade II, and $\geq$ 40.0 for overweight grade III. The authors classified populations according to higher, and middle and low-income countries. They showed that the United States, Germany, and Finland have the highest levels of grade II overweight. Italy appeared to have the highest level of grade I overweight. It was indicated that the level of obesity and the rate of change per year over a longer period of time were highest in the United States and England. For lower- and middle-income countries, the authors indicated that, for Latin America, it was found that more than 10% of females were obese in Brazil and Colombia, more than 50% of the population were overweight in Mexico, and more than 30% were overweight in Peru. Although the range was lower in other South American countries, data from several of these studies came from urban samples only. The authors expressed the lack of data from large-scale surveys in the Caribbean, however data from other sources from the Cuba have shown that the Caribbean nations have high levels of obesity (Forrester et al, 1996), namely: Jamaica and St Lucia 12-15% whereas Cuba and Barbados at the higher prevalence $\geq$ 20%. There was very little grade II and above obesity in Asia, and most countries had levels in the 5-15% range for grade I obesity with the exception of urban China, urban Thailand, Malaysia and the Central Asian countries that were members of the Soviet Union before 1992. Furthermore, the review indicated that nearly half the population in the countries of the Western Pacific had grade II or above obesity. For the Middle East countries, although the data were limited, it appeared that more than a third of the oil-producing countries such as Kuwait and Saudi Arabia were overweight or obese (Popkin et al, 1997).

Many European countries are experiencing a rise in the prevalence of obesity (Kuskowska, 1989; Blokstra, 1991; Pagano, 1994; Seidell, 1995). Table-2.1 summarises the prevalence of obesity in selected developed countries.

In Eastern Europe and Russia obesity is already common place (Table-2.2) and is undoubtedly contributing to an alarming increase in cardiovascular diseases.

Table-2.2 Ninetieth percentile of body mass index (kg / m^2) in Russia and selected Eastern European countries[1] , 35-64 years, age-standardised.

Sex	Russia	Poland	Czechoslovakia	Hungary	Former East Germany
Men	30.8	31.7	32.4	30.8	31.2
Women	36.0	34.3	34.9	32.4	33.6

1. Adapted from the World Health organisation, MONICA study; Seidell JC, Obesity in Europe: scaling an epidemic, 1995.

Between 1983 and 1986, the WHO MONICA study was conducted to determine the distribution of BMI $\geq$ 30.0 among 48 population groups of men and women aged 35-64 years. The countries included were the majority of European countries, as well as Canada, USA, and China. The results showed that in all but one male population, and in the majority of female population, between 50% and 75% of adults aged 35-64 were either overweight or obese. Based on the evidence of increasing prevalence of obesity on a global basis, the current situation is likely to be even worse (Report of a WHO Consultation on Obesity, 1998).

Secular trends data are available for Brazil, USA, and Canada (Table-2.3). These figures indicate that obesity rates for both men and women are increasing not only in developed countries, but also in developing countries and in countries in transition, such as Brazil.

Table-2.3 Trends in Obesity (BMI≥ 30.0 kg/m²) in selected countries in the Americas.

	Brazil		Canada		USA		
Year	1975	1989	1978	1988	1960	1978	1991
Prevalence of Obesity							
men	3.1	5.9	6.8	9.0	10.0	12.0	19.7
women	8.2	13.3	9.5	9.2	15.0	14.8	24.7

Report of a WHO Consultation on Obesity. 1998

In both Eastern and sub-continental Asia, the prevalence of obesity lags behind that in the United States, but is rising (Gopinath, 1994; Popkin, 1995). However, good quality, nationally representative, secular trend data for countries in the South-East Asian Region were not identified. Nonetheless, data from two studies in Thailand showed that diet-related chronic diseases, including obesity, are on the increase in affluent urban populations (Tanphaichitr, 1990).

In Africa, a similar picture is emerging (El Mugamer, 1995). In the majority of African countries, the situation is one of undernutrition and food security. However, some of the countries, such as Mauritius and South Africa, have shown similar trends of increasing obesity as seen in the West (Table-2.4).

Table-2.4 Prevalence of obesity (BMI≥ 30.0 kg/m²) in selected countries in Africa

Country	Year	Ages (years)	Prevalence of obesity (%)	
			Men	Women
Ghana	1987/8	20+	0.9	0.9
Mali	1991	20+	0.8	0.8
Mauritius	1992	25-74	5	15
Rodrigues				
Creoles	1992	25-69	10	31
South Africa (Cape Peninsula)				
Blacks	1990	15-64	8	44
Tanzania	1986/89	35-64	0.6	3.6

Report of a WHO Consultation on Obesity. 1997

2.1.1. Obesity in selected countries of the Arabian Gulf

In the oil producing countries of the Gulf region (Table-2.5) studies of obesity in men and women have shown a similar increasing trend (Al Awadi & Amine, 1989; Proceedings of a Workshop on Nutrition and Chronic Disease in Arab Middle East Countries, 1994; Al Shammeri, 1994; Al Isa, 1995; El Hazmi, 1995). A study on overweight and obesity in 3000 adult women conducted by Al-Awadi and Amine (1989b) where obesity was categorised as slightly obese if body weight was 20-49% in excess of ideal weight, moderately obese if 50-79% in excess of ideal body weight, and very obese if 80% in excess of ideal body weight. The results showed that 53% were slightly obese and 42% moderately obese. It also showed that obesity increased in those of low social class, low level of education and those with large families (more than 4 children). A more recent study conducted by Al-Isa (1995) on overweight and obesity in men and women attending health clinics for minor ailments between the ages 18-60 years have shown that 68% of men and 73% of women were categorised as grade I obesity (BMI > 25.0) and 32% and 40.6% grade II obesity (BMI >30.0) respectively. El-Hazmi and Warsy (1997) conducted a study which was

Table-2.5 Obesity prevalence (BMI ≥ 30.0 kg/m²) in selected Eastern Mediterranean Countries.

Country	Year	Ages (years)	Prevalence of obesity (%) Men	Women
Bahrain	1991-92	20-65	9.5	30.3
Kuwait	1994	18+	32	44
Saudi Arabia	1990-93	15+		
Total			16	24
Urban			18	28
Rural			12	18
United Arab Emirates	1992	17+	16	38

Report of a WHO Consultation on Obesity, 1998.

part of the national study of various aspects of diabetes mellitus in different areas of Saudi Arabia. The results reported the prevalence of obesity, defined as BMI ≥ 30.0, in males and females of the 15-70 year age group to be 13.05% and 20.26% respectively. In the Proceedings of the Workshop on Nutrition and Chronic Diseases in the Arab Middle East Countries (1994), obesity among females, (BMI ≥ 30.0), has been reported to be 38% in the United Arab Emirates , 64% in Bahrain, 27.6% in Oman and 33.6% in Qatar. These prevalence rates are higher than rates reported in the United States of America (19.7% in males and 24.7% in females 20-64 year old), Australia (11.5% in men and 13.2% in age 25-64 year), the United Kingdom (15.0% and 16.5% in males and females respectively; 15-64 years old), and Italy (4.9% and 3.9% in males and females respectively; 15-44 years old; 9.9% and 11.1% in males and females respectively; 45-64 years old) (Epstein and Higgins, 1992).

Industrialisation and adoption of western lifestyle habits clearly predisposes these populations to weight gain and the associated metabolic consequences. In the future, obesity induced diseases will increasingly compete with infectious diseases. Consequently the medical complications of obesity will impose a heavier burden on the already fragile health-care systems of many nations.

2.2. Classification of Obesity

Descriptions of obesity have changed as classifications have been revised. Quetelet's index of body mass, that is weight in kilograms divided by height in meters squared (wt / ht ^{2}), provided a classification that placed a desirable range of weight and height distribution for men and women to be at 20.0-25.0 kg/m^2. This classification thus placed grade I obesity at a body mass index (BMI) of 25.0-29.9, grade II obesity at 30.0-39.9, and grade III obesity at $\geq$ 40.0 kg/ht^2; at the grade III level, there is morbid obesity (Garrow, 1988).

The World Health Organisation (WHO, 1998) revised the classification of obesity in 1997 thereby making two modifications; 1) obesity was defined as a BMI $\geq$ 30.0, and 2) a new category of obesity was created, class II obesity . Thus, the revised classes, seen in Table-2.6, are as follows: class I obesity (30.0-34.9), class II obesity (35.0-39.9), and class III obesity ($\geq$ 40.0), overweight (pre-obese, 25.0-29.9), normal (18.5-24.9), and underweight ($\leq$ 18.5).

Table-2.6 Classification of overweight in adults according to BMI kg/m^2.

Classification	BMI (kg/m^2)	Risk of co-morbidities
Underweight	< 18.5	Low (but risk of other clinical problems increased)
Normal range	18.5-24.9	Average
Overweight	$\geq$ 25.0	
Pre Obese	25-29.9	Increased
Obese class I	30-34.9	Moderate
Obese class II	35-39.9	Severe
Obese class III	$\geq$ 40	Very severe

Adapted from: WHO, 1998 Obesity, Preventing and Managing the Global Epidemic.

2.3. Determinants of Obesity

Research on weight gain and obesity has identified a number of factors that leads to this problem (Grundy, 1998). Among these are age, occupation, level of awareness that may come through education, maternal and reproductive characteristics such as short pregnancy interval and breastfeeding practices, physical inactivity and sedentary lifestyle. There are also gender differences; for example, although relative body weight increases with age, the proportion of fat body mass to lean body mass is more in women than in men (Van Itallie, 1985). This gender difference in body composition changes are probably related to the reproductive and maternal factors and menopause. Other researchers have also noted that with increasing industrialisation and urbanisation, the prevalence of obesity is expected to rise as the availability of food increases and a reduction of physical activity increases (Grundy, 1998). Even then, industrialisation does not necessarily mean a parallel change in societal behaviour. Customs and traditions have changed very little, if at all, in many societies although evidence of the influence of western life style is noticeable in certain aspects such as food habits. It may be that the combination of western influence but at the same time the preservation of tradition, such as perception of weight status, has contributed to the increasing risk of obesity and its health implications.

2.4. Health Consequences of Obesity

There is conclusive evidence that obesity is associated with a range of chronic non-communicable diseases such as atherosclerotic vascular diseases (CHD, hypertension, and stroke), NIDDM, some forms of cancer, degenerative disease of joints, gall bladder stones, sex hormone imbalance and respiratory diseases. It must be noted that many of the above mentioned complications of obesity are the consequence of the metabolic complications that are associated with excessive fat deposition. In addition, the detrimental health consequences of obesity are influenced to a greater or lesser extent by body weight, the location of body fat, the magnitude of weight gain during adulthood, and a sedentary lifestyle (Bray, 1988). Overweight has been associated with excess mortality in many studies (Armstrong et al, 1951; Build and Blood Pressure Study, 1960; Lew, 1961; Build and Blood Pressure Study 1979).

Table-2.7 presents mortality data from three such studies, namely: (1) the Build and Blood Pressure Study of 1959, (2) The American Cancer Society study, and (3) the Build and Blood Pressure Study of 1979.

Table-2.7 Mortality ratios according to variation in weight.

	Build and Blood Pressure Study 1959		American Cancer Society Study		Build and Blood Pressure 1979	
Weight Group	Men	Women	Men	Women	Men	Women
20 % Underweight	95	87	110	110	105	110
10% Underweight	90	89	100	95	94	97
10% Overweight	113	109	107	108	111	107
20% Overweight	125	121	121	123	120	110
30% Overweight	142	130	137	138	135	125
40% Overweight	167		162	163	153	136
50% Overweight	200		210		177	149
60% Overweight	250				210	167

1. Each study measured departures from its own set of average weights, where mortality would be 100. Van Itallie, 1979.

2.5. Obesity in Kuwaiti Women

The state of Kuwait lies at the corner of the Arabian Gulf. To the north and west it shares a border with the Republic of Iraq. To the south and south west it shares a border with Saudi Arabia. To the east it has a coastline on the Arabian Gulf. The total area is 17,818 square kilometres. The weather of the region is typical of the Sahara geographical region. In 1996, the mid year population of Kuwait was 1,036,026. Of these 717,95, (69%), were Kuwaiti nationals. Kuwait is highly urbanised with 96% of the population living in urban areas. Life expectancy is 72 years for men and 76 years for women (Health and Vital Statistics Department, 1996; Statistical and Information Center, 1997).

Since the early 1980s, several studies in Kuwait have been conducted that mainly looked at the prevalence and determinants of obesity among Kuwaiti nationals. Some of the studies on obesity on the adult population also assessed the association of the metabolic complications of obesity. However, the sample selected for these studies were clinic walk-in patients and not community based which can affect the representativenesss of the sample.

Several studies on obesity have been conducted on different age groups; *viz.* school children, adult males and females (Al-Awadi, 1989b; Al-Awadi, 1990; Amine, 1993; Al-Awadi, 1994). Weight for height indices have been used as reference values (overweight if current weight $\geq$110% ideal weight, obese if current weight $\geq$120% ideal weight). Using the same criteria for obesity, Eid et al (1986) reported that 18.1% of Kuwaiti boys and 26.8% of girls aged 6-17 years were obese. Al-Awadi and Amine (1989b) conducted a study in Kuwait on overweight and obesity among adult females using the same criteria. The results showed that 20.6% of the young females, less than 20 years, were obese. The results also showed that obesity increased with age to a maximum value of 57.2% among females aged 40 years compared to 26.9% in males. The study also looked into the possible contributing factors leading to obesity and reported that obesity was most prevalent among those of low education level, and those of low social class. Of those in the low level of education, it was found that being obese was more attractive to husbands which encouraged the wives to keep their fatness. The reliability of this finding depends on the accuracy of the information and the sample that was used.

A cross-sectional study of obesity among adult Kuwaitis attending primary health care clinics for minor illnesses by Al Isa (1995) showed that 36.4% of Kuwaiti women had a BMI 30.0 -39.9 and 4.2% BMI $\geq$ 40.0. An analysis of two independent cross-sectional studies, one in 1980-1981 and the other in 1993-1994 , was conducted to determine the temporal changes in body mass index (Al Isa, 1997). The first study was part of the Nutrition Status Assessment of Adults conducted by the Unit of Nutrition, Ministry of Public Health and Planning in Kuwait in 1980-1981. The second included a sample drawn from ambulatory clients attending the primary health care clinics for minor aliments and of those accompanying them. The results showed a significant average increase ($P < 0.001$) of 13.7% of obesity defined as BMI $\geq$ 25 kg/m^2 between 1980-1981 and 1993-1994.

An excess of abdominal fat is a potent risk factor for the development of diabetes and cardiovascular disease (Han et al, 1995). However, there is limited information regarding the body fat distribution in obese Kuwaiti women.

2.6. PURPOSE AND DESIGN OF THE STUDY

The purpose of this study is: (1) to determine the prevalence of obesity among Kuwaiti female adults, (2) to identify the characteristics of this obesity, (3) to identify contributing factors to the obesity, and (4) to determine the association of obesity to metabolic and other health disorders.

All recent studies of obesity in Kuwait have sampled the population through those attending primary health care clinics or accompanying a client to the clinic. These studies have all indicated that a large number of the Kuwaiti female population is overweight or obese. However, the representativeness from this method of sampling has limitations and is thus questionable. This study improves on population representativeness by employing a design of random sampling from health centre registries where all families are required to register. Furthermore, in previously conducted studies, the characteristics of obesity were not comprehensively explored, nor its contributing factors or associated health disorders. This study undertakes a comprehensive examination of these issues pertaining to obesity among adult Kuwaiti women. There have been no studies in Kuwait to characterise the obesity or to assess the distribution of fat in obese women.

In this cross-sectional study, adult Kuwaiti females between 20-60 years of age were randomly drawn from health centre registration files. The randomly selected subjects were interviewed and administered a questionnaire pertaining to socio-demographic, lifestyle and maternal characteristics. Measurements of blood pressure and anthropometry were taken as well as venous blood samples.

CHAPTER III

REVIEW OF THE LITERATURE

Obesity is a serious public health problem facing the world today. It is increasing in developed as well as in some of the developing countries; in the latter it has replaced malnutrition and food security which used to be life threatening. Obesity is affecting people of all age groups; the prevalence is rising alarmingly in children due to reduced leisure time physical activity and increased sedentariness. Gradual weight gain is observed with ageing due to reduced activity levels, more time spent indoors as well as the replacement of muscle tissue by adipose tissue. These factors lead to lowered total energy expenditure and subsequently to weight gain. Furthermore, women are more predisposed to weight gain and obesity than their male counterparts. Adipose tissue is deposited during puberty, pregnancy, and lactation to accommodate for the physiological bodily changes and the increased energy requirements over the reproductive cycle.

One of the contributing factors to weight gain is the way people perceive obesity. For a considerable amount of time, the media were and still are responsible for sending the wrong messages as far as weight status and its relationship to glamour and beauty is concerned. Many teenagers and adolescent girls misinterpret this and suffer the other extreme of eating disorders such as anorexia nervosa. However, in other societies weight status is perceived differently. For example, women are regarded as beautiful if they were overweight or obese. Similarly, husbands prefer their wives to be overweight or obese too. Furthermore, customs and traditions probably play an underestimated role concerning food habits and social behaviour.

Obesity is, to an extent, a heritable disorder in terms of both total body fatness and body fat distribution. The presence of susceptible genes makes an individual more at risk of becoming obese but does not necessarily indicate the inevitable development of obesity. There is an overlap, because it is here that the environment plays an important role to either encourage the development of obesity or diminish it.

Many industrialised nations are privileged with stable political governments and strong economies. The citizens of these nations enjoy the comforts of affluence; namely: good income, plenty of food, and the use of technology for the provision of optimal efficiency and comfort and at the same time minimal physical activity. However, the other side of this pretty picture is the rising rates of non-communicable and chronic diseases such as CHD, NIDDM, and hypertension.

3.1. Definition and classification of obesity.

Obesity is simply a state of excess adipose tissue which can be localised or general. For many years methods for estimating obesity in population was extremely difficult due to wide inter- and intra- population variation as well as ethnic and racial group mixing which results in genetic herteogeneity. Consequently, there is wide variation in weight, height, and other body measurements, such as waist and chest circumferences.

Several methods have been used in epidemiological studies to estimate and classify obesity; Quetelet (1871) has derived one of the earliest. Standardised charts of body weight for height, such as those used in Life Insurance Companies, have been used because they provided a means of defining a normal range for weight. However, these were later considered inaccurate. Later, other indices were developed and used to assess the appropriateness of weight to height measurements and these include: the Quetelet Index or Body Mass Index (BMI), {weight (kg)/height (m) ^{2}}, Khosla-Lowe Index, {Weight (kg)/height (m) ^{3}}; and Benn Index, {weight (kg)/height (m) ^{2}}. BMI or the Quetelet's Index is now widely used because of its simplicity of computation, practicality, and cost effectiveness. More accurate and precise methods of estimating adiposity exist but are expensive and difficult to employ on a large scale community based studies.

Although, it has its limitations in that it does not provide a direct measure of adiposity or fatness, but rather a measure of proportional weight (Ledoux et al, 1997), the Quetelet's Index or BMI {weight in kilograms (g) divided by height in meter squared

(m^2)} is the most widely used and accepted anthropometric index. It provides a simple and more precise approach to the increase of weight with increasing height. It is also a simple to determine index of overweight and is claimed to be a significant predictor or risk factor of atherosclerotic CVD.

Garrow (1981) classified obesity into three grades (Table-3.1). The desirable range for adult men or women is 20-25 kg/m^2, which he called Grade 0. Grade I obesity corresponded to a body mass index of 25-29.9, Grade II of 30-40 and Grade III > 40 kg/m^2. Grade III corresponded to morbid obesity. This classification system was recognised as an international standard until recently (Jequier, 1987).

Table-3.1 Classification of body mass index (BMI)[1]

Grade	BMI (kg/m^2)
0, desirable	20 - 24.9
I, overweight	25-29.9
II, obese	30-39.9
III, morbid obesity	> 40

1. Garrow's classification, 1981

3.1.1. Current Classification of Obesity

In 1997, the Technical Committee of the World Health Organisation (WHO) revised the classification of BMI and compiled a modified version based on the Quetelet's index or BMI. It has made two modifications; the cut-off for obesity became BMI $\geq$ 30.0 instead of > 25.0, and added a new category, BMI = 35 to 39.9, due to the fact that the management of obesity differs above this cut-off point (Table-2.6).

3.1.2. Body Fat Distribution

The major weakness of BMI is that it indicates excess body weight and not fat, and more importantly, does not account for the variation in the distribution of fat within the body.

There is conclusive evidence that the health implications of obesity are not only related to total body fat but also to body fat distribution (Bray, 1988). Where excess fat is located within the body may actually be more important than the total body fat. Two classifications of body fat distribution are recognised: upper body, android or male type (apple shaped); and lower body, gynoid, or female type (pear shaped) (Bray, 1988). Android obesity is when obese persons have a greater proportion of fat within the upper body, especially within the abdomen, compared with that within the hips and thighs. Gynoid obesity is when obese persons have most of their fat within the hips and thighs. Android obesity is generally, but not always, seen in obese males; whereas, females generally carry a greater proportion of their body fat on the hips and thighs (Bray, 1988).

Determining the ratio of the waist or abdominal circumference to the hip or gluteal circumference, i.e., waist-hip ratio (WHR), is one method of assessing regional body fat distribution and is a valuable guide in assessing health risk (Bray, 1988). The circumference of the waist relates closely to the body mass index and is also the dominant measurement in the waist: hip ratio which reflects the proportion of body fat located intra-abdominally, as opposed to subcutaneously (Bjorntrop, 1987). Waist circumference is also the best indicator of changes in intra-abdominal fat during weight loss (Van der Kooy, 1993). Waist circumference is, nonetheless, unrelated to height (Han, 1995) and predicts well total and abdominal fat content in adult women (Taylor, 1998). WHR > 0.85 is used as a clinical method of identifying patients with abdominal fat accumulation (James, 1996). Women have an almost equivalent absolute risk of coronary artery disease to men at the same waist-hip ratio (Larsson, 1984). However, they show increases in relative risk of coronary heart disease at lower waist circumference than men (Han, 1995). Han and associates (1995) assessed the relative risk for a random sample of 2698 women aged 20-59 from the Netherlands. Their results indicated that the risk of obesity- associated metabolic complications were increased for women with a waist circumference of ≥ 78.0 cm and substantially increased at a waist circumference ≥ 88.0 cm.

Populations differ in the level of risk associated with a particular waist circumference (WHO, 1998). Examples include the observation that abdominal fatness in black women is not as strongly associated with NIDDM as in white women (Dowling, 1993). South Asian migrants living in urban societies have a higher prevalence of many of the complications of obesity which is associated with abdominal fat distribution. The incidence of complications in the South Asian population group is significantly higher than for Europeans at a similar BMI (McKeigue, 1996). The prevalence of NIDDM and mortality from CHD have been shown to be higher in this population group and it is most likely due to the effects of central obesity / insulin resistance syndrome.

3.2. Factors Contributing To Weight Gain and Obesity.

Obesity is multifactorial; however, the fundamental problem is an energy imbalance where energy intake has exceeded energy expenditure over a considerable period of time. This is at the physiological level which is influenced by internal factors such as age, sex, and the genetic make-up as well as external factors such as changes in the environment, e.g., food habits, and lifestyle. The internal and external factors do not act separately but overlap and can even have an additive effect on each other. At the same time, when one observes how obesity is increasing in many societies in such a short period of time, it becomes hard to interpret that purely on the basis of genetic change.

3.2.1. Age

In the industrialised nations, obesity usually starts in infancy and it has been suggested that one third or more of infants in these countries are obese. Data from studies in school children, on the other hand, are more limited but have shown that the prevalence is between 6 and 15% and the general trend is a continuous increase (WHO, 1998). Hard evidence is lacking, but data from WHO (1998) and Japan (Kotani, 1997) have reported that obesity in children or adolescents increases the likelihood of obesity later on and increases the prevalence of obesity-related disorders.

Relative body weight increases with age in both men and women, but there is a greater proportional increase among women than men (Van Itallie, 1985). Most of the increase in weight occurs in adipose tissue (Garrow, 1991). Moreover, if muscle mass decreases with age, the increase in adipose tissue mass may actually exceed absolute weight gain. When adipose tissue mass increases, not all of the gain is in the form of fat (triglycerol) *per se*. Adipose tissue itself contains a component of lean body mass; nearly 25% of the increment in weight occurs in the lean portion of adipose tissue (Garrow, 1991). When young adults gain weight, the additional weight is a combination of both muscle and fat tissue, the increase in muscle mass is probably to support the increase in fat tissue. However, because the ageing process is accompanied by loss of muscle mass, any increase in weight is probably composed primarily of adipose tissue (Grundy, 1998)

The causes of weight gain with ageing are multifactorial. Efforts to delineate these causes seem worthwhile at this point in time since each determinate or factor may be a target for public health intervention to deal with the problem of increasing weight gain as age advances. Because weight gain typically occurs slowly over decades, from age 20 to 50 years (National Institute of Health, 1979), most causes of weight gain are likely to be insidious. Certainly in some persons the gain in weight can occur in sizeable, short-term increments followed by stable periods. Many people probably are unaware of the gradual accumulation of body fat, or may view it as innocuous and inevitable, and even as a sign of maturity.

3.2.2. Sex

Obesity affects populations of all age groups. However, more women than men suffer from this problem. It is widely stated that pregnancy is a major contributor to permanent weight gain in women and that the higher prevalence of overweight in women compared to men is partly due to childbearing (Brown et al, 1992). Several cross-sectional and longitudinal studies have been conducted to investigate the relationship of maternal and reproductive factors and weight change and the long-term public health implications for women.

However, the results of many studies often overestimate the effect of pregnancy on long-term changes in maternal body weight. Cross-sectional studies do not account for confounding factors such as age. Longitudinal studies overcome this bias, but share other weaknesses such as tendency to rely on recalled pre-pregnancy weights or not to include an adequate control group to control for the weight gain that usually occurs with increase in age (Rookus et al, 1987; Smith et al, 1994; Harris et al, 1997). A cross-sectional study that investigated this relationship on a sample of 17688 non-pregnant women aged 25-48 showed parity to be closely related to adiposity and prevalence of obesity. This was part of a multiphasic screening examination of women who took part in this study in various parts of Finland in 1966-72. The relationship was independent of other factors such as marital status, occupation, smoking habits, and geographical area (Heliovara et al, 1981). It has also been reported that some women put on more weight with each successive pregnancy and that 15% of those women taking part in this study remain at a weight five or more kg heavier at one year postpartum compared to their pre-pregnancy weight.

Other studies examined the effect of parity on fat distribution as well which showed significant relationship between waist hip ratio (WHR) and repeated pregnancies (Rodin et al, 1990). This is consistent with the results of a prospective cohort of 2788 women (53% black) aged 18 through 30 years which examined the longitudinal association between a pregnancy and persistent changes in adiposity in young black and white women (Smith et al, 1994). The results showed an increase in weight by 2-3 kg in both white and black primiparous women during the first 5-year period compared to women who remained nulliparous. In addition, the women also demonstrated an increase in WHR compared to nulliparous women. The data also indicated that it is the first pregnancies that are associated with weight gain beyond that expected with age. The increase in weight and WHR were independent of demographic and life style factors.

These results are in contrast to the longitudinal study that assessed the effect of pregnancy on the body mass index (Rookus et al, 1987). The change in the body mass index from pregestation through 9 months postpartum in 49 pregnant women was compared with the change in the body mass index during the same period of follow-up in 400 non-pregnant women. The observations suggested that there was not a significant difference in the change in BMI between the two groups than that expected from ageing. It was also suggested in this study that maternal obesity might be the result of the changed life-style associated with having children rather than factors related to the pregnancy itself. This is consistent with another study that investigated parity related weight change in women which indicated a strong association between ageing and weight gain and a weak association between parity and both weight and overweight in women (Brown et al, 1992). In this study it was suggested that the association between greater parity and weight gain could be related to food availability, physical activity and stress levels, income and other environmental changes that may accompany an increasing number of children in the household.

Ohlin and co-workers monitored body weight development during pregnancy for 2295women, and up to one year post-partum for 1423 women at 14 maternity clinics throughout Stockholm. The results showed that weight gain during pregnancy was highly correlated to post-partum weight retention. The results also showed that weight gain in the third trimester explained more of the increase in weight than the other trimesters. However, when pre-pregnancy weight was included in the analysis, the first trimester showed stronger correlation to the increase in weight (Ohlin et al, 1990).

These results are in agreement with other studies that indicated that body weight increases with parity, and that many women have a higher body weight at the beginning of a subsequent pregnancy compared to the previous one (Rossner, 1992). The association of the effect of childbearing on weight change in 2547 white women aged 25-45 years who were initially weighed in the First National Health and Nutrition Examination Survey (1971-75) and who were re-weighed an average of 10 years later indicated that the average weight gain associated with childbearing after the age of 25 is quite modest in US white women. However, for some women who gave birth after the age of 25 the risks of major weight gain and becoming overweight are increased in association with childbearing (Williamson et al, 1994).

The association of weight change in women and pre-pregnancy weight was also assessed. In one study, pre-pregnancy weight and previous weight history did not seem to be predictors for weight change after delivery (Ohlin et al, 1990). This is in contrast to a retrospective, repeat-pregnancy study which examined the change in maternal body weight from the beginning of the first successful pregnancy to the beginning of the second of 243 mothers. The results showed that pre-pregnancy BMI determines long-term weight gain which occurs during pregnancy and the post-partum period. Those mothers who gained more weight from their first pregnancy gained more weight from one pregnancy to the next. This suggests that pregnancy may be associated with a permanent increase in maternal body weight simply because it is a period of positive energy balance during which some women gain excessive amounts of weight (Harris et al, 1997).

There have been conflicting reports on the effect of lactation on body weight during the postpartum period. It is suggested that 3.0-4.0 Kg of fat are deposited during pregnancy that serves as an energy reserve to be modified during the lactation period. The results of a Swedish study indicated lack of correlation between lactation and post-partum weight loss, and even showed that women who lactated for more than 2 months had retained more body mass than women who lactated for a shorter period of time. Similar findings were observed in the study on maternal body weight development after pregnancy; the association of lactation to change in weight post-partum was weak. The effect of lactation had the largest effect on weight loss between 3-6 months post-partum and in only a small group of women who exclusively breastfed for a considerable length of time. The study group suggested that may be this group had a high health consciousness and dietary habits that facilitated the post-partum weight loss. This means that lactation has no general clinical importance for post-partum weight loss for the majority of women, and cannot be practically used as a predictor for weight development after delivery (Ohlin et al, 1990).

The biological nature of the women is, to a certain extent, responsible because at specific physiological stages in the life cycle, adipose tissues is deposited in her body. This phenomenon occurs as a result of the sudden surge of sex hormones which are released for preparing the body for further maturation of the reproductive organs as well as for the support and the satisfaction of the energy requirements during pregnancy and lactation.

At puberty, during pregnancy and lactation adipose tissue is deposited mainly in the gluteal region which has the role of providing for energy during pregnancy and lactation. Some women gain weight after marriage; this is probably more related to environmental factors.

Hormones cannot be entirely held responsible for weight gain, since other factors are also involved. Total energy intake is one factor; many women have the wrong concept that they should feed two persons during pregnancy and, as a result, the total calorie intake is increased. This concept is not entirely wrong; there is an increased need of approximately 300 calories per day needed for the development of the foetus. That really translates into 500 cal per day after confirmation of pregnancy. This is particularly true for those who also experience nausea of pregnancy. Weight gain during pregnancy should be 12-15 kg depending on pre pregnancy weight. It is the quality of the food intake that matters. No one should limit their intake during pregnancy (i.e. lose weight) or the likelihood of a low birth weight infant occurs with all of the problems with that. The increase in intake for pregnancy is 500 over a 2000 kcal diet or at least 20%-25%. At the same time, in many societies culture plays a role; older women provide specially prepared high-density meals to nurture the pregnant mother which over the nine months increases the quantity as well as the quality of food consumed. These cultural practices have been protective for pregnant mothers in the past. The issue now is the pre-pregnancy weight may indeed be already high. Then the quality of food becomes paramount. In addition, pregnant mothers reduce physical activity to a minimum from the first month to avoid complications such as the loss of the baby. Another important factor is lactation. In this day and age, most mothers are at least aware of the nutritional benefits of breastfeeding but the majority do not realise that they should breastfeed exclusively for a specific period of time. Others are concerned about the risk of conceiving again. This is the result of lack of proper information at ante-natal clinics where education programs for mother and child should be intensified for the health benefit of both.

The interval between pregnancies is a very crucial factor. The shorter the interval the less time there is to be rid of the fat tissue laid from the previous pregnancy, and at the same time more fat tissue will be laid down in preparation for the next pregnancy. Parity, total number of pregnancies, is another risk factor. A study by Raissanen (1991) on the determinants of weight gain and overweight in 12,669 adult Finns found that childbearing did not result in permanent weight gain in the well-educated women but did so in other women. It was also shown in the same study, that the prevalence of weight gain increased with the number of children. There should be no reason for mothers not to be educated and informed of the risk of obesity during pregnancy, breastfeeding and its related health consequences in the long run.

3.2.3. Genetic Factors

Fatness runs in families and the evidence for a genetic contribution towards this predisposition comes from several types of studies. For instance, it has been reported that obese children frequently had obese parents (Bouchard, 1994). It was found that in about 30% of the cases, both parents of obese children are obese, with a range in frequency of about 5-45%. It has also been estimated that about 25-35% of the obese cases occur in families with normal weight parents despite the fact that the risk of becoming obese is higher if the person had obese parents. A study was conducted which compared the current body mass index of full adoptees with that of their biological full and half siblings from whom they were apart (Thorkild et al, 1989). The adoptees represented four groups who by sampling from a larger population were categorised as thin, medium weight, overweight, or obese. The results showed that in full siblings body mass index of the half siblings showed a steady but weaker increase across the four weight groups of adoptees. Body mass index of the half of the half siblings showed a steady but weaker increase across the four weight groups of adoptees. There were no significant interactions with sex of the adoptees, sex of the siblings, or sex of the common parents. The degree of fatness in adults living in the same environment appears to be influenced by genetic factors independent of sex, which may include polygenic as well as major gene effects on obesity. The same group of researchers conducted another study that assessed the correlation in body mass index between adoptees in childhood and both their biological fathers and adoptive parents as well as their age-matched biological and adoptive siblings (Thorkild et al, 1992). The data from this study showed that a genetic influence on body mass index as strong as that in adult life is already expressed by age 7 years. The rearing environment shared by the family has a real influence during childhood.

In another study it has been reported from a number of twin and adoption studies that there is strong evidence for a heritable component of human obesity (Stunkard, 1986; Stunkard, 1990; Bouchard, 1990) and that the familial correlation in total body fatness, expressed as BMI, from parent to offspring is about 0.2, and from sibling to sibling 0.25 (Bouchard, 1988; Friedlander, 1988; Jebb, 1997). Other reports highlight the fact that there may be single or multiple genes responsible for some individuals to be overweight or obese. However, this does not appear to hold true for the majority of people. Other adoption and twin studies have concluded that the true heritability estimate for BMI in large sample sizes was likely to be from 25% (adoption) to 40% (twins) (Bouchard, 1995; Bouchard, 1996).

The level of heritability is another issue that has been investigated. The level of heritability is simply the fraction of the population variation in a trait – such as BMI- that can be explained by genetic transmission. Nonetheless, results obtained by other investigators indicate that the heritability level estimates depend on how the study was conducted and on the kind of relatives upon which it is based. For example, studies conducted with identical twins and fraternal twins or identical twins reared apart have yielded the highest heritability level, with values clustering around 70% of the variation in BMI. In contrast, the adoption studies have generated the lowest estimates, i.e. up to about 30%. Studies investigating families have generally found levels of heritability intermediate between the twin and the adoption study reports. Few investigators have included all or most of these kinds of relatives in the same analysis. (Bouchard, 1996).

Garrow, on the other hand, (1993) argues that although obesity runs in families, that does not prove that it is genetically determined. The characteristic that is inherited is a tendency to overeat in some circumstances. If this tendency is resisted, obesity will be avoided. The current consensus is generally in agreement with this argument in that genes involved in weight gain increase the susceptibility or risk of an individual becoming obese only if that individual is exposed to a risky environment (National Institutes of Health Consensus Development Conference Statement, 1986; WHO, 1997). At the same time, epidemiological research to determine the effects of genetics on fat distribution has suggested that central fat accumulation is more strongly influenced by genetic factors than subcutaneous fat (Perusse, 1996; Jebb, 1997; Bouchard, 1998).

Obesity is a complex multifactorial trait that is influenced by the interactions of several factors from the social, behavioural, physiological, metabolic, cellular, and molecular domains. This makes the isolation of a single gene impossible and no matter what the influence of the genotype on the aetiology, it is generally made weaker or stronger by non-genetic factors.

3.2.4. Environmental Factors

The interaction of low levels of physical activity, high total caloric intake in the presence of high-density food have contributed to the high risk of weight gain and obesity and the health risks associated with that. This combination has been the underlying problem related to industrialisation and modernisation of our lives where technology has developed and is still developing all the means of comfort for populations to do the least physical activity in the presence of a wide variety and great quantities of food. Over the years, nutrition related non-communicable diseases have increased in the majority of countries of the world; developed and developing (James, 1995).

3.2.4.1. Food Intake

It is well known that within any society, the size of a child or an adult reflects the outcome of interactions between environmental factors, such as dietary intake and physical activity, and the genetic potential for growth. The genetic contribution to BMI within a population has been considered to range between 25% and 75% of the variance in BMI. The dietary component, an important part of energy balance, is not as well determined. However, in a publication which assessed some of the environmental factors relating to BMI in a very large and comprehensive household survey in 1974 in Brazil and involved 51000 households in all parts of the country, the results showed that there was a positive association between the fat content of the diet and weight gain if the fat content was 12% or more of the total energy intake (Francois et al, 1994). It was also shown that below this value the relationship does not hold. Other data on energy intakes suggest that the total available energy in low fat diets may be the prime determinant of whether BMIs fall below 18.5. Analysis of the data from this study did not discuss the mechanisms whereby dietary fat influences the development of overweight. Nonetheless, it was clear to the investigators not only was there a poor thermogenic response to fat but appetite control is less able to induce the appropriate control of inhibition of food intake when high fat diets were being consumed (James, 1996).

To determine the role of the macronutrient composition of total energy intake, and specifically the effect of increasing the fat content in the diet, on weight gain, two calorimeter studies were conducted by the same group of researchers. In the first calorimeter study, the researchers used three manipulated diets which were low, medium and high in fat. The results showed that increasing the percent fat and energy density of a diet led to a marked increase in energy intake in six men, resulting in a mean positive energy balance of 17.3 M over 7 days on high fat diet (Stubbs et al, 1994). In the follow-up study, the researchers used an identical dietary regimen to seven men who were residents in, but not confined to, a metabolic suite for two weeks' diet. This added a component of increased physical activity will be discussed in the following section. The results showed that, in both studies, there was an increased energy intake as the energy density and fat content of the diet increased. The results also indicated that carbohydrate balance and protein balance, either directly or indirectly, showed potential to exert suppressive effects on subsequent intake, whereas fat balance tended not to show this potential (Stubbs et al, 1995).

Some people are fortunate enough to overindulge in one of life's pleasures, food, without having to worry about its consequences; weight gain. However, this group of people are a minority and are often labelled to have an inefficient energy metabolism which may be the result of a genetic defect. However, for the majority of people, weight gain is the consequence of an imbalance in energy metabolism; namely, energy intake exceeding energy output. Researchers interested in the aetiology of obesity have conducted studies to investigate factors such as appetite control, satiety and food density as well as food habits and their role in weight gain and obesity (Jebb, 1997).

One such study has been conducted to investigate the role of appetite control to weight gain and obesity and has suggested that obese individuals are unable to control their appetite at a meal, even after a pre-load, when compared to lean individuals (Spiegel, 1989). But, because such studies are of short duration and are usually conducted in an artificial environment, the results may not give an accurate account of eating behaviour.

In addition, studies conducted to determine the effect of individual macronutrients on satiety have shown that fat has a weak satiating capacity compared to protein and carbohydrates (Decastro, 1987; Hill, 1990; Lawton, 1993; Rolls, 1994; Stubbs, 1995), and that fat is an important determinant of energy balance, especially in sedentary individuals. It is well known that fat diets are energy dense and studies have shown that the energy density of the diet is the principle factor determining the total quantity of food eaten (James, 1995).

When studies were done to determine food preference, although the results lacked accuracy, it was shown that the higher the fat content of food, the more the quantity of food consumed and thus the more the weight gain (Stubbs, 1994; James, 1995). Fat intake (as percent of total calories) rather than energy level is associated with increased adiposity for both male and female adults (Miller, 1990). It was reported that individuals that have small but frequent meals are more likely to lose weight than those that have fewer but larger meals (Jebb, 1997; Bellisle, 1997). However, the results of these studies were unreliable due to under-reporting by participants (Jebb, 1997).

3.2.4.2. Physical Activity

It is generally believed that physical activity in the western world has undergone a decline which is in parallel to the increasing mechanisation of life. This has affected both sexes; but has particularly affected women on whom society relies in the industrial world for carrying out most of the household work (Ferro-Luzzi, 1996).

Data from studies investigating energy expenditure and physical activity level (PAL) of populations in different parts of the world have shown that BMI is lowest in the third world subjects with a mean of 20.9 kg/m^2 for men and 21.0 kg/m^2 for women. In contrast, BMI is highest in the western subjects with a mean of 25.2 kg/m^2 in men and 25.3 kg/m^2 in women. After adjusting for BMI, the results showed only a non-significant difference in PAL value for men and no differences for women. The interpretations for these results were assumed to be related to the difference in leisure time activity (low in third world subjects, and high in western subjects) and to increased risk of exposure to chronic energy deficiency.

Studies were conducted to assess the relationship between PAL and obesity, that is whether fatter individuals tend to spend less energy than leaner individuals. In one such study the results showed that there was a drop in men from a PAL of 1.91 for individuals with a BMI below 18.5 kg/m^2 to 1.70 for BMI above 25.0 kg/m^2. In women, however, it was shown that for an increase of energy expenditure, from a PAL of 1.55, denoting a very sedentary lifestyle, to a PAL of 2.05, which was rather intense lifestyle, the BMI would drop by only 0.36 kg/m^2 (Ferr0-Luzzi, 1996). The same group of researchers questioned the amount of energy required to prevent obesity to occur in individuals. The results suggested that the risk of being overweight or obese is about sevenfold lower at a PAL of more than 1.8.

In the study conducted by Stubbs and others in 1994, to determine the effect of macronutrient composition of total energy intake, the second group of participants were exposed to an added factor, increased physical activity. The results illustrated that an increase in physical activity can limit the build-up of positive energy balance that frequently occurs when subjects feed ad libidum on high fat, high energy density diets. The data also suggested that increased physical activity can assist in precipitating a negative energy balance when subjects consume low fat, lower-energy density diets.

Physical activity is the most variable component of total energy expenditure (TEE) because it comprises a low of 15 % of TEE in sedentary individuals and as high as 50% in vigorously physically active individuals. One of the reasons populations are gaining weight and becoming obese is the fact that modernisation has provided energy-saving devices starting from the home environment all the way to the office environment. This has dramatically minimised the physical activity that used to be exerted to perform these tasks.

It is well recognised that physical activity is less in obese than in the lean, but this may result from, rather than cause, the obesity. Moreover, the amount of energy expended by an obese person on most tasks is likely to be more because of the extra weight to be moved (Edwards and Bouchier, 1991). Researchers investigating the physical activity levels (PAL) of subjects in relation to BMI have always faced problems of inaccuracies due to inter-individual variation or by the imprecision of the methods used. However, when the doubly-labelled water method was used it was shown that PAL was similar in subjects with a BMI < 20.0, 20.0-25.0, and 25.0-35.0 kg/m^2 in both men and women which means that their total physical activity level is similar. It also showed that those with a BMI > 35.0 had their physical activity level considerably reduced indicating that their weight probably was causing the disability to move (Coward, 1988; Prentice, 1996).

Several studies have indicated their results were in agreement with other studies that, in both sexes, there was an inverse relationship between physical activity and BMI (Kromhout et al, 1988; Jeffrey et al, 1991, Ferro-Luzzi, 1996). However, other studies did not find a significant association between physical activity at leisure and at work and BMI (Wamala et al, 1997). This could be attributed to under-reporting of participants. Obese subjects more than overweight or normal weight subjects have a tendency to underestimate their food intake, and overestimate the energy they expend in physical activities (Lightman et al, 1992).

Exercise probably has a positive effect on the protection of fat-free mass while promoting the loss of fat mass but does not appear to prevent the decline in RMR during weight loss, which is more closely related to the rate of weight loss. Similarly, long-term habitual exercise has not been found to increase resting metabolic rate (RMR) beyond its effect on lean body mass. Independent of its effect on energy expenditure and body weight, physical activity may also beneficially affect muscle fibre type, capillary density, and substrate utilisation. Finally, exercise alone can reduce body weight but, due to the lower total caloric deficit, the rate and amount of weight loss is less than can be achieved through dieting alone (Blair et al, 1995).

3.2.5. Lifestyle, Socio-Economic Status, and Other Factors

Overweight and obesity in any individual or population is the result of a long term positive energy balance. The transition that has accompanied rising economies, industrialisation of countries, and modernisation of our life styles has brought about rising rates of non-communicable diseases all over the globe. Developed nations are continually conducting research to try to understand the problem and to find solutions to solve it.

This transition has affected all age groups. Children are more obese because most of their time is spent indoors either watching TV, or playing computer games. There is very little time to spend exercising outdoors either because of school duties or for safety. Even at school, physical activity lessons are not as important as other academic subjects are and therefore are not given the best efforts. Adults are as pre-occupied; occupational work during the day, and domestic responsibilities after that. This is especially true for women. Physical exercise has become similar to other duties which has to be kept as an appointment. Obesity has also been found to be higher in those with a low level of education and in low-social classes (Seidell, 1995; James 1995).

Conclusive evidence for the influence of environmental factors on the prevalence of obesity were reported in the results of two National Health Nutrition Examination surveys (NHANES) conducted in 1976-1980 and again in 1981-1991 in the US (Kuczmarski et al, 1994). The first study showed that the prevalence of obesity was at 25%. However, less than 10 years later this rate increased to 33%. It was clearly indicated that the increase was not confined to the obese population. It included all weight classes, with an increase in the body weight of all Americans that averaged 3.6 kg. This increase in the prevalence of obesity over this short period of time cannot be entirely blamed on genetic susceptibility. The primary responsibility must lie on the environmental changes of populations (Stunkard, 1996).

An inverse relationship between obesity and socioeconomic status (SES) has previously been found. A study on a population of 1462 middle-aged women in Goteborg, Sweden was conducted to assess this relationship (Noppa et al, 1980). The results confirmed the inverse relationship between SES and obesity and also showed that the differences found between a woman's obesity level, her social class, and that of her husband indicate that the social class of husbands is a much stronger predictor of obesity in women than their own. Others investigated the whether race or socio-economic factors during adulthood were independently associated with a woman's likelihood of gaining weigh (Khan et al, 1991). In this study 514 Black and 2770 white women were included from an initial cohort of the NHANES I study. The results showed that Black women had a greater increase in mean weight compared to White women, and that women in greatest help in preventing weight gain were those with an education below college level, those with low family incomes, and those who were married. Black race did not appear to be an independent risk factor for weight gain.

Further research was carried out and interest was focused on factors that may explain the SES-obesity relationship. Lower SES individuals may eat more calories or eat a higher fat diet. They may exercise less and may engage less often and less successfully in efforts to control weight. Healthier behaviour in higher SES persons might be due to more exposure to information about healthy lifestyles, to greater access to opportunities to engage in healthy behaviours because of residential, employment, or economic advantage, and to normative expectations regarding personal appearance and life style (Jeffery et al, 1991).

A study was carried out to investigate the hypothesis that suggested that behaviours that affect energy balance may differ by social class (Jeffrey et al, 1991). They recruited a population of 2108 men and 2539 women in relation to social class. The results indicated that among men and women, social class was positively related to intentionally trying to control weight, to a diet lower in fat, to non smoking, and to forms of physical activity suggestive of purposeful training. These findings support the argument that higher SES individuals engage in a 'healthier' lifestyle that is reflected in a variety of behaviours. In agreement with other investigators, Tavani et al, 1994, found that in women age, social class education, and marital status were strongly associated with BMI. A more recent study examined overweight and obesity in relation to SES and several factors that may explain the social gradient in obesity among middle-aged women in Western society. These factors included unhealthy lifestyle {smoking, physical inactivity (at work and at leisure), alcohol consumption, unhealthy dietary habit}, intentional dieting, psychological stress (lack of self esteem, poor coping, poor quality of life, lack of social support, and job strain), and reproductive history. The results were consistent with other studies, that is low social class position and obesity were related to unhealthy dietary habits, and psychosocial stress. The limitations of these cross-sectional studies are that they do not account for how long term patterns of lifestyle, and psychological factors may influence obesity (Wamala et al, 1997).

The way an individual perceives their weight status is as important as the other factors. The majority of populations of the developed nations have had enough exposure to understand that obesity is bad, however among young girls, the message meant looking ugly and not fashionable. It is estimated that 50% of women dislike their bodies and fear overweight; two manifestations of a negative body image. There has been a trend in recent years for more and more individuals to experience a discontent with their bodies (Gingras, 1998). However, in some countries, such as Kuwait, women prefer to be overweight than to be of the appropriate weights. Not only that, but they perceive their current weights to be lower than what their actual weights are. This then is the problem; overweight is beautiful and obese is regarded and perceived as normal. Furthermore, when married women were asked what their husbands preferred their weights to be, a large proportion reported that they were expected to be overweight and a smaller group reported that they were expected to be obese or overweight (Musaiger, 1987).

3.2.6. Intrauterine Nutrition and Adult Morbidity

Foetal or intra-uterine nutrition is a subject of increasing interest. There are two reasons for this. The first one is the observation that being born small for gestational age is associated with increased risk of cardiovascular disease and diabetes in later life. The second one is the discovery that nutritional factors directly influence activity of genes. If nutritional inadequacies in the foetal period permanently alter expression of genes, the individual's susceptibility to perinatal complications and diseases in later life may be altered. The main causes of intra-uterine malnutrition are poor maternal diet, placental insufficiency, and impaired foetal usage of nutrients (Henriksen et al, 1998). The consequences of foetal malnutrition may include important determinants of health throughout life.

Different lines of evidence have emerged that investigated the effect of intra-uterine nutrition and onset of adult morbidity. In 1994, Khan and Couper examined whether weight and length is related to age at onset of IDDM. Data from infant records of 232 patients with IDDM, including birth weight, birth length, gestational age, weight at 6 months of age, and feeding history during the first 6 months of life were analysed. The results showed that low birth infants (< 2.5 kg) had a significantly earlier onset of diabetes, 4.3 years vs. 9.9 years, and infants small for gestational age also had earlier onset than those with birth weight above the 10^{th} percentile after correction for gestational age, 6.2 years vs. 9.2 years. In addition, infants who were exclusively breast-fed for 6 months showed a slightly later onset of diabetes than those who were bottle- or mixed-fed, independent of weight, 9.4 years vs. 8.3 years. Another study assessed the effect of size at birth, maternal nutrition, and body mass index on blood pressure in late adolescence (Loar et al, 1997). This was a population based analysis of birth weight corrected for gestational age, mother's weight before pregnancy and weight gain in pregnancy and blood pressure and body mass index at 17 years of age. This data was obtained from 6684 men and 4199 women born in Jerusalem during 1974-6 and subsequently drafted to the army. The results showed that systolic and diastolic blood pressures were significantly and positively correlated with body weight, height, BMI at age 17 and with mother's body weight and body mass index before pregnancy, but not with birth weight or mother's weight gain in pregnancy.

Although BMI or measures of total adiposity show important relations with measures of risk, there are much stronger relations with the abdominal or visceral partitioning of adipose tissue (Jackson et al, 1996). To investigate the relationship between abdominal fatness, rather than increased weight, and retarded growth in foetal life and infancy, Law (1992) followed a population of 845 men born between 1920 and 1930, in whom the weight at birth and weight at one year had been recorded, and men born between 1935 and 1943, in whom the size at birth had been measured in detail. The waist/hip circumference ratio (WHR) was measured as an index of abdominal fatness.

These results indicated that, corrected for current BMI, abdominal fatness is programmed and inversely related to early growth.

Researchers were also interested to investigate whether obesity in adulthood was more influenced by intra-uterine environment than genetic factors. In one study, birth weights compared with self-reported adult weights and heights of 3100 twin pairs were analysed (Allison et al, 1995). The results showed that birth weights correlated with adult height and adult weight, but not adult BMI. This indicates that the intra-uterine environment had a stronger impact on adult height independent of weight, but not weight independent of height.

In a review which discussed the current evidence for the critical periods in childhood for the development of obesity, Dietz (1994) identified three periods of increased risk: the prenatal period, the period associated with childhood of adiposity rebound, and adolescence. The author emphasises the characteristic dragging along of the susceptibility to fat deposition and fat distribution with its attendant complications of diabetes, hypertension, hypercholesterolemia and CHD. The mechanisms that trigger adipose tissue deposition in specific locations at some periods of foetal development and childhood remain unclear. However, these periods represent maturation stages that may be influenced by the interaction of environmental and genetic factors. It was suggested that there appears to be two peaks of adiposity; an early peak that coincides with adiposity rebound and a second peak in adolescence that is more marked in females than in males. These observations seem to support the likelihood that these two periods represent critical periods for the onset of obesity.

3.3. Consequences of Obesity

The health consequences of obesity are many and varied, ranging from an increased risk of premature death to several non-fatal but debilitating complaints that can have a marked effect on the quality of life. It is a major risk factor for:

(1) Metabolic disturbances

(2) Non-Insulin Dependent Diabetes Mellitus (NIDDM)

(3) Coronary Heart Disease (CHD)

(4) Debilitating health problems; such as osteoarthritis, pulmonary disease,

(5) Gall bladder disease

(6) Endocrine disturbances

(7) Some forms of cancer and

(8) Various psychological problems

3.3.1.Metabolic Disturbances

3.3.1.1. Dyslipidemia

Dyslipidemia is a metabolic state in which plasma levels of triglycerides (TG), low-density lipoprotein cholesterol (LDL), and high-density lipoprotein cholesterol (HDL) are abnormal. In obese individuals, dyslipidemia is commonly characterised by raised plasma levels of TG, low levels of HDL concentrations and raised levels of LDL concentrations. This abnormal metabolic state is even more commonly seen in obese individuals with central obesity, and intra-abdominal fat accumulation (Despres, 1990). Central obesity is associated with increased production and reduced degradation of TG-rich lipoproteins (Despres, 1990). This, in turn, leads to the increased production of dense LDL particles and low levels of HDL. This process favours raising the concentration of the TG-dense-LDL particles in the circulation which are later degraded by the hepatic enzymes, released into the blood stream causing further increase in the concentrations of plasma HDL. This cannot be estimated by measuring total or cholesterol or LDL cholesterol because it would be within the normal range. The most useful indicator is the ratio of LDL-apo B to LDL-cholesterol. In addition, impaired fat tolerance (i.e. prolonged and/or exaggerated lipaemia following fat ingestion) is now also recognised as a component of insulin resistance and the Metabolic Syndrome (Griffin, 1995).

3.3.1.2. Metabolic Syndrome

The metabolic abnormalities engendered by obesity occur in the cardiovascular system. These abnormalities can be called risk factors because they raise the likelihood for cardiovascular disease. The major metabolic risk factors resulting from obesity are

1) atherogenic dyslipidemia (borderline-high total cholesterol concentrations, raised triacylglycerol concentrations, small LDL particles, and low HDL concentrations);
2) raised blood pressure;
3) insulin resistance and glucose intolerance; and
4) abnormalities in the coagulation system (procoagulant state) (Grundy, 1996).

This group of risk factors is common in individuals who develop premature CHD, i.e. CHD before the age of 65 years (National High Blood Pressure Education Program, 1990). Some researchers are convinced that the basic problem lies in the insulin resistance that accompanies the condition. The mechanism whereby obesity predisposes one to metabolic syndrome is not fully understood. On the basis of energy balance, energy overload leads to accumulation of fat tissue in the body. Research questioning the aetiology of the metabolic syndrome abnormalities are still being investigated. So far, theories have been put forward but none have as yet been conclusive (Grundy, 1998).

Although obesity and related adipose tissue disorders are major contributing factors of the metabolic syndrome, other factors have been known to further increase the risks. Physical inactivity, for example, can worsen insulin resistance and thus lead to the metabolic abnormalities. The composition of the diet consumed by individual groups or populations; dense, high fat diets can lead to abnormal lipid plasma concentrations. Ageing is also a contributing factor; the metabolic abnormalities characteristic of the metabolic syndrome are known to worsen with age. Genetic predisposition can affect the severity of the risk factors (James, 1995; Grundy, 1998).

The risk of insulin resistance, hyperinsulinemia (elevated blood insulin levels), non insulin-dependant (Type II) diabetes mellitus, hypertension, hyperlipidemia (elevated blood cholesterol and triglyceride levels), and stroke, as well as risk of death are increased in persons with android obesity (Bray, 1988; Kaye, 1990; Bouchard, 1990).

3.3.2. Non-Insulin Dependent Diabetes Mellitus (NIDDM)

Several cross-sectional and prospective studies have been conducted to determine the association between obesity and the risk of developing NIDDM (Dowse, 1991; McKeigue, 1992; Marshall, 1993; WHO, 1998). It was observed that, despite the differences in the degree of fatness and the criteria for the diagnosis of NIDDM, there was a significant level of association in the relationship. In one study in which women aged between 35 to 55 years were observed for 14 years, it was shown that those women who were obese were 40 times more at risk of developing NIDDM compared to those who remained slim with a BMI < 22.0 (Colditz, 1990). In two recent large prospective studies, it was concluded that NIDDM could be prevented if BMI of both men and women remained below 25.0 (Colditz, 1990; WHO 1998). Moreover, there were additional characteristics of obese individuals that increased the risk of developing NIDDM further even after controlling for age, smoking, and family history of NIDDM. These were: obesity during childhood and adolescence, progressive weight gain from the age of 18 years, and intra-abdominal fat accumulation. In particular, it was specifically stressed that intra-abdominal fat accumulation carries an independent risk factor for NIDDM in a variety of populations and ethnic groups. As far as the latter is concerned, some studies have shown that intra-abdominal fat accumulation is a stronger predictor of NIDDM than total body fatness (Lundgren, 1989; Schmidt, 1992).

Other researchers (Bjorntrop, 1996) have hypothesised that the relationship of NIDDM and obesity is the result of the disturbance excess fat, and specifically enlargement of the visceral fat depots, poses on the hypothalamic-pituitary-adrenal axis (HPA). This results in oversecretion of cortisol upon stimulation. Growth hormone in diminished in both sexes, and testosterone concentrations in men are lower than normal. In women a moderate hypergonadism is often present. It has been suggested that the elevated sensitivity of the PHA axis may be a primary event, followed by adrenal androgen production in women, and by interaction at several levels, with inhibition of both the growth hormone and pituitary-gonadal axes. It is postulated that this hormone disturbance seems to lead to the deposition of fat centrally because of a high density of steroid hormone receptors. As a result, insulin resistance develops. Elevated cortisol levels, deficiencies in sex-specific steroid hormones and excess androgens result in insulin resistance. It has also been suggested that this picture is made worse under conditions of stress because stress increases the production of cortisol (Bjorntorp, 1996).

Other studies have assessed the impact of obesity in different ethnic groups. It was reported that the prevalence of NIDDM was higher in people of South Asian descent living in urban societies than in other ethnic groups in the United Kingdom (Mackeigue, 1996). This high prevalence of diabetes is one manifestation of a pattern of metabolic disturbances related to central obesity and insulin resistance. It was also shown that the average waist/hip circumference ratios were higher in South Asians compared to Europeans of the same BMI; in this respect South Asians differ from other populations such as the Pima Indians where high prevalence of NIDDM occurs in association with generalised obesity. In another study, a sample of 1058 male and female subjects in the Caribbean (Barbados, Jamaica, and St. Lucia) were investigated. The results showed that obesity was high and was associated with a parallel increase in the prevalence of hypertension and DM. Twelve percent of males and 15% of females with no previous history of diabetes were shown to have impaired glucose tolerance. (Forrester et al, 1996).

A study in East Finland has assessed the association of obesity and distribution of obesity with glucose tolerance in a population-based study which included 396 non-diabetic men and 673 women aged from 65 to 74 years (Mykkanen et al, 1992). The results showed that obese men and women (BMI$\geq$ 27 kg/m2) had higher levels of fasting and post-prandial blood glucose levels as well as high insulin levels. The results also showed that central obesity per se rather than its distribution was associated independently of obesity with high fasting glucose and insulin levels.

Researchers were then trying to investigate other factors that made obese individuals more at risk for developing NIDDM. The concept of genetic predisposition in the presence of insulin resistance and glucose intolerance seemed to be the most likely explanation. The passage of an obese patient from a normal state of glucose tolerance to insulin resistance and to diabetes is determined by factors independent of the obesity itself. The most important of these is the presence of genes that influence the adequacy of compensatory insulin secretion (Flier, 1994). Obesity-induced insulin resistance is the responsible factor for an increased risk of NIDDM (Olefsky, 1981). The severity of insulin resistance has, in most instances, been found to increase when individuals proceed from normal to increasingly abnormal glucose homeostasis (Olfesky, 1981).

The cellular and biochemical basis for tissue resistance to insulin in established obesity is due to several factors; a defect in receptor expression, a decrease in insulin receptor kinase activity, and a decrease in the activity of the glucose transport system and in the number of GLUT-4 glucose transporters in adipocytes (Olfesky, 1981; Koltreman, 1980; Caro, 1989; Ciaraldi, 1981; Garvey, 1991). Insulin has been shown to cause receptor down-regulation and certain post-receptor desensitising effects. It is possible that hyperinsulinemia, whether simply a result of overeating or caused by something else, might bring about some of these effects (Olfesky, 1981). Free fatty acids (FFA) are the second potential molecular mediator of insulin resistance. Therefore, obesity is associated with increased levels of FFA (Bjorntrop, 1991), which probably are due to the presence of more lipolytically active intra-abdominal adipocytes (Bjorntrop, 1991). Ohlson and co-workers (1985) have reported that abdominal obesity increases the risk of diabetes among men independently of body mass index. Other studies have found similar associations; a family history of diabetes was a significant risk factor (Everhart, 1985; Kobberling, 1971; Barnett, 1981); a positive family history for diabetes, however, was not nearly as a strong a risk factor for NIDDM as was body mass index.

Pfeifer and co-workers have reported in 1981 that excessive production of insulin for a prolonged period may lead to pancreatic exhaustion in those who are genetically predisposed. Consequently, insulin response can decrease resulting in metabolic decompensation (DeFronzo, 1992). Data suggesting that the duration of obesity rather than the degree can be best correlated with carbohydrate intolerance in those adults has been reported (Pi-Sunyer, 1994).

In the management in the NIDDM, regular daily physical exercise and the intake of a healthy diet are fundamental therapeutic measures for the control of and long term management of the disease. The prevalence of NIDDM is 2-4 times higher in the least physically active individuals compared to the most physically active (Helmrich, 1991), and diet high in complex carbohydrates and fibre, low in fat (saturated fat) can help maintain a normal plasma glucose levels (O'Dea, 1984).

The association between current body mass index and risk of diabetes has important public health implications, since obesity is extremely common (National Centre for Health Statistics, 1983; Van Itallie, 1985). Obesity is a major risk factor for NIDDM. As many as 80% of patients with NIDDM are obese. According to the Vital Health Statistics Department in the Ministry of Health, Kuwait (1979), the prevalence of NIDDM was reported to be 6%. A survey was conducted in two health areas of Kuwait in 1995 to estimate the prevalence of NIDDM in the adult population aged 20 years and over. The results showed that 12% of this population have diabetes. In the age group 30-50 years, 24% of the sample were found to have diabetes. In addition, another 6.9% were found to have impaired glucose tolerance. The total glucose intolerance in Kuwait adults was 18.9% (Arouj and Ben Niki, personal communication, 1998).

3.3.3. Coronary Heart Disease

Obesity is associated with increased mortality and morbidity from cardiovascular disease, and the association persists even when age, blood pressure, smoking history, cholesterol, and diabetes are factored out (Hubert, 1983). Since obesity is clearly associated with known cardiovascular risk factors such as diabetes and hypertension, these contribute additionally to the risk of cardiovascular disease. However, this is in disagreement with another study in which it was shown that when both these variables, i.e. hypertension and diabetes were adjusted for in multivariate analysis, obesity is no longer an independent risk factor in predicting CHD. In one of the longest follow-up studies to determine the association between BMI and risk of CHD for middle-aged men in several developed countries, it has been reported that in none of the populations was BMI or fatness significantly associated with CHD incidence or mortality (Keys et al, 1980; Shaper et al, 1996).

It is well established that BMI is strongly associated with serum lipid level (Thelle, 1983; Mykkanen et al, 1992; Kuller, 1994). Serum total cholesterol rises with increasing BMI until about 28kg/m^2 but thereafter it shows no further increase. High density lipoprotein has an inverse relationship with BMI but the relationship with TG is positive and linear. This is observed in other studies (Sojostrom 1992; Bray, 1992; Birmingham et al, 1993, Garrison et al, 1993; Pi-Sunyer, 1993; Ledoux et al, 1997). Furthermore, it has been observed that weight gain on the usual American diet is directly associated with the changes observed in a wide range of biochemical and hormonal factors which are characteristic of insulin hypersensitivity (Sims et al, 1973). Data from other studies showed strong positive relationships between BMI and insulin levels. It was observed that the mean insulin concentration increases steadily from a BMI of < 20.0 kg/m^2 and the percentage of high levels increases six fold over the range of BMI. It was, therefore, assumed that CHD is also an expression of insulin resistance (Shaper, 1996).

CHD and stroke account for a large proportion of deaths in men and women in most industrialised countries, and the incidence is also increasing in developing countries (WHO, 1998). Long term prospective studies have reported that obesity is an independent risk factor for CHD morbidity and mortality (Willet, 1991) and that body weight was ranked as the third most important predictor of CHD among females after age and dyslipidemia (Hubert, 1983). These findings are in agreement with similar studies from other countries. A 15-year follow-up study of 16,000 men and women in Eastern Finland has shown that obesity is an independent risk factor for CHD mortality in men and contributes to the risk of CHD in women (Jousilahti , 1996). Han and his group (1995) have concluded that the risk of CHD in association with obesity is more acute in younger age groups, and that it is higher in people with abdominal obesity compared to those with excess fat around the hips and thigh (Han, 1995). In the Southall study, the relationship between central pattern of obesity and the metabolic disturbances were assessed and the investigators hypothesised that South Asians are at an increased risk of CHD compared to Europeans. The mechanism of increased risk may be mediated through disturbance of lipoprotein metabolism related to increased synthesis of VLDL triglyceride. It was suggested that control of obesity and increased physical activity are likely to be the most effective means of reducing the risk of CHD in South Asians (Mackeigue et al, 1988). Data from the study conducted by Willet and co-workers on 115818 women aged 35-55 years (1995) to assess the validity of the 1990 guidelines that support a substantial gain in weight at approximately 35 years of age and recommend a range of BMI from 21 to 27 kg/m, in terms of CHD risk in women have shown that excess body fat is a cause of CHD. They have also indicated that even modest gains in weight during adult life and levels of body weight not generally considered to be overweight are associated with important increases in risk of CHD.

Obesity results in increased cardiac work. Blood volume, stroke volume, and cardiac output are all increased (Vaughan ,1980). These physiologic changes are reversible with weight loss (MacMahon, 1986). Obesity is also associated with an atherogenic lipid profile, i.e., increased low-density lipoprotein (LDL) cholesterol, increased VLDL and triglyceride, and decreased high-density lipoproteins (HDL) cholesterol (Hubert, 1983). This profile tends to occur in persons with abdominal obesity.

There have been no recent prevalence studies of coronary heart disease or other diseases of the circulatory system amongst the Kuwaiti population.

3.3.4. Hypertension

Blood pressure elevation is a common concomitant of obesity (Stamler, 1975; Tobian, 1978). The causes of the association of obesity and hypertension are not clear but a relationship between weight gain and increase in blood pressure is well documented (Johnson, 1973; Kannel, 1967). Both systolic and diastolic blood pressure increases with BMI, and obese individuals are at a higher risk of developing hypertension than are lean subjects (Stamler, 1989).

Large scale community-based surveys have reported that the prevalence of hypertension in overweight adults is 2.9-fold higher than overweight adults (Van Italie, 1985). The risk for those 20 to 44 years is 5.6 times greater compared to those

45 to 74 years (Pi-Sunyer, 1991) which in turn is 2 times higher than for non-overweight adults (Burton, 1985).

Obesity is a cause of reversible hypertension (Tuck, 1981) that is typically associated with increases in both peripheral resistance and cardiac output (Messerli, 1982) which do decrease with weight loss. In hypertensive patients, weight reduction reduces blood pressure (Obermen, 1967; Tyroler, 1975; Reisin, 1978) and weight regain raises pressure. The fall in blood pressure with weight reduction is associated with a decrease in blood volume, cardiac output, and sympathetic activity (Reisin, 1983).

Studies have stressed the role of body sodium and insulin in lowering blood pressure with weight reduction (Dahl, 1958, Kaplan, 1989, Zavaroni, 1989). Changes in plasma insulin concentration can affect sodium transport in the human kidney. Insulin reduces sodium excretion independent of changes in plasma glucose. The hyperinsulinemia of obesity may raise the blood pressure by increasing renal sodium absorption, which in turn expands the extracellular fluid volume, raising cardiac output, peripheral resistance, and blood pressure. Hyperinsulinemia is found in hypertensive subjects with or without obesity, and consequently work has focused on the ability of insulin to exert actions on the kidney (i.e. salt retention), vasculature, and possibly other sites that could elevate systemic blood pressure (DeFronzo, 1980).

The distribution of fat in the body may have an important effect on blood pressure risk, as it does in diabetes, with central fat or upper body fat being more likely to raise blood pressure than the lower body fat of the gluteal and thigh region (Weinsler, 1985; Bjorntorp, 1985).

In one recent study the effect of obesity on hypertension has been disputed (Haynes, 1998). It was suggested that several mechanisms have been implicated in the association between obesity and hypertension including salt-retention, insulin resistance and sympathetic activation. In addition, several facts were brought to the discussion. It was argued that although insulin resistance is common in obesity, it is clear that abnormal insulin action is not the sole or sufficient cause of hypertension. In addition, how obesity is associated with increased activity of the sympathetic nervous system and how sympathetic blockade attenuates sodium retention and hypertension in experimental models of obesity. The mediators responsible for salt sensitivity, insulin resistance and sympathetic activation in obesity remain unclear. It was discussed that Leptin, the protein hormone produced almost exclusively by adipose tissue, acts in the central nervous system through a specific receptor and multiple neural pathways to decrease appetite and increase energy expenditure. There is increasing evidence that leptin has wider actions influencing autonomic, cardiovascular, renal, and endocrine functions. The study group have shown that administration of leptin does not cause arterial pressure or heart rate in anaesthetised animals which reflect the opposing anti-hypertensive actions of leptin. The study group have concluded that leptin may act as a mediator linking body adiposity with changes in insulin action, sympathetic neural outflow and renal sodium excretion and that alterations in leptin generation or action may, in part, underlie the sympathetic, endocrine, and renal complications of obesity.

Review of the literature describing populations with low blood pressure which does not rise with age and the impact of rural-urban migration on the blood pressure of these populations suggest that the major determinants of blood pressure are increased body weight, increased body sodium intake, and decreased potassium intake, with some contribution from alcohol (Shaper, 1996). Furthermore, the National Health and Nutrition Examination Surveys (NHANES) II data show clearly that the higher the prevalence of hypertension in North American Blacks cannot be attributed to obesity alone, and also emphasises the greater relative risk of hypertension in younger obese subjects compared with older subjects (Van Italie, 1985). The large number of trials showing that weight reduction in blood pressure provides some support for the causal role of obesity in hypertension and this effect seems to relate more closely to weight loss than to dietary sodium restriction (Tuck et al, 1981). Furthermore, other studies suggest that weight control may reduce the incidence of hypertension in those with high to normal blood pressure but in almost all these studies intervention involves other aspects of diet and lifestyle (Stamler et al, 1989), although calorie reduction appears to be more effective than sodium restriction (Trials of Hypertension Prevention Collaborative Research group, 1992).

The single most important cause of death in Kuwait in 1996 for both sexes and for both Kuwaitis and non-Kuwaitis was cardiovascular disease (Vital and Health Statistics, Ministry of Health, 1996). The mortality rate was 67.6/100,000 population. Among the Kuwaiti population, the rate was higher at 90/100,000. Chronic ischaemic heart disease, acute myocardial infarction, essential hypertension, atherosclerosis and hypertensive heart disease are among the ten leading causes of diseases of the circulatory system. The rate of death due to hypertensive disease was 15.6/100,000. There have not been any data relating obesity to hypertension and CHD in Kuwait.

3.3.5. Pulmonary disease

Abnormalities in pulmonary function may be seen in obese patients (Kryger, 1974, Vaughan, 1980; Luce, 1980). These range from quantitative abnormalities in pulmonary function tests that have no clinical significance to major dysfunction replete with symptoms and morbid consequences. In subjects with marked obesity, compliance of the chest wall is reduced, the work of breathing is increased and the respiratory reserve volume and vital capacity are reduced; a resultant mismatch between ventilation and perfusion may result in hyperaemia. Severe obesity may cause hypoventilation, defined by the development of CO_2 retention. The full designation of the obesity-hypoventilation or Pickwickian syndrome includes somnolence, lethargy, and respiratory acidosis, and typically includes sleep apnoea as part of the picture. Sleep apnoea occurs in 10% of men and women with a BMI $\geq$ 30.0, and 65% to 75% of individuals with obstructive sleep apnoea are obese. In one study, sleep apnoea occurred in 77% of those with a BMI > 40.0. In addition, it has been reported that obstructive sleep apnoea in obese individuals is more likely to be associated with central obesity and neck size probably due to narrowing of the upper airway when lying down. The nocturnal disruption of sleep is associated with daytime somnolence, hypercapnia, morning headaches, pulmonary hypertension and, eventually, right ventricular failure (Strollo, 1996). These patients may have reduced ventilatory drive to hypoxia and hypercapnia, as well as obstructive/mechanical causes of hypoventilation (Flier, 1994).

3.3.6. Osteoarthritis

The spine and lower extremities are weight-bearing and thus body weight plays a role in the strain on these joints and can contribute to the development or progression of arthritis. Osteoarthritis (OA) is the form of arthritis most likely to be affected by obesity because it is a wear-and-tear process characterised by breakdown of cartilage and bone with secondary proliferative changes (Bollet, 1994). Other possible mechanisms underlying the relationship between obesity and osteoarthritis include mechanical stresses related to increased load of obesity, metabolic changes associated with increased fatness, and dietary elements that are related to the development of obesity. The strength of the data supports mechanical damage above other causes (Roubenoff, 1991; Felson, 1992).

Mechanical factors that put an extra strain on joint tissue can accelerate the development or rate of progression of this disease. It has been reported that a higher incidence of OA in both weight-bearing and non weight-bearing joints in obese patients (Bollet, 1994).
Lean et al. (1995) reported the symptoms of breathlessness and arthritis correspond with waist circumference of $\geq$ 88.0 cm for women and the health risks are such that medical consultation and weight loss should be urged.

3.3.7. Gall Bladder Disease

Gall bladder stones are the commonest of the gall bladder diseases. They occur more commonly in women than men and the risk of developing the disease increases with age. Obesity, however, increases the risk of gall bladder stones in all age groups and in both men and women. Data from the Nurse's health Study suggests that even moderate overweight may increase the risk (Maclure, 1989; WHO, 1998).

Obesity is associated with enhanced billiary secretion of cholesterol which results in supersaturation of bile and a higher incidence of gallstones- particularly cholesterol gallstones (Grundy, 1983). Supersaturation of the bile and reduced motility of the gallbladder, both of which are present in the obese, are thought to be underlying factors for gallstone formation. Furthermore, since gallstones enhance the propensity to gallbladder inflammation, acute and chronic cholecystitis is also more common in the obese. Billiary colic and acute pancreatitis are other potential complications from gallstones (WHO, 1998).

Fasting, as opposed to more-limited caloric restriction, increases the saturation of bile by reducing the phospholipid component and cholecystitis induced by fasting is a well recognised problem in obese individuals (Flier, 1994).

3.3.8. Endocrine Consequences.

Many changes in endocrine function can be seen in patients with established obesity (Glass, 1978). These changes can be induced by overeating, and normal function resumes after weight loss. These changes are secondary to the obese state.

3.3.8.1. Gonadal Function

Obesity is associated with hormonal changes of in men and women. Marked obesity in women is associated with increased androgen production, increased peripheral conversion of androgen to oestrogen, an increased rate of oestrogen production and, decreased levels of sex hormone-binding globulin (SHBG). Specific findings in women with upper body obesity differ from those in women with lower-body adiposity (Kirschner, 1990; Glass, 1978; Pasquali, 1989). Upper body obesity is associated with increased testosterone production, decreased SHBG, and increased levels of free testosterone in comparison to levels in obese women with lower-body or gynoid obesity. Upper body obesity may be a major cause of the ammenorrhea seen in morbidly obese women. The fact that upper-body obesity is also associated with hyperinsulinemia has led to the hypothesis that insulin may be a factor that contributes to the hyperandrogenism through actions on the ovary, as seems to be the case in syndromes of extreme insulin resistance (Poretsky, 1991). In contrast, the increased peripheral production of oestrogen from androstenedione, which occurs to a greater degree in women with lower-body obesity, may contribute to the increased incidence of uterine cancer in post-menopausal women with obesity (Flier, 1994).

3.3.9. Cancer

It has been reported that weight gain and obesity increases with the risk of cancer in both men and women, in particular cancers of the gastro-intestinal tract and those that are hormone-dependent.

Hormone Dependent	Gastrointestinal, hepatic, renal
Endometrial	Colorectal
Ovarian	gall bladder
Breast	Pancreatic
cervical	Liver
Prostate	Renal

Adapted from the publication of the Report of a WHO Consultation on Obesity, 1998.

Studies have shown greater risk of endometrial, ovarian, and post-menopausal breast cancer in obese women and higher rates of cancer of the prostate in obese men. The incidences of these type of cancers in women were even greater in those with a predominantly abdominal fat distribution which emphasises the most likely role of hormones in the aetiology of these malignancies (Schapira, 1994). There have been inconsistencies in the studies reporting the association of cancer risk of the gastrointestinal tract and obesity in both men and women. However, with renal cell cancer it has been suggested that an association does exist, especially in women (Le Marchand, 1992; Wolk, 1996).

It has also been shown that intra-abdominal fat distribution increases the risk of post-menopausal breast cancer independent of weight gain, especially in the presence of a positive family history. Furthermore, weight gain during adulthood has consistently been associated with increased risk of breast cancer (Wing, 1991; Swanson, 1996).

In a study which monitored the mortality ratio of 750,000 men and women for 12 years showed that the mortality for any cancer was 1.33 and 1.55 in obese men and women, respectively (Lew, 1979). However, it is difficult to ascertain whether this relationship is more directly related to the component of food, such as fat content of food, or the effect of obesity.

Although there is still controversy surrounding this relationship, some studies have reported the beneficial role of high physical activity levels in reducing the risk of colon cancer in men, and to a lesser degree in women. The same reports also suggested that cancer of the breast and other cancers of the reproductive system were less prevalent in women who had been athletes at college compared to less active women (Frisch, 1987). This association was not shown in the risk of prostate cancer.

On a slightly different level, studies have been conducted in the late 1950s on the assumption that dietary fat may be a possible cause of cancer. Breast cancer is the most frequent malignancy among women in Western countries, and the disease still continues to show a steady rise (Willet, 1997). A major rational for the dietary fat hypothesis has been the international correlation between fat consumption and national breast cancer mortality. In a study of 65 Chinese counties in which both dietary assessment and mortality rates were measured using standardised methods and per capita fat intake (from 6 to 25% of energy), only a weak association was seen between fat intake and breast cancer mortality. This provided strong evidence that factors other than fat intake account for the large international differences. Nonetheless, because almost all of the reported literature from perspective studies is based on less than 10 years of follow-up, it has been recommended that, because excess adiposity adversely affects risks of several cancers and CVD, persons interested in reducing their risk of cancer should be advised to minimise their intake of foods high in animal fat, particularly red meat, because this likely to also increase the risk of prostate and colon cancer (Willet, 1997).

3.3.10. Psychological Consequences of Obesity

As a result of the intensified campaign by the media on the subject of body image portraying thin is best, and the negative attitudes towards obesity as a consequence of that, many teenagers and young adolescents, particularly among women, are preoccupied with remaining thin and accepted by their peers. Obese subjects, especially among female students in schools and universities, are more likely to be labelled as ugly and rejected than non-obese individuals. These attitudes are more prevalent among educated, high social class women in industrialised countries. It has been shown that in the United Kingdom and the United States obese individuals are less likely to complete their education, have less chances of getting a desirable profession and earn less than their non-obese counterparts (Gortmaker, 1993). Furthermore, the negative attitudes that the health professionals (nurses, nutritionists, and doctors) have towards obese patients has lead to reluctance on the part of the patients to seek medical advice (De Jong, 1986).

The image that obese individuals have of themselves is one of dissatisfaction (Gingras, 1998). This can be greatly influenced by culture; in one culture those that are of normal weight perceive themselves as overweight or fat, whereas in other cultures those that are overweight or fat as normal. More women than men are usually affected. Eating disorders such as anorexia nervosa and binge-eating disorders are psychological disorders of negative perceptions of body image which can be life threatening.

3.4 Clinical Aspects of Regional Fat Distribution.

Obesity has psychological, behavioural, and medical consequences, the nature and severity of which are influenced by the degree of obesity. The health consequences of massive obesity are clearly evident, with as much as a 12-fold increase in the rate of death from cardiovascular disease in men aged 25-34 with this condition (Kissebah, 1982). The recent realisation that intra-abdominal obesity, rather than total increase in body fat, is the parameter that correlates best with several of the key morbid consequences of obesity (NIDDM, CHD, hypertension, cardiovascular disease) is well documented (Kissebah, 1982). Conventional measurements of obesity, such as BMI, are significantly associated with myocardial infarction, angina pectoris, and premature death, but the W: H ratio was a stronger independent risk factor than BMI (Bjorntorp 1987).

Many of the important complications of obesity, including insulin resistance, NIDDM, hypertension, and hyperlipidemia, are linked to the amount of intra-abdominal fat rather than to lower-body fat or subcutaneous abdominal fat (Kissebah, 1982; 1989). In a study comparing Bangladeshi migrants to east London with native Europeans, the results identified a pattern of intercorrelated metabolic disturbances in Bangladeshi men and women: high prevalence of NIDDM, high levels of insulin and TG after a glucose load and low levels of HDL-cholesterol (Mckeigue et al, 1988). This pattern corresponds to insulin resistance syndrome. These results were in agreement with a larger study on Indians and Pakistani subjects in west London (Mckeigue et al, 1991). The results showed that insulin levels were twice as high at 2-hour glucose load. It was observed that South Asian men and women are characterised by a central distribution of body fat compared to Europeans with thicker trunk skinfolds and markedly higher mean WHR. It was suggested that the occurrence of metabolic disturbances associated with insulin resistance in people of South Asian descent in widely different environments, even after several generations of migration, suggests that some genetic predisposition to develop insulin resistance exists in this group (Mckeigue, 1996).

Data from several studies as to the possible association between central fat distribution and high levels of TG may lie in the response to glucose challenge (Austin et al, 1990; Coon et al, 1992). It was suggested that the most likely mechanism of this effect is that the rise in insulin levels suppresses lipolysis of fat to non-esterified fatty acids (NEFA), which is the main substrate for hepatic triglyceride synthesis. It also suggested that the relationship between central obesity and triglyceride levels is mediated through effects on the supply of NEFA to the liver. Raised triglyceride levels in turn may lower plasma HDL-C levels and cause changes in the composition and size of particles in the low density lipoprotein (LDL) fraction .

The detrimental effects of the metabolic abnormalities that accompany obesity increase the risk of mortality and morbidity because they raise the likelihood for cardiovascular disease.

Therefore, the major metabolic risk factors resulting from obesity are 1) artherogenic dyslipidaemia (borderline-high total cholesterol concentrations, raised triacylglycerol concentrations, small LDL particles, and low HDL concentrations); 2) raised blood pressure; 3) insulin resistance and glucose intolerance; and 4) abnormalities in the coagulation system (pro-coagulant state) (Grundy, 1996).

This is agreement with other studies which indicated a strong association between increase in waist circumference and risk factors of the insulin resistance syndrome (Edwards; 1994), and risks of breast cancer in women. Data from other studies showed that an increase in waist circumference can be a strong predictor of total health risks in men and women (Han, 1995).

In summary, most individuals on this globe will be at risk of developing obesity if they are in positive energy balance for a considerable period of time. Obesity has affected populations of all age groups with marked impact on children and women compared to other groups. The prevalence of obesity was observed to increase with age, is higher in low-social classes and low level of education categories. The world we live in today provides the appropriate environment to do so. Affluence is probably the most likely cause of the epidemic. Although modernisation and healthier economies of nations has provided advancement and comfort in several aspects of our daily life, nonetheless, it has assisted in creating a sense of laziness, due to the availability of energy-saving equipment at the home and at work, has made such advances in the food industry that food is available in vast quantities and variety, and affordable to the majority. This has contributed, no doubt, to the high prevalence rates of nutrition-related non-communicable diseases. Obesity, as total body fat or predominantly centrally accumulated fat, has been associated with rising rates of diseases such as CHD, NIDDM, hypertension to name only a few. Genetics are believed to have more control on the eventual type of obesity rather than the extent of the obesity. An interaction between genetics and the environment, and especially in predisposed individuals, are most likely causing the problem.

CHAPTER IV

SUBJECTS AND METHODS

In order to evaluate the prevalence of obesity, its characteristics, contributing factors and relationship to selected health disorders in adult Kuwaiti females, a random sample of 324 Kuwaiti women between 20-60 years of age were selected from 3 out of 5 governorates in Kuwait. Both quantitative and qualitative methods were used.

The qualitative methods were:

1- Questionnaires and interviews with the participants

The quantitative methods were:

1- Nutritional anthropometry
2- Blood biochemical analysis and
3- Clinical assessments including blood pressure measurement

This chapter provides a detailed description on the application of the procedures used in the study and also provides details related to the study design and study setting.

4.1 STUDY DESIGN

The design of the study was cross-sectional and recruited adult Kuwaiti females between the ages of 20-60 years randomly drawn from health centre registration files between May 1996 and October 1997. Probability sampling was undertaken to obtain a sample that guaranteed an appropriate size for achieving adequate estimates. The study sought to, first of all, estimate the prevalence of obesity among adult females in Kuwait and then to examine the factors contributing to obesity. In addition, selected health disorders known to be related or caused by obesity were also examined. The different grades of obesity in adult Kuwaiti women were examined and their associations with other parameters assessed.

4.1.1. Study Setting

Kuwait is divided into 5 governorates: Capital, Hawaly, Ahmadi, Jahra, Farwanya (Figure-4.1). Within each governorate are several areas (residential and/or other). Similar to the governorates, these areas belong to five health districts (Appendix-1). Each health district consists of

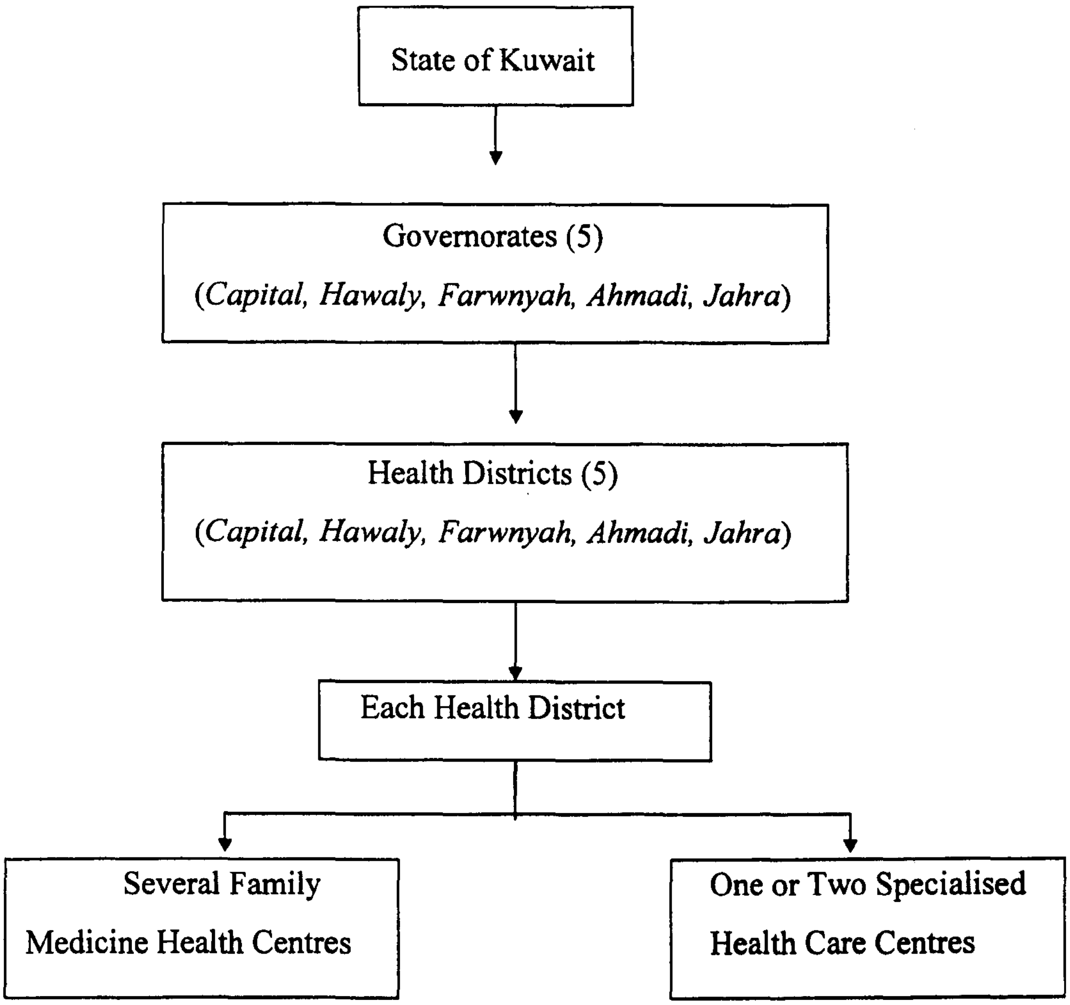


Figure-4.1. Schematic presentation of governorates and health districts in Kuwait.

several areas and within each area there is a primary health care facility that provides health care services to all residents free of charge. These services are for the care and treatment of minor illness for all age groups in addition to the routine vaccinations of infants and children, as well as specialities such as obstetrics and gynaecology, dentistry, and diabetic care sections. The general practitioners have the authority to refer any person to the nearest hospital if the condition of the patient is serious. The objective of this government policy is to reduce the load on tertiary hospitals.

Kuwaiti (41%) and non-Kuwaiti citizens (59%) register in the health centres, and services are free for all. The non-Kuwaiti citizens, or expatriates, come to Kuwait seeking better job opportunities and higher income rates compared to their homeland. They are not immigrants, and therefore after a period of time, when their objective is fulfilled, they return to their homeland.

Only Kuwaiti citizens were included in the study because the lifestyle they lead is probably more sedentary than that of the expatriates. No data are available on the prevalence rates of obesity between these two groups but according to the Vital Health Statistics of the Ministry of Health, diseases of the circulatory system, neoplasms and external causes of mortality, such as road traffic accidents, were three of the major causes of mortality in 1994,1995, and 1996. More Kuwaitis than non-Kuwaiti deaths were recorded due to diseases of the circulatory system, neoplasms, and metabolic disorders such as diabetes mellitus.

4.1.2 Sample Size Calculation

The results of a study conducted by AL-Awadi et al (1989) showed that the prevalence of obesity (BMI > 30.0) among adult Kuwaiti females aged between 20-60 years to be 52% whereas a more recent study suggested the prevalence to be 44% (Al-Isa, 1995). However, the sample from these studies was not representative of the general population of Kuwaiti women aged 20-60 years since they were selected from clients of outpatient clinics and hence the prevalence was likely to be grossly over-estimated.

The aim of this study is to measure the prevalence of adult Kuwaiti females with *some* precision. To this end, it was deemed to estimate the prevalence within $\pm$ 5 CI of the true estimate with 95% confidence (that is, the estimated prevalence would be within $\pm$ 5% of the true prevalence with certainty of 95%).

Statistically, this is achieved by ensuring that the width of the 95% CI is within 10% (Kirkwood, 1988), i.e.;

$$2 \times 1.96\sqrt{p(1-p)/n} < 0.1$$

where P = the assumed prevalence, i.e., 0.33

and n = the required sample number

Solving this equation results in n = 342.

4.1.3. Sampling

In 1996, the mid-year population of Kuwaiti nationals was 717,955 (41%) out of a total population of 1,036,026 (Health and Vital Statistics, 1996). In 1997, the female population of Kuwait was 366,883 of which 203,112 (55%) were 19 years of age and younger; 150,806 (41%) were aged 20-59 years and 12,965 (4%) were aged 60 years and above (Ministry of Planning, unpublished data for 1997). The Kuwaiti population has been growing at an estimated rate of 3.4% per year. The area of Kuwait is 17,818 square kilometres. The population is almost entirely urban based. The target population was females between the ages of 20 and 60 years who were registered in the primary health care facilities of Kuwait. Lists of random six digit numbers were used for the selection. The sample sources were the health centres in Kuwait.

The number of adult Kuwaiti females aged 20-60 years was 150,806 (Ministry of Planning, unpublished data, 1997). Eight thousand three hundred and thirty three numbers were used from the random number generation list (Appendix-2) to select files from the health clinics. Of those, 2108 (14.5%) numbers had corresponding files whereas the remaining 7125 (85.5%) numbers did not (Appendix-3), probably because they never registered at the health care clinic to which they would normally go for medical advice in an emergency (Figure-4.2). It is not uncommon for families who have moved into a new residential area to continue seeking medical advice from the previous medical centre where they used to reside before moving into a new area. Furthermore, 690 potential subjects could not be contacted due to wrong number, secret code, or the telephone out of order. A hundred and ninety-one of the selected subjects refused to participate in the study when contacted over the telephone. Three hundred and twenty five subjects agreed to participate in the study and later during the first meeting signed the consent form.

Table 4.1 summarises the percentage distribution of adult Kuwaiti female population compared to the study sample by age group. The population distribution by age group is from the latest publication of the 1995 census, Department of Population Census, Ministry of Planning, Kuwait from the results of the labour force survey of 1988. The figures show that, compared to our sample, the highest proportion (corrected) are for those in the 20-24 age group and then it tends to decrease gradually from 18% in 25-29 age group to 4% in the 55-59 age group. More than 20% of the participants in this study were in the 35-39 year age group, 18% in the 30-34 and 40-44 age groups, and 16% in the 20-24 age groups. The most likely interpretation for 50% of our study population to be in the 30-45 age group is that participants of this age group had more weight problems than the younger age group, and were more interested in participating in the study once they were approached. It is equally possible that they may have had more time and thus were more willing to participate. A careful examination shows that the age groups between 30-34, 35-39, and 40-44 years were over-represented in the sample whereas there does not seem to be a big difference between the study sample and the general population for the age groups 25-29, 45-49, 50-54, 55-59 years. The primary reason for this apparent discrepancy is that more than 43% of the female population of Kuwait are below the age of 19 years, whereas only 3% are 60 year of age.

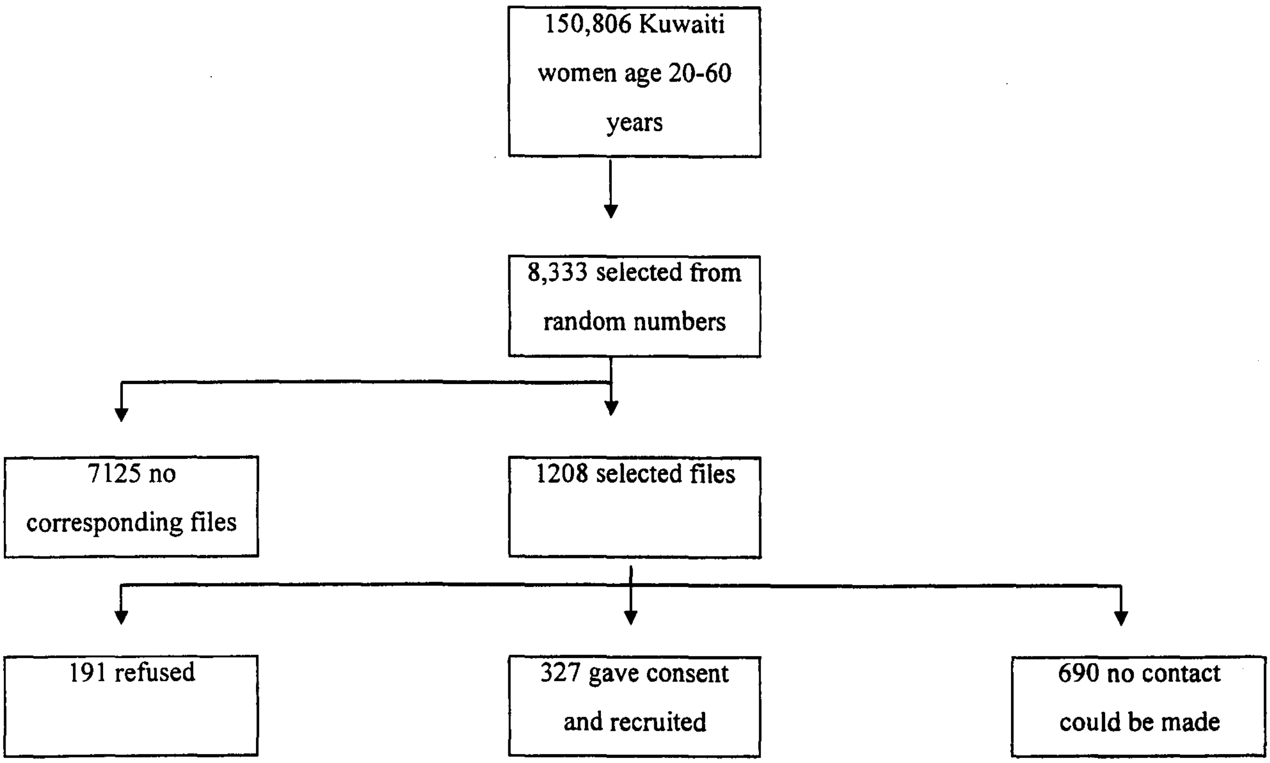
Table-4.1 Percentage distribution of adult Kuwaiti female population by age compared to the study sample population.

	Labour Force Survey[1], %		
Age group, years	**Actual**	**Corrected[2]**	**Study sample, %**
20-24	11	25	16
25-29	8	18	14
30-34	6	14	18
35-39	6	14	21
40-44	4	9	17
45-49	4	9	7
50-54	3	7	5
55-59	2	4	2

1. Adapted from the results of the labour force survey, 1995.
2. Percentage of General Population of Adult Kuwaiti Women aged 20-60 years in the various age groups.

The inclusion criteria were that all Kuwaiti non-pregnant and non-lactating females, aged 20-60 years of age were to be recruited for the study. Exclusion criteria included all pregnant and lactating women, all women under the age of 20 and those over 60 years of age, and insulin dependent diabetics.

Figure-4.2 Study Profile



There is no reason to believe that the population profiles differ among the health centres in each district because of current housing policy. The government had adopted a housing policy since the early 1960's that provided houses, low and middle-income, for its' citizens. Kuwaiti citizens who are married, have an occupation (monthly income), and do not own another property were eligible to apply. This system is based on a priority list; so those who apply first would be able to have the selected houses once the designated residential area is completed. The time it usually takes from submitting the application to actually owning a house can be from 15 to 17 years. Applicants are not permitted to choose a specific residential area and therefore can be allocated housing in any area of Kuwait.

The system of file numbering in the health clinics is based on the subjects' date of birth that corresponds to six digit numbers. The first 2 digits refer to the day, the second two digits to the month and the third two digits to the year of birth. In addition, the files are in two colours. The blue ones are for females; whereas, the green files are for males.

When a file number matched a number in the list, this number together with the name of the corresponding file holder was registered in a registry book. The latter consisted of a table (appendix-4) to keep record of all the random numbers that were to be used in the study for the selection of subjects. This table included the name of the subject, her telephone number, and whether she agreed or refused to participate. In the situation when the subject refused, the reason for refusal was also recorded. Having given the subject a serial number (appendix-5), this subject was contacted by telephone which was available in her file. If the number had not been included in the file, the name of the next of kin (father, husband, or eldest brother) was usually recorded as a routine procedure. The file number of the next of kin was retrieved from the clinic archives and the contact telephone number obtained. If, however, contact was still not available, that 6-digit number was cancelled and replaced by the next number in the list of random numbers.

The target population was females between the ages of 20 and 60 years who were registered in the primary health care facilities of Kuwait. Lists of random six digit numbers were used for the selection. The sample sources were the health centres in Kuwait.

From information in the files, potential participants were contacted. Of the 1208 files that were selected no contact could be made with 690 (57%) (secret code, no reply, phone number out of order). Direct refusals to participate in the study were 191 (15.8%). The reasons for refusals to participate were as follows:

R1= Too busy to come / no time to come	n= 86 (45%)
R2= Not interested	n= 43 (22.5%)
R3= No transport to clinic	n= 22 (11.5%)

R4= Unable to come for health reasons n=37 (19.3%)

R5= Husband/father refused n= 3 (1.5%)

4.1.4. Selection bias and response rate

Selection bias arises from errors in randomisation or it may not be truly representative of the population.

Response rate is the proportion of subjects that were contacted and actually participated in the study. 518 subjects were contacted; 63% participated and 37% refused to participate.

4.1.5. Informed Consent

Subjects who agreed to participate in the study were informed of the details of the procedures to be taken in the study and were requested to sign a formal consent form in Arabic. This form has been translated from English (Appendix-6).

4.2 DATA COLLECTION

4.2.1. Protocol

Subjects were given a serial number, and contacted by telephone to set up an appointment. The researcher introduced herself and explained the details of the study. When the subject agreed, the researcher requested her to come to the health clinic on a specific day and time. All appointments were made from 8:00 a.m. to 10:30 a.m. The health centres had laboratory facilities which enabled the collection of blood that was used for the biochemical analysis. Three main procedures were followed:

4.2.1.1. Procedure prior to appointment

The participant was requested to fast for 12 hours overnight and to have only a light meal preceding the fast prior to the appointment date.

4.2.1.2. Procedure at the appointment site

Six steps were taken at the appointment site. They were:

4.2.1.2.1. Interview with researcher and consent form given. The participant was met by the researcher at a room provided for the study by the health clinic administration. She was again informed about the details of the study. After the explanation the participant was asked to sign the consent form. After formal agreement was obtained to participate in the study, the subject's name and address were recorded in the participant's file.

4.2.1.2.2. First blood pressure measurement. The first blood pressure measurement was then taken after the participant had an opportunity to rest quietly for five minutes.

4.2.1.2.3. The administration of the questionnaire. The researcher administered a semi-structured questionnaire to each respondent. She used probes while questioning to elicit more comprehensive responses (Appendix-7).

4.2.1.2.4. The second blood pressure measurement. After completion of the questionnaire the second blood pressure measurement was taken.

4.2.1.2.5. Anthropometric measurements. The subjects were informed about this next procedure (for example, using the skinfold callipers for the measurement of skin folds in different areas of the body).

Prior to taking the anthropometric measurements, each participant was asked to empty her bladder. She was then requested to remove all of her clothes except her underwear. The measurements taken were: weight, height, triceps, biceps, sub-scapular, supra-iliac, and thigh skinfolds and waist and hip circumference. All measurements were taken in duplicate.

4.2.1.2.6. Blood sampling. Following the measurements of anthropometry, the participant dressed and then the blood sample was withdrawn by the laboratory technician.

4.2.1.3. Follow-up

The participant was then told that all of the procedures of the study were completed. The subjects were asked to return to the centre in one week's time to be informed about the results of the blood analysis. Participants who had abnormal blood pressures or biochemistry were referred immediately to the health clinic physicians.

After the results of the blood analysis were known, participants with abnormal levels or who were overweight or obese were advised to visit the nutrition out-patient clinic for consultation with a physician.

4.3 MEASUREMENTS AND PROCEDURES

The details of the different procedures used in the study *viz.*:

- Qualitative measurements, 1- the questionnaire,

- Quantitative measurements; 1- nutritional anthropometry
  2 -blood pressure measurement
  3-biochemical analysis of blood

4.3.1. Interview with subject and completion of the questionnaire

The researcher interviewed the subjects in the morning starting from 8:00 am until 11:00 am. The time taken to complete the questionnaire was 15-20 minutes.

A semi-structured questionnaire was used to obtain the following information:

1- Demographic data including age, marital status, and level of education

2-Contributing factors to obesity which included family history, smoking, physical activity, parity and breast feeding practices

3- Perceptions of own weight, husband's assessment of own weight, and current health status

4- Health seeking behaviour in the form of visits to the physician

5- Information on specific disease profiles of the participant for which excess weight may contribute or aggravate the disease condition.

For participants who had been married, questions were asked to determine if weight had been gained after marriage and if so, their perceived reasons for the weight gain. Questions surrounding weight gain and pregnancy were used to determine whether pre-pregnancy weight was achieved following childbirth and lactation, and if so what did the respondent consider contributed to her return to original weight.

Other questions relating to use of hormone therapy and use of contraceptive agents were asked to determine whether there was a relationship between hormones and weight.

Specific questions were asked to determine respondents health status related to blood pressure, diabetes mellitus, heart conditions, bronchial asthma, duodenal/ gastric ulcers, arthritis, gall bladder stones or other health problems. In addition, a question on surgical operations was asked. These questions were included to determine whether there was a relationship between weight and the above listed health conditions amongst the respondents.

Questions about physical activity and inactivity were included to describe the physical activity profile of respondents and to determine whether there was a relationship between weight status and activity. The questionnaire was developed and its validity determined by a group of 10 health personnel. They were asked to assess the items for clarity and straightforwardness. The questionnaire was developed in English, translated to Arabic, piloted and then re-drafted. The final questionnaire was translated to Arabic. It was then sent to a reviewer to re-translate back into English. The re-translation confirmed that the Arabic version and the English version had the same meaning.

4.3.2. Nutritional Anthropometry

The anthropometric data consisted of measurements made on the subjects and indicators derived from such measurements. Anthropometric measurements were obtained; *viz.*: (1) weight, (2) height, (3) skinfold measurements at five sites, (4) waist circumference, and (5) hip circumference. Derived values were obtained from these measures. All the measurements were all taken by the researcher who took duplicate measurements of each parameter.

4.3.2.1. Weight measurement A balance beam scale, Healthometer (model 231/233, HealthOMeter Inc., Bridgeview, Illinois) was used. Prior to weighing any participant, the large and the small weight knobs were adjusted to zero and the bubble level indicator centred. In addition and as a quality control procedure, 2 bricks, each weighing 10 kilograms, were weighed once every morning before weighing any participants to ensure accuracy of the weighing scale. It was calibrated to one tenth of a kilogram.

The participant was requested to remove all clothing and shoes and just retain the minimal underclothes. She was then asked to step in the centre of the horizontal platform and to look straight a head, standing relaxed but still. The small weight knob was adjusted until the bubble was centred. As long as the bubble moved equally across the reference marks, it eventually came to rest between the marks. The first reading was recorded. The participant was then requested to step down. The same procedure was repeated to take the second reading; then it was recorded. Body weight was recorded to the nearest 0.1 Kg (Weiner 1969, 1980). All weights were recorded with an empty bladder in the morning after a 12-hour fast.

4.3.2.2. Height measurement. Standing height was measured using the measuring device Healthometer (model 231/233, HealthOMeter Inc., Bridgeview, Illinois). The subject was asked to stand on the horizontal platform without shoes and stockings, hold the arms loosely at the sides with the palms facing the thighs; the head was not necessarily in contact with the vertical surface She was encouraged to stretch upwards to their fullest such that the Frankfurt plane is horizontal, feet together, knees straight, and heels, buttocks, and shoulder blades in contact with the vertical surface of the stadiometer. The researcher lowered the horizontal bar until it touched the crown of the head. The height measurement was taken at maximum inspiration. Height was recorded to the nearest millimetre. If the reading fell between two values, the lower reading was always recorded. As in weight measurements, height measurements were taken in the morning after a 12-hour fast. In cases where large amounts of adipose tissue prevented the heels, buttocks, and shoulders from simultaneously touching the wall, subjects were simply asked to stand erect. The subject was then asked to step down and stand again for the second reading (Gibson , 1990).

4.3.2.3. Skinfold Measurements

The most widely used method of indirectly estimating percent body fat in clinical settings is to measure skinfolds, i.e., the thickness of a double fold of skin and compressed subcutaneous adipose tissue (Pollock, 1984; Nieman 1990; Martin, 1985). For this study, the skinfold sites chosen were triceps, biceps, sub-scapular, supra-iliac, and upper thigh. For all of the skinfold measurements, the subjects stood erect with feet together and arms at the side. All skinfold measurements were taken using Harpenden calipers (CMS Weighing Equipment Ltd., London, UK). The methods used and described in detail below were all taken from Weiner (1969).

4.3.2.3.1. Triceps Skinfold. This measurement was taken at the posterior aspect of the right arm. The subject was instructed to bend the right arm at right angles to the body and place the forearm, palm down, across the body. The point mid-way between the tip of the acromion and the tip of the olecranon was measured by a non-stretchable tape measure and marked with a water-proof felt tip marker. A fold of skin was picked up by the calipers at this point. The fold was held for 2 seconds and the first reading recorded in the subject's file. The calipers were removed and the subject was instructed to hang the arm loosely. She was then instructed to repeat the same steps before the second reading was measured and recorded.

4.3.2.3.2. Biceps skinfold. The subject was instructed to hang the arm freely with the palm facing outwards. A fold of skin was picked up over the belly of the biceps muscle at the same level as the mid point of the triceps. Using the calipers and the same procedures, the first and second readings of the biceps skinfold were measured and recorded.

4.3.2.3.3. Sub-scapular skinfold. For this measurement, the subject was instructed to hang the right arm loosely. The researcher took permission from the subject to mark the point of measurement with felt tip. The oblique line running downwards and laterally 2.5 cm below the tip of the right scapula was marked. The fold of skin at the tip of the point was taken and, following the same technical procedures, the first measurement recorded. Having removed the calipers, the same procedure was repeated again and the second reading taken.

4.3.2.3.4. Supra-iliac skinfold The subject was instructed to remove all clothing over the waist. The point 2 cm above the iliac crest and along the mid axillary line on the right hand side was marked. A fold of skin at this point was taken and measured. The first and second reading was recorded in the subject's file.

4.3.2.3.5. Mid-thigh skinfold. The mid-point between the greater trochanter and the lateral epichondyle of the right leg was marked. At this point, a fold of skin was taken and measured. The first reading was taken. After removing the calipers, the same procedure was repeated for the second reading, and both were recorded in the subject's file.

4.3.2.4. Waist circumference. A non-stretchable tape measure was used for taking the waist circumference. The subjects were asked to stand erect with the abdomen relaxed, arms at the sides, feet together and with their weight equally divided over both legs. The right lowest rib margin was first located and marked with a felt tip pen. The iliac crest was then palpated in the mid-axillary line, and also marked. An elastic tape was then applied horizontally midway between the lowest rib margin and the iliac crest, and tied firmly so that it stays in position around the abdomen about the level of the umbilicus (Jones, 1986). The subject was asked to breathe normally, and to breath out gently at the time of the measurement to prevent them from contracting their muscles or from holding their breath. The reading was taken to the nearest millimetre.

The circumference of the waist relates closely to body mass index and is also the dominant measurement in the waist:hip ratio (WHR), which reflects the proportion of body fat located intra-abdominally, as opposed to subcutaneously (Bjorntorp, 1987), and waist circumference is the best indicator of changes in intra-abdominal fat during weight loss (Van der Kooy, 1993). Waist circumference as a predictor of health risk from overweight and through the central distribution of fat was measured by Lean and associates, (1995) who determined the following action levels for weight reduction in women.

Action Level 1 $\geq$ 80 cm

(A threshold above which health risks are increased.)

Action level 2 $\geq$ 88 cm

(Corresponds to the point at which symptoms of breathlessness and arthritis begin to develop from overweight.)

4.3.2.5. Hip circumference. A non-stretchable tape measure was used for taking the hip circumference. For this measurement, the subjects were asked to stand erect with arms at the side and feet together. The measurement was taken at the point yielding the maximum circumference over the buttocks (Jones, 1986), with the tape held in a horizontal plane, touching the skin but not holding the soft tissue.

The following indicators were derived from the direct measurements made by anthropometry.

4.3.2.6. BMI classification. BMI (kg/m^2) has a relatively high correlation with estimates of body fatness and a low correlation with stature (Simopoulos 1985; National Institute of Health 1985; Garrow, 1985). It is obtained by dividing weight in kilograms by height in meters squared. The classification of obesity for this study is based on the revised World Health Organisations classification (1998) of body mass index.

4.3.2.7. Waist Hip Ratio. The waist hip ratio (WHR) provides an index of regional fat distribution and is a valuable guide in assessing health risk (Bray, 1988). This ratio is calculated by dividing the waist circumference by the hip circumference. The risk of disease rises steeply when the WHR rises above 0.8 in females.

The percentage of females at risk of disease based on their waist hip ratio is given in Table-4.2.

Table-4.2 Risk of disease based on WHR in adult females, 20-69 years.

	Disease Risk Based on WHR			
	Low	**Moderate**	**High**	**Very High**
Age (years)		**70th**	**30th**	**10th**
20 - 29	< 0.71	0.71 - 0.78	0.78 - 0.82	> 0.82
30 - 39	< 0.72	0.72 - 0.79	0.79 - 0.84	> 0.84
40 - 49	< 0.73	0.73 - 0.79	0.79 - 0.85	> 0.85
50 - 59	< 0.74	0.74 - 0.80	0.80 - 0.87	> 0.87
60-69	< 0.76	0.76 - 0.81	0.81 - 0.88	> 0.88

Adapted from Bray GA, 1988.

4.3.2.8. Sub-scapular-Triceps Ratio. The sub-scapular-triceps ratio (STR) is another index of body fat distribution. It is calculated by dividing the sub-scapular skinfold thickness by the triceps skinfold thickness.

4.3.2.9 Percent Body Fat

Body fat (%) was estimated from skinfold measurements of 4 sites (triceps, biceps, sub-scapular, and supra-iliac skinfolds). Regression equations were used to predict body density and percent body fat from skinfold measurements. In this study, body density was estimated using the age and gender specific equations developed by Durnin and Womersley (1974). Percent body fat was estimated from body density using the formula developed by Brozek (1963) seen in Table-4.3;

$$\text{Percent body fat} = (4.57/\text{body density}) - 4.14$$

Table-4.3 Age related body composition equations for females (20-50+).

Age, years	Equation
20-29	Body density = 1.1599 - 0.0717 x (log Σ 4 skinfolds *)
30-39	Body density = 1.1423 - 0.0632 x (log Σ 4 skinfolds)
40-49	Body density = 1.1333 - 0.0612 x (log Σmn 4 skinfolds)
50+	Body density = 1.1339 - 0.0645 x (log Σ 4 skinfolds)

Equations from Durnin JVGA, Womersley J. 1974.

*Σ 4 skinfolds= sum of the triceps, sub-scapular, supra-iliac, and biceps skinfolds.

4.3.2.15. Desirable Level of Fatness

The norms for percent body fat were based on the categories suggested by Nieman (1995) and are given in Table-4.4:

Table-4.4 Percent Body Fat Standards For Adult Females

Classification	Females
Lean	< 13 %
Optimal	13 - 23 %
Slightly overfat	24 - 27 %
Fat	28 - 32 %
Obese	$\geq$ 33 %

Adapted from Nieman DC. 1995.

4.3.3 Blood Pressure Measurement

Blood pressure was measured using Accoson Sphygmomanometer and the Littman Stethoscope.

The participant was asked to sit comfortably for 5 minutes to rest before the blood pressure was measured. She was asked to lay the arm horizontally on the table at the level of the mid-sternum and to remove any tight or restrictive clothing from the arm. The investigator used the same blood pressure sphygmomanometer on all the participants. The cuff used was 15 cm in width and 35 cm in length to ensure that it can encircle the average arm as well as larger arms in fat individuals (WHO Expert Committee, 1996). It was applied making sure that the midpoint was over the position of maximal pulsation of the brachial artery. Systolic blood pressure was initially determined by palpation then the stethoscope was lightly placed over the brachial artery. The brachial artery was occluded by inflating the cuff approximately 30 mm above the pressure at which the radial pulse disappeared to palpation. Pressure was lowered, at the rate of 2 to 3 mm per second, through the valve of the inflating bulb. The point at which sounds returned (Korotkoff phase I) was taken as the systolic blood pressure. As the pressure was further lowered, and at the point at which the sounds disappeared was taken as the diastolic blood pressure. Both systolic and diastolic blood pressures were recorded to the nearest 2 mm mark and entered in the participants' file. This was the first measurement of the blood pressure. The second measurement was recorded after the questionnaire.

4.3.3.1. Classification of Blood Pressure

As systolic blood pressure increases above 120 mm Hg and as diastolic blood pressure increases above 80 mm Hg there is an increased risk of death from cardiovascular disease (National High Blood Pressure Education Program Working Group 1993). Guidelines developed by the National High Blood Pressure Education Program for classifying blood pressure are shown in the following table;

Table-4.5. Classification of Blood Pressure

Average DBP mm Hg	Average SBP mm Hg			
	< 120	120-129	130-139	≥ 140
< 80	Optimal[1]	Normal	High Normal	High
80-84	Normal	Normal	High Normal	High
85-89	High Normal	High Normal	High Normal	High
≥ 90	High	High	High	High

DBP = diastolic blood pressure SBP = systolic blood pressure

1 Optimal blood pressure, with regard to cardiovascular risk, is SBP <120 mm Hg and DBP < 84 mm Hg. From: National High Blood Pressure Education Program (1993) Fifth Report of the Joint National Committee on Detection, Evaluation, and Treatment of high Blood Pressure. Betesda Md. US Department of Health and Human Services; National Institutes of Health; National heart, Lung, and Blood Institute.

For blood pressure to be considered within 'normal range' the systolic blood pressure must be 120 to 129 mm Hg with the diastolic pressure being no more than 84 mm Hg, or the diastolic blood pressure must be within the 80-84 mm Hg range with the systolic blood pressure no more than 129 mm Hg.

4.3.4. Laboratory Procedures for Blood Biochemistry

Included in the laboratory procedures were the collection of blood samples and procedures to perform the biochemical analyses.

4.3.4.1. Collection of Blood Sample

Two samples of blood were withdrawn by venous puncture from the right arm of the participant by vacutainer. The blood samples were taken by the phlebotomist or the laboratory technician assigned to the health clinic. Samples were collected by the researcher, labelled and then refrigerated at 4°C. After completing the procedures and measurements for the assigned number of participants by the researcher for that day, she would transfer the blood samples into an ice box containing ice packs to be taken by the researcher to the medical laboratory at Mubarak Hospital (approximately 11:00-11:: 30 am).

4.3.4.2. Biochemical Analysis

At Mubarak Hospital Central Laboratory, the researcher takes the blood samples to the separation room to be separated. The tubes are labelled, and each with the request form attached. The request from has the name of the participant, age, serial number, contact telephone number, name of the health clinic and the blood analysis to be performed. The sample should be clotted. If not, it was left to clot.
Some of the earlier blood analysis such as separation of the blood sample (centrifuge), transfer to the auto-analyser for analysis of fasting blood glucose were done by the researcher.

4.3.4.3. Blood glucose, serum cholesterol and serum triglycerides.

Samples were centrifuged for 10 minutes in a Peckman centrifuge (Ghanim Company). The blood was separated into serum (upper) and cells white blood cells and platelets (lower). The upper layer (serum) was put into a separate plastic test-tube and stoppered.

A sample of serum analysed for blood glucose, serum cholesterol and serum triglycerides using a BM/Hitachi 911 analyser (Boehringer Mannheim Company).

4.3.4.4. High density lipoproteins and apolipoproteins.

For a sub-sample of 53 participants another sample of the serum was prepared and put in the ACA discrete clinical analyser for analysis of high density lipoproteins.

The remaining sample was analysed for Apolipoprotein A-1 and Apolipoprotein B-1 in a Nephelometers (Behring, Behringwerke AG.).

The analysers are calibrated and commercial control samples designed to test that all biochemical tests are within the acceptable range (3 STD) are run each morning and after every 20 samples to ensure quality control.

4C-Plus , Coulter Cell Control.

4C Plus cell control, for in vitro diagnostic use, is prepared from stabilised human blood so that repeated measurement can be made to monitor daily performance of the instrument system. Assigned values are determined on validated systems using specific COULTER reagents. Assigned Values are confirmed by multiple analyses of the control product.

Coulter Corporation, 11800 SW 147 Avenue, Miami, FL 33196-2500 EE.UU.

4.3.4.5. Calculation of low density lipoproteins. Low density lipoproteins were calculated from measurements of total cholesterol, triglycerides, and HDL- cholesterol using the following formula:

$$[\text{LDL-chol}] = [\text{total chol}] - [\text{HDL- chol}] - TG/5$$

where TG/5 corresponds to an estimation of the [VLDL - chol] and all measurements are expressed in milligrams /decilitre. This formula was recommended by the National Cholesterol Education Program in the United States (1993).

4.3.4.6. Serum Lipids and Lipoproteins

Guidelines developed by the National Cholesterol Education Program for classifying total cholesterol and HDL-C levels in adults are shown in Table-4.6.

Table -4.6 Classification of total cholesterol, HDL-C, LDL-C and Triglycerides for women.

	mmol/L
Total Cholesterol[1]	
Desirable	< 5.17
Borderline high	5.17-6.19
High	≥ 6.20
HDL-C	
Low HDL-C	<0.9[1]
	<1.3[2]
LDL-C	
High LDL-C	>3.4[1]
Triglycerides[1]	
Normal	<2.3
Borderline high	2.3-4.5
High	4.5 - 11.3
Very high	>11.3

1 Adapted from National Cholesterol Education Program (1993) Second report of the expert panel on detection, evaluation, and treatment of high blood cholesterol in adults. Bethesda Md. US Department of Health and Human Services, Public Health Service; National institutes of health: National Heart, Lung, Blood Institute.
2 Adapted from Bass, 1993.

Ratios of various lipoproteins have been used to assess risk. A high risk of CHD is associated with a total cholesterol/HDL ratio of 5.6 or greater in women (Kinosian, 1994).

A total cholesterol/HDL ratio of 6 in women is considered a target for beginning intervention (Schaefer, 1994).

4.3.4.7. Fasting Blood Sugar

The following classification of fasting blood sugar was used;

Fasting Blood Sugar[1]	mmol/L
Normal	3.3-6.4
Borderline	6.4 - 7.7
High	$\geq$ 7.8

1. Adapted from Anderson, 1994.

4.4. Quality Control

4.4.1. <u>Questionnaire</u>

To ensure that the questions were clear and correctly interpreted, the questionnaire was tested on a random sample of 12 women, who were divided into 6 groups, 2 women in each group. These women were taken randomly from the record registration clerks. The questionnaire was translated into Arabic and back translated to ensure that the meaning of the questions was the same in both languages. The researcher conducted all interviews.

4.4.2. <u>Nutritional Anthropometry</u>

All measures were taken in duplicate by the researcher thus eliminating inter observer error.

4.4.3. <u>Blood Analysis Data</u>

All analysis were conducted in the same laboratory. Standard quality control procedures were used. All auto analysers were calibrated every morning and standards run each morning and after each 20 samples.

4.4.4. Data Management

All questionnaires were reviewed for completeness immediately following each interviewing session. All coding was re-checked for accuracy.
All data was entered directly form the questionnaires and the standardised coding forms in the participant's file. The only information that was transferred to the file was the laboratory data. All transfers were re-checked for accuracy.
During data entry, one person read the coding from the participant file and checked the entry while the other person entered the data. Spreadsheets from the database were reviewed for any information that was out of range. Random files were reviewed for accuracy of data entry. All data entry errors were corrected.

4.5 DATA MANAGEMENT AND ANALYSIS

Interview data was recorded and coded directly on the interview form. Anthropometric data was recorded directly onto standardised recording forms during the data collection process. Blood analysis data was transferred to recording forms in the participant's file as soon as the information was received from the laboratory. The laboratory results were stapled into the file.

Questionnaire data was reviewed for completeness at the end of each interviewing session. If any data was missing the participant was telephoned to ascertain the information. All coding was re-checked for accuracy. The questionnaire consisted of 6 sections and the total number questions were 80. However, when responses to the questions were analysed, only 39 questions were included in the final analyses.

Section 1 of the questionnaire dealt with socio-demographic characteristics of the sample. Questions on weight gained after marriage and the average weight gained during pregnancy were not reliable. Many respondents were not sure or could not remember. Other questions related to smoking behaviour were also excluded as less than 4% of the respondents smoked.

The questions in section 2 were on general health of the subjects. Specific questions on the diagnosis of CHD, type of heart disease and the duration of the illness were excluded because less than 4% had CHD as well as many were unsure of the exact diagnosis. Furthermore, questions on type of medication respondents were on were not reliable.

Questions on regular exercise in section 3 (physical activity and lifestyle characteristics) were excluded, as they were not reliable. Many of the respondents who answered yes to regular exercise were discovered to have answered no to the duration of exercise in hours per week.

Section 4 was on maternal characteristics. Responses to questions on average weight gained during and after each pregnancy, and the average weight of the new-born were unreliable. In addition, neither questions on history of miscarriages, new-borns having had accidents at birth, menstrual cycle, nor age at menopause were reliable.

Section 5 of the questionnaire questioned participants on attitudes and level of awareness on breastfeeding practices.

Section 6 of the questionnaire was intended to provide information on dietary habits. However, the questions were unreliable.

Computer data entry was made using a database program Claris Works (Version 4; Claris Co-operation; 5201 Patrick Henry Drive, PO BOX 58168; Santa Clara, California; 95052-8168, USA). Data entry was made by two people: one to read data from participant's file and to check entry and one to enter the data.

Spreadsheets of the data were reviewed for any information that was out of range. Columns of data were sorted in order to check for data entry errors. In addition random files were reviewed for accuracy of entry. All data entry errors were corrected. Some questions were recoded to reflect the responses reported in the 'other' category.

Data was defined for SPSS and STATA analysis. The data was analysed using SPSS for the Macintosh (SPSS International B.V. The Netherlands), and STATA for windows (version 5, stata corporation, 702 University Drive East, College Station, Texas, 77840, USA). Data was initially tabulated using frequency tables. Means, medians and standard deviations and ranges were calculated. The data was then examined using stem and leaf plots and box plots. Outliers were checked against the participant records.

The characteristics of the sample were assessed. The data was then subdivided into age groups: 20-29, 30-39, and 40 and over, and the characteristics of body composition analysed.

BMI was subdivided into six categories: underweight (BMI ≤ 18.5), normal (18.5-24.9), overweight (25-25.9), obese class I (30-35.9), obese class II (35-39.9), and obese class III (> 40).

To assess the prevalence of overweight the following models were used: the proportions of those who were of normal weight compared to those with BMIs' ≥ 18.5, those who were overweight (BMI 24-29.9) were compared to those with BMIs' ≥ 25.0; those who were obese class I (30-34.9) to those with BMIs' ≥ 30.0; those who were obese class II (35-39.9) with those with BMIs' ≥ 30.0, and those who were obese class III (≥ 40.0) with those with BMI ≥ 30.0.

Model	**BMI**
I	Non-obese - BMI< 25.0
	Obese - BMI ≥ 25.0
II	Normal - BMI = 18.5 - 24.9
	Overweight - BMI = 25.0 - 29.9
	Obese - BMI ≥ 30.0
III	Normal - BMI = 18.5 - 24.9
	Obese - BMI ≥ 30.0

The demographic and lifestyle characteristics and determinants of weight gain were determined for all those with three models of BMI categories:

4.6 Ethical Approval

This study was reviewed and approved by the Ministry of Health, Government of Kuwait, and the Kuwait Foundation for Advancement of Science. Ethical approval was also obtained from the London School of Hygiene and Tropical Medicine.

In consideration of subjects, all participants who had abnormal blood pressures and/or abnormal blood biochemical analyses were referred immediately to the health clinic physicians.

CHAPTER V

RESULTS

This chapter presents the findings from analyses undertaken in determining the prevalence of obesity, its characteristics, contributing factors, and associations with other health disorders. It includes the following six sections: (1) Socio-demographic and other characteristics of the participants in the study, (2) the prevalence of obesity in adult Kuwaiti women, (3) anthropometric characteristics, (4) the determinants of obesity in this population, (5) other health disorders associated with obesity, and (6) perceptions of weight, overweight, and obesity of adult Kuwaiti women.

5.1 SOCIO-DEMOGRAPHIC AND OTHER CHARACTERISTICS OF PARTICIPANTS

Of the original 1208 potential participants, no contact (secret code, telephone out of order, no reply) could be made with 690 (57%) and a further 191 (15.8%) subjects who were contacted directly refused to participate. Hence, 324 (26.8%) subjects participated in this study. Less than 2.1% of the total (n=324) participants refused to have anthropometric measurements taken. For blood analyses, there was a further 44 percent refusal rate.

The Sample

A summary of the socio-demographic characteristics of the sample is presented in Table 5.1.

5.1.1 Socio-demographic Characteristics

324 Kuwaiti women within the age range of 20-60 years participated in the study. Thirty percent were between 20-29 years, 39.1% were between 30-39 years, and

30.6% were 40 years and over. The majority (73.1%) were married. The rest were either single (17%), divorced (7.3%) or widowed (2.5%). Of the participants in the study, 64.2% were working. This working group consisted of 33.6% civil servants, 23.5% professionals (doctors, engineers, nurses, teachers), and 7.0% students. In the non-working group 29.7% were housewives and 6.1% were retired. Fifty-six percent of the sample had intermediate or secondary education, 31% had post secondary education, and nearly 14% were illiterate or had primary education only.

Table-5.1 Socio-demographic characteristics of adult Kuwaiti females, 20-60 years, 1996-97.

		Age in years		
	Total (%)	**20-29**	**30-39**	**40 +**
Number (%)	324 (100)	98 (29.6)	126 (38.8)	100 (30.8)
Marital status				
Single	55 (17.0)	40 (72.7)	6 (10.9)	9 (16.3)
Married	237 (73.1)	49 (20.6)	109 (45.9)	79 (33.3)
Divorced	24 (7.4)	8 (33.3)	9 (37.5)	7 (29.1)
Widowed	8 (2.5)	1 (12.5)	2 (25.0)	5 (62.5)
Occupation				
Working	208 (64.2)	74 (35.5)	97 (46.6)	37 (17.7)
Not working	116 (35.8)	24 (20.6)	29 (25.0)	63 (54.3)
Level of education[1]				
Low	44 (13.6)	1 (2.2)	8 (18.1)	35 (79.5)
Medium	180 (55.5)	57 (31.6)	79 (43.8)	44(24.4)
High	100 (30.8)	40 (10.0)	39 (39.0)	21 (21.0)
Parity				
Nulliparous	89 [2] (27.5)			
1-2	59 (18.2)	33 (55.9)	22 (37.2)	4 (6.7)
3-5	100 (30.8)	12 (12.0)	53 (53.0))	35 (35.0)
6+	76 (23.4)	0	34 (44.1)	43 (56.5)

1. Low = illiterate and primary; medium = intermediate and secondary; high = diploma and higher education
2. The 89 in nulliparous category includes 55 single and 34 married women without children.
3. Figures in parentheses denote percentages.

Of those with education below the primary level (n=44), 80% were over 40 years of age. Of those participants who had children (n=235), 25% had 1-2 pregnancies, 43% had 3-5 pregnancies and 32% had six or more pregnancies. Parity increased with age. Fifty-six percent of those who had 1-2 pregnancies were in the 20-29 year old age group, 37% were in the 30-39 year old group and 7% in the 40 and over age group. For those participants who had 3-5 pregnancies, 53% were in the 30-39 year old group, 35% were in the 40-year-old group, and 12 % in the 20-29 year old group. For those with six or more pregnancies the majority, 56%, were over 40 years. There were 89 nulliparous women in the sample (27.5%), 55 were single and 34 were married but had no children.

Analysis of the socio-demographic characteristics of 324 adult Kuwaiti females indicated that the mean age was 35 years (SD = 8.92), the majority being married with 3 to 5 children, employed with a medium level of education.

5.1.2 Anthropometric Characteristics

One percent of the sample of adult Kuwaiti women, n=3, refused measurement of height, weight, waist and hip circumference measurements as well as triceps, biceps, supra-iliac and upper thigh, and sub-scapular skinfold measurements. As a result of these losses, the number of participants for individual anthropometric measures vary. The number of participants with complete nutritional anthropometric measurements were 324.

The means for height and weight were 1.55 m and 77.43 kg respectively. The means and the percentiles of all skinfold indices, i.e., biceps, triceps, sub-scapular, supra-iliac, and upper thigh of the 324 females are summarised in Table-5.2. In addition, the means and percentiles for waist and hip circumference are also presented.

Table-5.2 also presents the 15th, 50th and 85th percentile for anthropometric measurements of the sample by age group.

Height was greatest among those in the 85th percentile for height of the 20-29 age group and lowest among those in the 15th percentile of the over 40. Weight, some of the skinfolds (biceps, triceps, supra-iliac, upper thigh), and waist and hip circumferences were greatest in participants age 40+ and lowest in the 20-29 years old groups.

Table-5.2. Anthropometric dimensions of adult Kuwaiti females aged 20-60 years, 1996-97; n=324

	Mean (SD)	Age (Number of subjects) 20-29 (98)			30-39 (126)			40+ (100)		
		15th	50th	85th	15th	50th	85th	15th	50th	85th
Height, (m)	1.55 (0.16)	1.52	1.58	1.63	1.50	1.56	1.64	1.48	1.55	1.61
Weight, (Kg)	77.4 (19.2)	54.0	68.0	89.5	62.0	78.0	94.8	67.4	80.0	98.4
Skinfolds,(mm)										
Biceps	24 (11.2)	11.0	21.2	36.0	12.0	22.0	33.0	15.8	24.0	42.0
Triceps	38 (15.0)	21.0	35.6	47.0	24.0	38.0	49.0	28.0	40.0	50.0
Sub-scapular	37.1 (15.4)	20.0	41.0	52.3	19.2	35.0	54.0	25.0	40.0	55.0
supra-iliac,	46.0 (22.0)	27.1	46.3	59.2	29.2	45.0	60.0	35.0	48.0	60.0
Upper thigh,	54.5 (11.2)	43.0	56.0	60.0	48.4	60.0	60,0	40.0	60.0	60.0
waist circumference, (cm)	96 (16)	72	88	101	83	96	112	87	101	117
Hip circumference, (cm)	110 (12.5)	94	106	120	100	108	123	102	110	130

Table-5.3 summarises the 15th, 50th, and 85th percentiles of derived measurements: body mass index (BMI), waist hip ratio (WHR), subscapular triceps ratio (STR), and percent body fat, by age group category.

5.1.2.1. BMI. One percent of the sample (n=3) did not have calculated BMI's due to refusal for either weight or height measurements or both.

5.1.2.2. WHR. Waist hip ratio was calculated as a measure of regional distribution of body fat. One percent of the sample refused waist or hip measurements.

5.1.2.3. STR. This is a measure of body fat distribution and an index of central to peripheral body fat.

Ratio of fat to body weight is frequently expressed as a percentage of body fat (Nieman, 1995). Percent body fat is estimated using the formula developed by Brozek (1963)

$$\text{Percent body fat} = (457/\text{body density}) - 414$$

Body density was estimated using the equations developed by Durnin and Womersley (1974).

Table-5.3 Body mass index (BMI)) and body fat distribution (% body fat, WHR, STR) of adult Kuwaiti females aged 20-60 years, 1996-97.

		Age (Number of subjects)								
	Mean (SD)	**20-29 (98)**			**30-39 (126)**			**40+ (100)**		
		15th	50th	85th	15th	50th	85th	15th	50th	85th
BMI	31.8 (7.6)	22.1	27.8	35.3	24.2	30.8	39.3	26.7	32.9	40.[illegible]
Percent body fat	40.0 (6.7)	32.4	40.6	44.5	33.6	40.3	44.6	36.4	41.6	45.[illegible]
Waist/hip ratio	0.87 (0.1)	0.74	0.82	0.90	0.80	0.88	0.98	0.80	0.90	1.0[illegible]
Sub-scapsular /triceps ratio	1.0 (0.32)	0.71	1.04	1.36	0.64	0.94	1.25	0.76	1.02	1.2[illegible]

BMI increased with age for the 15th, 50th, and 85th percentiles. The mean percent body fat is 40, and the 85th percentile for all age groups approaches 45% body fat. The mean for the waist hip ratio (WHR) is 0.87 and it increases with age. The subs-sub-scapsular triceps ratio decreased with age except for the 15th percentile in the 40+ age group where it increases.

The percent body fat norms as proposed by Nieman in 1995 were applied in this study. These ranges classified adult females into lean/optimal ($\leq$ 23%), slightly fat / overfat (24-32.9 %), and obese/overfat ($\geq$ 33). A summary is reported in Table-5.4. Ninety percent of the participants were in the obese or over fat category of percent body fat Eight percent of the participants were in the slightly fat/overfat category and 2% were in the lean/optimal category. Of those n the 40 and over age group, nearly 98% were in the obese category.

Table-5.4. Percentage body fat[1,2] of adult Kuwaiti females 1996-97, n=324

	Body Fat			
	Lean/optimal	slightly fat/over fat	obese/overfat	
Age, years	< 23% (%)	23-32.9 % (%)	≥ 33 % (%)	Total (%0)
20-29	4 (4.08)	11 (11.22)	83 (84.69)	98 (30.3)
30-39	2 (1.58)	14 (11.11)	110 (87.30)	126 (39.0)
40+	0	2 (2.02)	97 (97.97)	99 (30.7)
Total	6 (1.85)	27 (8.35)	290 (89.78)	323 (100.0)

1. Lean: ≤13%, optimal: 13-23%, slightly overfat: 24-27%, fat: 28-32, obese/overfat: ≥33%. Nieman 1995.
2. $P \leq 0.046$.

Table-5.5 shows the values of the sum of four skinfolds (biceps, triceps, sub-scapular, and supra-iliac), body density, and body fat expressed as percentage of body weight. For all age groups, the mean percent body fat was 40% and above. The mean of the sum of four skinfolds for the 20-29 age group was 141 mm, for the 30-39 age group it was 139 mm, and for the over 40 year-old group it was 156 mm. The mean body density was 1.010, 1.009, and 0.009 for the same age groups respectively.

Table-5.5 Total of skinfolds, total body density and fat content of adult Kuwaiti females age 20-60 years, 1996-97.

		Sum of skinfolds[1]			Body Density[2]			Body fat[3] %		
Age	N	mean	SD	range	mean	SD	range	mean	SD	range
20-29	98	141	61	10-470	1.010	0.012	0.968-1.088	40	9.1	5.01-61.3
30-39	126	139	45	5-223	1.009	0.054	0.992-1.083	40	7.2	-3.4-49.23
40+	99	156	51	54-488	1.004	0.009	0.967-1.036	43	4.6	28.0-62.0

1. Sum of 4 skinfolds biceps, triceps, sub-scapular, and supra-iliac.
2. Equation from Durnin J, and Womersely J. 1974
3. Brozek equation (1963); % body fat = (457/body density) - 414.

The distribution of indicators of coronary risk varied according to age group (Table-5.6). Adiposity increased with age. Hypertension, diabetes, and elevated serum cholesterol levels were three to fifteen times more prevalent in the older age group. Seventy-seven percent of the sample did not indulge in any physical exercise.

Body fat, expressed as percent body weight, was positively associated with age, BMI, waist circumference, and WHR. Eighty five percent of the participants between the ages 20-29 yr, 87% of those between 30-39 yr, and 98% of those 40 yr and over groups had more than 33% of their total body weight as fat; i.e., in the obese (over fat) category of body fat (Nieman, 1995). Body fat increased with BMI, 100% of those in the 30-39 and 40 categories of BMI in the 33% body fat category. Only 40% of the women exercised; and of those who did 89% had more than 33% body fat. Almost hundred percent of the diabetics, 97% of the hypertensives, and more than 95% of those with moderately high and high levels of cholesterol had body fat of 33% and over. Similarly, 99% of those with a waist circumference over 0.88 mm and 94% of those with WHR greater than 0.78 were in the high category of body fat.

In the sub-sample of 183 women who completed the lipid profile tests, 100% of those with borderline high and high levels of TG and 100% of those with low HDL, and 95% of those with high serum levels of LDL were in overfat category.

Table-5.6. CHD risk factors by percent body fat among adult Kuwaiti females.

		% Body fat [1]			
	p	< 23	23-32.9	≥ 33	Total (%)
Number of subjects		6	27	291	324
Age	0.014				
20-29		4 (4.5	11 (11)	83 (85)	98 (30.2)
30-39		2 (2)	14 (11)	110 (87)	126 (38.8)
40+		—	2 (2)	97 (98)	99 (30.5)
BMI[2]	<0.0001				
18.5-24.9, normal		4 (7.8)	22 (40)	29 (53)	55 (16.9)
25-29.9, overweight		—	5 (6)	81 (94)	86 (26.4)
≥ 30.0, obese		—	—	180 (100)	180 (55.5)
Waist circumference, mm	< 0.0001				
≥ 0.88		—	2 (0.8)	233 (99.2)	235 (72.5)
WHR[3]	< 0.0001				
≥ 0.78		2 (0.73)	15 (5.5)	291 (93)	273 (84.3)
Exercise[4]	0.25				
Yes		3 (3)	9 (11)	72 (86)	84 (26)
No		3 (1)	18 (8)	218 (92)	239 (74)
Diabetes[5]	0.04				
Yes		—	1 (2)	46 (98)	47 (14.7)
No		6 (2)	27 (10)	237 (88)	270 (84.9)
Hypertension[6]	0.073				
Yes		2 (2.4)	2 (2.4)	79 (95.2)	83 (25.6)
No		4 (1.6)	25 (10.4)	212 (87.9)	241 (74.3)
cholesterol, mmol/L[7]	0.098				
5.7-6.19		1 (2.7)	—	36 (97.3)	37 (11.4)
> 6.2		—	2 (3.7)	51 (96.2)	53 (16.3)
N=183					
Triglycerides[7]	0.17				
2.3-4.4		—	—	33 (100)	33 (18)
4.5-11.3		—	—	15 (100)	15 (8.2)
LDL-cholesterol[7]	0.001				
3.4-4.0		—	7 (14.6)	41 (85.4)	48 (26.2)
> 4.0		5 (2.7)	5 (2.7)	32 (76.2)	42 (23)
HDL-cholesterol[7]	0.38				
< 0.9		—	—	16 (100)	16 (8.7)

1. Equation from Durnin J, and Womersely J. 1974; Brozek equation (1963); % body fat= (457/body density) - 414.
2. BMI, weight (kg)/height $(m)^2$, WHO classification (1998).
3. Bray GA (1988) Low risk: <0.71, moderate risk: 0.72- 0.779, high risk: ≥ 0.78.
4. Participants who did not exercise.
5. *Number of subjects in whom diabetes was reported*
6. National High Blood Pressure Education Program. 1993. Diastolic ≥ 90 mm Hg, systolic ≥ 140 mm Hg or self reported on treatment.
7. National Cholesterol Education Program, 1993. **Cholesterol (TC)**; desirable: < 5.17mmol/L, borderline high: 5.17-6.19 mmol/L, high: > 6.20 mmol/L . **Triglycerides (TG)**;normal: < 2.3 mmol/L, borderline high: 2.3-4.5 mmol/L,high: > 4.5. **LDL** =TC - HDL (TG/5). **HDL**; Low: <0.9mmol/L; high: > 1.6 mmol/L.

The WC, (cm) was used because it correlates closely with CHD risk factors (Ledoux et al, 1997). The cut-offs proposed by Han et al, <80 cm, 80-87 cm, ≥ 88 cm., were used in this study (Han et al, 1995). Seventy-three percent of the total number of participants had a WC that categorises as high risk for CHD. The figures also show that WC increased with age ($p < 0.001$).

Table-5.7 WC (cm) of adult Kuwaiti females, 20-60 years, by age, 1996-97, n=324.

	Waist circumference, cm (%)			
Age, years	**< 80**	**80-87**	**≥ 88**	**Total**
20-29	29 (29.6)	16 (16.3)	53 (54.)	98 (30.2)
30-39	10 (8.1)	17 (13.7)	97 (78.2)	124 (38.2)
40+	9 (9.0)	6 (6.0)	85 (85.0)	100 (30.8)

* $P < 0.001$

A summary of the relationship of waist circumference with selected diseases and blood lipid levels as risk factors to CHD are reported in Table- 5.8. The results show that 95 % of those with NIDDM ($p<0.002$) and with hypertension ($p<0.05$) were in the high risk level of waist circumference. There was no statistically significant association with subjects diagnosed as having CHD. More than 80% of those with high serum cholesterol, high serum TG, high serum LDFL and low serum levels of HDL were in the high level of waist circumference measurements which categorises them as high risk for CHD. The relationship of serum cholesterol and serum TG was statistically significant, ($p< 0.02$).

Table-5.8 CHD risk factors by WC (cm) of adult Kuwaiti females, 20-60 years of age,1996-1997.

	P	WC, cm (%)			Total
		< 80	80-87	≥ 88	
NIDDM[1]	0.002				
Yes		1 (2.1)	3 (6.4)	43 (91.5)	47 (14.8)
No		46 (17.0)	39 (14.4)	185 (68.5)	270 (85.2)
Hpertension[2]	0.051				
Yes		7 (8.4)	7 (8.4)	69 (83.1)	83 (25.6)
No		41 (17.2)	32 (13.4)	166 (69.5)	239 (24.4)
CHD[3]	0.91				
Yes		2 (16.6)	1 (8.3)	9 (75)	12 (3.7)
No		46 (14.8)	38 (12.2)	226 (73.0)	310 (96.3)
SC,mmol/L[4]	0.02				
5.7-6.19		1 (2.7)	3 (8.3)	32 (88.8)	36 (11.4)
≥ 6.2		6 (11.0)	3 (6.0)	44 (83.0)	53 (16.3)
ST,mmol/L[4]	0.02				
2.3-4.4		-	2 (6.0)	31 (94.0)	33 (18)
4.5-11.3		2 (13.3)	-	13 (86.7)	15 (8.2)
LDL,mmol/L[4]	0.76				
3.4-4.0		4 (8.5)	7 (14.9)	36 (76.6)	47 (25.9)
≥ 4.0		3 (7.5)	4 (10.0)	33 (82.5)	40 (22.1)
HDL,mmol/L[4]	0.70				
< 0.9		2 (17.5)	1 (6.25)	13 (81.25)	16 (8.7)

1. *Number of subjects in whom diabetes was self- reported*
2. National High Blood Pressure Education Program. 1993. Diastolic ≥ 90 mm Hg, systolic ≥ 140 mm Hg or self reported on treatment.
3. Number of subjects in whom CHD was reported
4. National Cholesterol Education Program, 1993. **Cholesterol (TC)**; desirable: < 5.17mmol/L, borderline high: 5.17-6.19 mmol/L, high: > 6.20 mmol/L . **Triglycerides (TG)**;normal: < 2.3 mmol/L, borderline high: 2.3-4.5 mmol/L,high: > 4.5. **LDL** =TC - HDL (TG/5). **HDL**; Low: <0.9mmol/L; high: > 1.6 mmol/L.

In summary, the mean height, 1.55 m, mean weight, 77 kg, and mean waist circumference, 96 cm, of adult Kuwaiti females categorises this study sample as obese with a central pattern of obesity. The mean BMI is 32.0 which classifies them as class I obesity according to the recent WHO classification of BMI (1998). The means for % body fat, WHR, and STR are 40%, 0.87, and 1.0 respectively; which classifies them as high risk group for CHD. Univariate analysis of the association % body fat and the risk of CHD indicated that age, BMI, waist circumference, WHR, and LDL to be statistically significant whereas NIDDM and hypertension showed borderline significance. However, univariate analysis of the association of WC and risk of CHD indicated that more than 90% of those with NIDDM and hypertension, and more than 88% of those with high blood lipids were at high risk for CHD.

5.2 THE PREVALENCE OF OBESITY

The classification of obesity for this study (Table-2.6) is based on the revised World Health Organisation classification (1997) of body mass index, BMI, wt (kg)/ ht (m^2). The ranges of BMI for adult men and women are:

5.2.1 <u>BMI Distribution.</u>

5.2.1.1. Age

Table-5.9 shows that 16% of the sample were of normal weight (BMI = 18.5-24.9). Almost 29% were between 20-29 years, 15% between 30-39 years, and 7% in the over 40 years age group ($p < 0.0001$). The two participants whose BMI were less than 18.5 and were excluded.

Table-5.9 The prevalence of participants with normal weight (BMI = 18.5-24.9 kg/m²) in the sample.

Age, years	Total (%)	Prevalence of Norm Wt[1] (%) (18.5-24.9)
20-29	98 (30.2)	28 (28.5)
30-39	126 (38.8)	19 (15.0)
40 +	100 (30.8)	7 (7.0)
Total	324 (100.0)	54 (16.6)

1. Norm Wt: normal weight equivalent to BMI = 18.5-24.9 (WHO Classification).

Table-5.10 shows that the prevalence of overweight subjects, i.e. BMI = 25-29.9, within the sample was 27%. The prevalence of those who were overweight (Ov wt) was nearly 32% between the ages 20-29 years, 25% between the ages 30-39, and 25% in the over 40 years age group.

Table-5.10 The prevalence of overweight (Ov Wt) subjects (BMI= 25-29.9 kg/m²) in the sample.

Age (years)	Total	Prevalence of Ov Wt[1] (%) (25-29.9)
20-29	98 (30.2)	31 (31.6)
30-39	126 (38.8)	32 (25.3)
40 +	100 (30.8)	25 (25.0)
Total	324 (100.0)	88 (27.1)

Ov wt: overweight, i.e. BMI = 25-29.9 as classified by WHO (1998)

Table-5.11 presents the prevalence of obesity class I (BMI: 30-34.9), obesity class II (BMI: 35-39.9) and III (BMI $\geq$ 40) in the sample.

Of the total sample, over one quarter have a BMI between 30-34.9 classified as class I obesity, and of those 33%, were between 30-39 years. For obesity class II and class III, the highest prevalence were in the over 40 age group, at 26 % and 15% respectively. However, the overall prevalence of obesity in this group of adult Kuwaiti women is 56%.

Table-5.11 The prevalence of class I obesity (BMI: 30-34.9), class II obesity (BMI: 35-39.9), and class III obesity (BMI: $\geq$ 40) in the sample of adult Kuwaiti females, 20-60 years, 1996-97.

Age group (years)	BMI, kg/m² Ob I: 30- 34.9 (%)	Ob II: 35-39.9 (%)	Ob III: $\geq$ 40	Total (%)	Over all total (%)
Age					
20-29	24 (24.4)	9 (9.2)	6 (6.1)	39 (39.7)	98 (30.2)
30-39	42 (33.3)	13 (10.3)	18 (14.2)	73 (57.9)	126 (38.8)
40 +	27 (27)	26 (26.0)	15 (15.0)	68 (68.0)	100 (30.8)
Total	93 (28.7)	48 (14.8)	39 (12.0)	180 (55.5)	324 (100.0)

1. Ob I:: Class I obesity (BMI: 30-34.9)
2. Ob II: Class II obesity (BMI: 35-39.9)
3. Ob III: Class III obesity (BMI: $\geq$ 40)

In this study, to determine the percentage of the different classes of obesity within the obese participants, i.e. only those with a BMI $\geq$ 30.0, the percentage of the sub-groups of obesity within the sample was calculated. Table-5.12 presents the percentages of:

1) those participants who are categorised as class I (BMI: 30.0-34.9) among the obese population in the sample.

Therefore, $\frac{30\text{-}34.9}{\geq 30.0} = \frac{\text{All those in class I obesity}}{\text{All obese}}$

2) those participants who are categorised as class II obesity (i.e. BMI 35-39.9) among the obese population in the sample

Therefore, $\frac{35.0\text{-}39.9}{\geq 30.0} = \frac{\text{All those in class II obesity}}{\text{All obese}}$

3) those participants who are categorised as class III obesity (i.e. BMI $\geq$ 40) among the obese population in the sample

Therefore, $\frac{\geq 40.0}{\geq 30.0} = \frac{\text{All those in class II obesity}}{\text{All obese}}$

Participants aged 30-39 years rated highest for class I and III obesity whereas those aged 40 years and over rated highest for class II obesity within the overall obese sample. Furthermore, the mean BMI for adult Kuwaiti females aged 20-60 years is 31.8, which places them in class I obesity category of BMI according to WHO classification.

Table-5.12 The percentage of obesity class I (BMI: 30.0-34.9), class II (BMI: 35.0-39.9) and class III (BMI $\geq$ 40.0) (kg/m^2) within the obese sample of Kuwaiti females.

Age group	Percentage of obese groups in the sample		
(years)	Ob I (30- 34.9)/$\geq$ 30 (%)	Ob II (35-39.9)/$\geq$ 30 (%)	Ob III (40)/$\geq$ 30 (%)
20-29	61.5	23.1	15.3
30-39	66.6	4.7	28.5
40 +	39.7	38.2	22.1

5.2.1.2. Obesity and Occupation

Almost two thirds of the sample were working whereas the remaining third were either housewives or retired (Table-5.13). Nearly two thirds of the non-working group were obese compared to 50% of those that were working. However, as a group of obese (n=180), nearly 60 % of the working group were obese.

Table.-5.13 Distribution of BMI (kg/m²) by Occupation

	BMI[1]				
	NormWt 18.5-24.9	Ov Wt 25-29.9	Ob I,II, III ≥ 30.0	Total	P
Occupation					0.05
Not working	13 (11.2)[2]	28 (24.1)	75 (64.6)	116 (35.8)	
Working	41 (19.7)	60 (28.8)	105 (50.5)	208 (64.2)	
Total	54 (16.6)	88 (27.1)	180 (55.5)	324 (100.0)	

1. categories of BMI; U Wt: Under weight ($\leq$ 18.5), Norm Wt: Normal weight (18.5-24.9), Ov Wt: Overweight (25-29.9), Ob I: class I obesity (30-34.9), Ob II: class II obesity (35-39.9); Ob III: class III obesity (40 +)

Figures in parenthesis are percentages.

5.2.1.3. Obesity and Level of Education

Table-5.14 summarises the findings of the distribution of BMI by level of education. It shows that 45% were at the high level, 41% at the medium level of education, and the remaining 14% were at the low level of education (either illiterate or at the elementary).

Of the obese category of BMI, 43% and 37% were at the high and medium levels of education, respectively. Almost 56% of those in high education were of normal weight compared to 41% in the medium level. Forty-eight percent of those in the medium level and 43% of those in the high level of education were overweight. Of those that were in the lower level, 77% were obese.

Table-5.14 Distribution of BMI (kg/m²) by levels of education

	BMI				
	NormWt 18.5-24.9	Ov Wt 25-29.9	Obesity I,II,III ≥ 30.0	Total	P
Education					< 0.0001
Low	2 (4.5)[1]	8 (18.1)	34 (77.3)	44 (13.6)	
Medium	22 (16.4)	42 (31.3)	68 (50.7)	134 (41.4)	
High	30 (20.5)	38 (26.0)	78 (53.4)	146 (45.1)	
Total	54 (16.6)	88 (27.1)	180 (55.5)	324 (100)	

1. Figures in parenthesis are percentages

5.2.1.4 Obesity and Marital Status

Seventy-three of the sample were represented by married women, and hence, they were the majority in all the categories of BMI (Table-5.15). The married group represented 56% of those whose weights were normal, 74% of those who were overweight, and almost 60% of those who were obese ($p < 0.0001$). Seventeen percent (n=55) of the sample were single; of those 35% were in the normal weight category and 25% in the overweight category of BMI.

Table.-5.15 Distribution of BMI (kg/m^2) by marital status.

	BMI, (%)				
	NormWt 18.5-24.9	Ov Wt 25-29.9	ObI,II, III ≥30.0	Total (%)	P
Marital Status					<0.0001
Single	19 (34.5)[1]	14 (25.4)	22 (40.0)	55 (17.0)	
Married	30 (12.6)	65 (27.4)	140 (59.0)	237 (73.1)	
Divorced	5 (20.8)	8 (33.3)	11 (45.&0	24 (7.4)	
Widowed	0	1 (12.5)	7 (87.5)	8 (2.5)	
Total	54 (16.6)	88 (27.1)	180 (55.5)	324 (100.0)	

1. Figures in parenthesis are percentages.

In summary, the prevalence of obesity (BMI ≥ 30.0) in adult Kuwaiti females between the ages 20-60 years is 55.5%, the prevalence being highest among those of the 40 and over age group who are married, of high level of education and working.

5.3. DETERMINANTS OF WEIGHT GAIN AND OBESITY IN THIS STUDY POPULATION

Selected socio-demographic, reproductive and maternal, and lifestyle characteristics were examined to determine whether they were associated with the risk of BMI in the overweight/obesity category in this sample and if so to what extent.

Three models of BMI categories were employed to assess the statistical strength of the association between the selected contributing or determining factors and the dependent variable BMI. The three models were:

BMI category- **Model I**

The dependent variable BMI categorised as 1) non-obese (BMI < 25.0)
2) obese (BMI > 25.0)

The two BMI categories allowed for analysis based on the earlier and well accepted international cut-off of obesity (Garrow, 1981).

BMI category- **Model II**

The dependent variable BMI categorised as 1) normal (BMI = 18.5-24.9)
2) overweight (BMI = 25.0-29.9)
3) obese (BMI > 30.0)

These BMI categories allowed for the analysis based on the recent WHO cut-off and classification of obesity (WHO, 1997)

BMI category- **Model III**

The dependent variable BMI categorised as 1) normal (BMI = 18.5-24.9)
2) obese (BMI > 30.0)

These BMI categories are an attempt to separate, for purpose of analysis, features of those with normal weight with others who are categorised as obese by the recent WHO cut-off of BMI $\geq$ 30.0 kg/m^2.

(Note that in model 3 the overweight category was removed).

Logistic regressions were carried out to investigate the association between soci-demographic, life style, and reproductive and maternal characteristics and the risk of being obese. Firstly, univariate analysis were carried out to investigate the association of each variable in turn. Secondly, multivariate strategy was developed where those variables that were deemed slightly significant at the univariate level (i.e. $p < 0.2$) were included in the multivariate model.

5.3.1. Socio-demographic Factors

The following three tables summarise the relationship of socio-demographic characteristics, namely: age, occupation, education and marital status, of adult Kuwaiti females 20-60 years of age with the dependent variable BMI which was assessed using the above three BMI category (Table-5.16). The chi-squared statistic was used to assess the relationship of these factors with BMI.

Occupational status was categorised as working and non-working. Education was defined as low, meaning having primary education; medium meaning an intermediate or secondary education, high meaning after high school diploma and other post high school education. Marital status was categorised in 3 groups; namely: 1) single, 2) married, and 3) divorced or widowed
Occupational status was categorised as working and non-working. Education was defined as low, meaning having primary education; medium meaning an intermediate or secondary education, high meaning after high school diploma and other post high school education. Marital status was categorised in 3 groups; namely: 1) single, 2) married, and 3) divorced or widowed.

5.3.1.1. Model I

5.3.1.1.1. Age

The results show that 267 of the 324 participants were obese (82% of the participants) as classified by Garrow (1981). Seventy-two percent of those between 20-29 years were obese, 83% of those between 30-39 years were obese, and of those in the 40 and over age group 93% were obese. The percentage obese in for all age groups was high; 72-93% increasing with age. The older the participants the greater the likelihood that they were obese ($p < 0.000$).

The odds ratio shows that, using the 20-29 age group as reference, the 30-39 age group are twice as likely to be obese, and the 40+ group five and a half times as likely to be obese compared to the reference group. The corresponding 95% CI shows the range of values within which the true odds ratios are likely to lie.

5.3.1.1.2. Occupation

Sixty-four percent of the participants were working and 36% were not working at the time of the study. There was no significant difference in BMI between participants who were working and those who were not working. Among those with BMI > 25.0, 61% of the participants were working whereas 39% were either housewives or retired (p= 0.026). When the working group were used as reference, the odds ratio showed that the non-working group were twice as likely to be at risk of being obese compared to the working group.

Table-5.16 Socio-demographic characteristics of adult Kuwaiti females by non-obese (BMI < 25.0) and obese (BMI $\geq$ 25.0) categories of BMI (Model I), 1996-97. N=324

Socio-demographic Characteristics	p--value	BMI, kg/m² Non-obese (< 25.0)	%	Obese (>25.0)	%	Total	Odds ratio (95% CI)
Age	<0.0001						
20-29*		29	30.2	69	71.8	98	1
30-39		21	16.6	105	83.3	126	2.10 (1.11, 3.98)
40 +		7	7.0	93	93.0	100	5.58 (2.31, 13.49)
Occupation	0.026						
Working*		44	21.1	164	79.6	208	1
Non-working		13	11.2	103	88.8	116	2.13 (1.09, 4.14)
Education	0.005						
High*		25	25.0	75	75.0	100	1
medium		30	16.9	150	84.7	177	1.66 (0.92, 3.03)
Low		2	4.5	42	95.4	44	7.0 (1.58, 31.03)
Marital Status	.0009						
Single*		20	36.3	35	63.6	55	1
married		32	13.5	205	86.4	237	3.66 (1.88, 7.11)
Divorced/widowed		5	15.6	27	84.3	32	3.09 (1.03, 9.28)

* Reference category

5.3.1.1.3. Level of Education

Of the participants in the sample, 14% had a primary education only, 55% had an intermediate or secondary education and 31% had a post secondary education.
While education is not statistically significant ($p < 0.06$), the trend is for a greater prevalence of obesity in those who had the lowest education (95.5%) than those with medium (85%) or those with high education levels (75%). Of those who were obese, more than half the sample, 56%, were at the medium level and 28% at the high level of education whereas 50% of those who had a BMI < 25 were at the medium level and 45% were at the high level of education. The odds ratio showed that those at the low level of education were seven times more at risk of being obese, BMI > 25.0, than the reference , high level, whereas those at the medium level were 60% more at risk of being obese.

5.3.1.1.4. Marital Status

Seventy three percent of the participants were married whereas 17% were single and 10% were either widowed or divorced. Of those that were single, 64% were obese, whereas 86% of the married participants were obese and 84% of the divorced or widowed were obese. Of those who were obese, 77% were married and 13% were single ($p < 0.001$). The odds ratio showed both the married and divorced/widowed categories were more than three times more at risk of being obese than the reference group, the single category. The corresponding 95% CI shows the range of values within which the true odds ratios are likely to lie.

Multivariate analysis of the socio-demographic variables were carried out after controlling for age (Table 5.15).

Table 5.17 Adjusted odds ratios of being at risk of obese, Model I.

Socio-demographic Characteristic	Odds Ratio (95% CI)	P-value
Age, years		
20-29	1	0.04
30-39	1.40 (0.68, 2.88)	
40+	3.20 (1.21, 8.43)	
Education		0.30
High	1	
Medium	1.51 (0.81, 2.83)	
Low	2.70 (0.50, 14.52)	
Occupation		0.72
Working	1	
Non-working	1.15 (0.54, 2.47)	
Marital Status		0.06
Single	1	
Married	2.52 (1.18, 5.37)	
Divorced/widowed	1.98 (0.62,6.36)	

Each variable is adjusted for the other variables in the table.

The odds ratio showed an increasing trend with age, and of being in the married category, but a decreasing trend with increasing level of education. However, *age* was the only statistically significant variable associated with being obese. The odds ratio form marital status, specifically among the married group compared to the reference category, however, showed a borderline level of significance (Table-5.17).

5.3.1.2. Model II.

To further explore the association between the socio-demographic factors and BMI, the sample was further categorised into normal, overweight, and obese as per the recent WHO (1998) classification. The results are reported in Table-5.18

The results show a similar trend for age, occupation, education, and marital status as was reported in Model I.

Table-5.18 Socio-demographic characteristics of adult Kuwaiti females by normal, overweight, and obese categories of BMI (Model II), 1996-97. n=322[1]

Socio-demographic Characteristics	p--value	Normal (18.5-24.9)	%	OvWt (25-29.9)	%	Obese (> 30)	%	Total
		BMI, kg/m^2						
Age	0.0002							
20-29		29	29.6	30	30.6	39	39.8	98
30-39		19	15.3	32	25.8	73	58.8	124
40 +		7	7.0	25	25.0	68	68.0	100
Occupation	0.035							
Non-working		13	11.2	28	24.1	75	43.1	116
Working		42	20.3	59	28.6	105	50.9	206
Education	0.002							
Low		2	4.5	8	18.1	34	77.2	44
medium		28	15.7	48	26.9	102	57.3	178
High		25	25.0	31	31.0	44	44.0	100
Marital Status	0.002							
Single		20	36.6	13	23.6	22	40.0	55
married		30	12.7	65	27.6	140	59.5	235
Divorced/widowed		5	55.5	9	28.1	18	56.2	32

The total number (N) is 322 compared to 324 in Model I because 2 of the participants are underweight, i.e., their BMI is less than 18.5.

5.3.1.3. Model III

The socio-demographic characteristics were again examined but with normal (BMI 18.5-24.9) and obese (BMI > 30.0) categories of BMI (Model III). When the chi-squared test was used age ($p < 0.0001$), occupation ($p < 0.017$), education ($p < 0.0007$), and marital status ($p < 0.005$) were significant. The odds ratio again showed that the 30-39 age group and the 40 + age group are 3 times and 7 times, respectively, more at risk of becoming obese (BMI $\geq$ 30.0) than the reference, 20-29 age group. Similarly, the non-working group was 2 times more at risk than the working group; those at low level and medium level 9 times and 2 times more at risk compared to those at high level of education. The married group and divorced and widowed group was almost at the same level of risk of 4 times as likely of being obese as the single group (Table-5.19).

Table-5.19 Socio-demographic characteristics of adult Kuwaiti females by normal (BMI = 18.5-24.9) and obese (BMI $\geq$ 30.0) categories of BMI (Model III), 1996-97. n=237[1]

Socio-demographic Characteristics	p--value	BMI, kg/m² Normal (18.5-24.9)	%	Obese (> 30)	%	Total	Odds Ratio (95% CI)
Age	<0.0001						
20-29*		29	42.6	39	57.3	68	1
30-39		19	20.6	73	79.3	92	2.86 (1.42, 5.74)
40 +		7	9.3	68	90.6	75	7.22 (2.89, 18.02)
Occupation	0.017						
Working*		42	28.5	105	71.4	147	1
Non-working		13	14.9	75	86.2	87	2.31 (1.16, 4.60)
Education	0.0007						
High*		25	36.2	44	63.7	69	1
medium		28	21.5	102	78.4	130	2.07 (1.09, 3.94)
Low		2	5.5	34	94.4	36	9.66 (2.14, 43.64)
Marital Status	0.0005						
Single*		20	47.6	22	52.3	42	1
married		30	17.6	140	82.3	170	4.24 (2.06, 8.74)
Divorced/widowed		5	21.7	18	78.2	23	3.27 (1.02, 10.45)

1. The total number in this model III is 235; 324 less 89 (87 = overweight group and 2 = underweight group).

* Reference category

In addition, multivariate logistic regressions were carried out using a definition of BMI that categorised the dependent variable, BMI, into 2 categories: normal and obese (Model III) (Table-5.20).

Table 5.20 Adjusted odds ratios of being at risk of obese for BMI category Model III.

Socio-demographic Characteristic	Odds Ratio (95% CI)	P-value
Age, years		
20-29	1	0.03
30-39	1.80 (0.81, 4.00)	
40+	3.83 (1.35, 10.87)	
Education		0.15
High	1	
Medium	1.80 (0.91, 3.57)	
Low	3.39 (0.61, 18.75)	
Occupation		0.86
Working	1	
Non-working	1.08 (0.48, 2.44)	
Marital Status		0.13
Single	1	
Married	2.39 (1.02, 5.59)	
Divorced/widowed	1.97 (0.58, 6.85)	

Each variable is adjusted for the other variables in the table.

The odds ratio for age, education and being married shows a trend of an increasing risk of being obese. However, the statistical significance is only associated with age.

In summary, among the socio-demographic characteristics, increase in *age* was the variable that continued to be strongly associated with obesity and although the married group and the category of low education showed a greater risk of being obese, this association was confounded by age. That is, age is associated with both obesity and with education and marital status.

5.3.2. Lifestyle Characteristics

Lifestyle characteristics, namely exercise (if participants indulged in regular exercise), hours of TV watching per week, the presence of house assistant, and physical disability (excluding congenital or trauma- induced disabilities) were examined to assess the statistical strength of the relationship of these factors to weight status of adult Kuwaiti females 20-60 years of age by using the three models of categories of BMI, i.e.: Model I, II, III respectively.

5.3.2.1. Model I

Lifestyle characteristics of adult Kuwaiti females, between 20-60 years, were examined against the categories non-obese (BMI < 25.0) and obese (BMI $\geq$25.0). (see Table-5.21)

5.3.2.1.1. Exercise

Nearly 74% of the participants did not indulge in any regular exercise, and of those nearly 85% were obese. Of those that exercised regularly, 26% (n=84), 74% were obese and 25% were of normal weight. Compared to those that exercised (reference), the odds ratio showed that there is an 80% risk of being obese in the group that did not exercise.

Table-5.21 Life style characteristics of non-obese (BMI < 25.0) and obese (BMI $\geq$ 25.0) of Kuwaiti females aged 20-60, 1996-1997 (Model I)

Lifestyle Characteristics	p--value	BMI, kg/m² Non-obese (< 25)	%	Obese (> 25)	%	Total	N	Odds Ratio (95 CI)
Exercise	0.04						324	
Yes*		21	24.7	63	74.1	84		1
No		36	15.0	204	85.0	240		1.89 (1.03, 3.47)
TV watching, hrs/week	0.88						301[1]	
< 7*		10	18.8	43	81.1	54		1
7-14		14	18.4	62	81.5	76		1.01 (0.41, 2.47)
> 14		28	16.2	144	83.7	172		1.17 (0.53, 2.59)
Home assistant	0.91						324	
Yes*		50	17.4	237	82.5	287		1
No		6	16.6	30	83.3	36		1.05 (0.42, 2.67)
Physical disability	0.011						324	
No*		53	19.8	214	80.1	267		1
Yes		4	7.0	53	92.9	57		3.28 (1.14, 9.47)

1. 23 participants were not included; they did not watch TV at all.

* Reference variable

5.3.2.1.2. Hours of TV watching

Hours of TV watching was available for 301 participants. Fifty-seven percent of the participants were watching more than 2 hours of TV per day compared to 25% who watched between one to two hours, and 18% who watched one hour or less. Of those that watched more than 2 hours per day, nearly 58% were obese compared to 25% among those that watched one to two hours of TV per day. The association did not show any significance (p = 0.88) and the odds ratio showed no increase in risk between those that did watch TV to those that did not.

5.3.2.1.3. Home assistant

Nearly 90% of the participants had assistance at home and 83% of this group were obese. The association between the provision of a house assistant and the prevalence of BMI was not statistically significant and the odds ratio did not show any increased risk between the two groups.

5.3.2.1.4. Physical disability

Physical disability had a negative effect on weight status. Seventeen percent of the participants (N=57) reported that they had a physical disability. However, of those who were obese only 20% had some kind of physical disability compared to 80% who did not (p < 0.011). The odds ratio shows that those that have a disability are 3 times more likely to become obese compared to the reference group. The mean age of those

Table-5.22 Multivariate analysis of lifestyle factors.

Life Style Characteristic		Odds ratio (CI)	P-value
Physical Disability			0.09
	No	1	
	Yes	2.60 (0.88,7.64)	
Exercise			0.07
	Yes	1	
	No	1.79 (0.95, 3,38)	

Each odds ratio was adjusted for the other variables as well as age in the table.

subjects who did not have physical disability were 34 years whereas the mean age of those that did was 37 years.

Table-5.22 shows that, after adjusting for age, both physical disability and exercise showed borderline significance, 0.09 and 0.07 respectively, in the association with the risk of being obese. That is, compared to those to those who exercise, those who do not have approximately 80% increase risk of being obese, however, the 95% CI ranged from a decrease of 5% to an increase of over 200%.

5.3.2.2. Model II

Lifestyle characteristics were further examined in model II where BMI was categorised as normal (18.5-24.9), overweight (25-29.9), and obese (> 30.0) (Table-5.21).

Table-5.23 Lifestyle characteristics of normal (BMI =18.5-24.9), overweight (BMI = 25.0-29.9), and obese (BMI $\geq$ 30.0) of Kuwaiti females aged 20-60, 1996-1997 (Model II).

Lifestyle Characteristics	p–value	BMI, kg/m[1] Norm Wt (18.5-24.9)	%	OvWt (25-29.9)	%	Obese (> 30)	%	Total	N
Exercise	0.13								322
Yes		20	24.1	22	26.5	41	49.3	83	
No		35	14.6	65	27.2	139	58.1	239	
TV watching, hrs/week	0.87								299
< 7		10	18.8	15	28.3	28	52.8	53	
7-14		13	17.3	17	22.6	45	60.0	75	
> 14		27	15.7	51	29.8	93	54.3	171	
Home assistant	0.10								322
Yes		49	17.1	81	28.3	156	54.5	283	
No		6	17.1	6	17.1	24	68.5	36	
Physical disability	0.033								322
Yes		3	5.3	13	23.2	40	71.4	56	
No		52	19.5	74	27.8	140	52.6	266	

1. Underweight group (BMI < 18.5), N=2, not included in this model.
2. 23 participants did not watch TV.

A similar trend in the relationship between exercise and weight status was shown in Model II (Table-5.23) where nearly 74% of the participants did not exercise and of those 58% were obese and 27% overweight. More than half the participants were watching more than 2 hours of TV per day; 54% of this group were obese and 30% were overweight whereas of the 25% who were watching between one and two hours 60% were obese and 23% were overweight. Eighteen percent watched less than one hour per day of TV, of those more than half, 53%, were obese. As is shown in Model I, 88% of the sample had home assistant; 55% of this group were obese and 28% were overweight. Almost 96% of those who did not have a home assistant were obese and 17% were over weight.

Physical disability had a significant effect on weight status ($p < 0.03$). Only 5% of those with a disability had a normal weight compared to 19% of those without reported disability. For those with a physical disability, 71% were obese compared to 53% of those without disability. The relationship of physical disability with BMI in this Model is similar to Model I; the majority did not have any physical disability, 83%, and of those 53% were obese.

Table-5.24 Lifestyle characteristics of normal (BMI = 18.5-24.9) and obese (BMI ≥ 30.0) of Kuwaiti females aged 20-60, 1996-1997 (Model III).

Lifestyle Characteristics	p–value	BMI, kg/m^2 Normal (18.5-24.9)	%	Obese (> 30)	%	Total	N	Odds Ratio (95% CI)
Exercise	0.046						235	
Yes*		20	32.7	41	67.2	61		1
No		35	20.1	139	79.8	174		1.94 (1.01, 3.71)
TV watching, hrs/week	0.905						216	
< 7*		10	26.3	28	73.6	38		1
7-14		13	22.4	45	77.5	58		1.19 (0.46, 3.08)
> 14		45	37.5	93	77.5	120		1.19 (0.51, 2.74)
Home assistant	0.43						235	
Yes*		49	24.5	156	78.0	200		1
No		6	20.0	24	80.0	30		1.51 (0.55, 4.16)
Physical disability	0.011						235	
No*		52	27.1	140	72.9	192		1
Yes		3	6.9	40	93.0	43		4.95 (1.47, 16.70)

* Reference category.

The association between lifestyle factors and Model I of BMI showed statistical significance only with physical disability ($p < 0.033$).

5.3.2.3. Model III

Lifestyle characteristics were even further examined with the BMI categories normal (18.5-24.9) and obese (>30) (see Table-5.22).Lifestyle characteristics continued to show similar trends as in Model I and II with physical disability ($p < 0.002$) and exercise, though at a weaker level of significance ($p = 0.46$), being the only two variables statistically associated with BMI. The odds ratio of risk was similar to Model I.

Multivariate analysis were carried out to assess the statistical significance of the association of the variables physical disability and exercise and the risk of obesity when adjusted for age (Table 5.23)

Table-5.25 Multivariate analysis of life style factors, physical disability and exercise.

Life Style Characteristic		Odds ratio (CI)	P-value
Physical Disability			0.04
	No	1	
	Yes	3.82 (1.10-13.27)	
Exercise			0.22
	Yes	1	
	No	1.54 (0.77, 3.10)	

Each odds ratio was adjusted for the other variables as well as age.

Controlling for age, multivariate analysis has shown that physical disability is an independent risk factor as a determinant of obesity although the level of significance has weakened (Table-5.25). Age has an effect on the relationship because the mean age for those that do not have physical disability was 34 years whereas the mean age for those that do was 39 years. Similarly, the association with exercise is now weakened.

In summary, *physical disability* and, at a weaker level of significance, *exercise*, were the two variables among life style factors that may contribute to the risk of obesity in adult Kuwaiti women.

5.3.3 Reproductive and Maternal Factors

A number of maternal characteristics namely; total number of pregnancies, pregnancy interval, return to pre-pregnancy weight, oral contraceptives/hormonal therapy, and breast feeding duration were examined and their relationship with weight status assessed by using the three models of BMI categories; Model I, Model II, and Model III.

5.3.3.1.Model I

5.3.3.1.1. Total number of pregnancies

Two hundred and thirty five (73%) of the participants reported that they had been pregnant one or more times. Of these, nearly 14% had a BMI within the normal range and 86% were obese (Table-5.24). This compares with 17% and 82% of the total participants sampled. Of those who reported that they had been pregnant, one or more times, 25% had 1-2 pregnancies, 42.5% had 3-5 pregnancies, and 32% had 6 or more pregnancies. While there was no significant difference with parity, there was a trend towards a greater prevalence of obesity with more pregnancies. For those women with 6 or more pregnancies, 92% were obese. Forty-two percent of the participants had 3-5 total number of pregnancies, 32% had 6 or more, and 25% had 1-2. Of the obese group, (BMI $\geq$ 25.0), the majority, 42%, had 3-5 total number of pregnancies and 34% had 6 or more. However, the association was not statistically significant. The reference group used are single subjects and nulliparous mothers; the odds ratio showed there was 70 % risk of becoming obese among the 1-2 category; more than twice as risk for the 3-5 category and almost 5 times at risk for the 6 and over category ($p < 0.006$).

5.3.3.1.2. Inter-pregnancy interval

Information was missing for 3 participants. Of those who were obese, 85% were mothers with an inter-pregnancy interval of more than one year compared to 91% of the non-obese group. Using the single, mothers with no children, and mothers with one pregnancy only as reference, the odds ratio showed that those with an inter pregnancy-interval less than one year

Table-5.26 Reproductive and maternal characteristics by non-obese and obese categories (Model I) of adult Kuwaiti females 20-60 years, 1996-97.

Reproductive and Maternal Characteristics	p–value	BMI, kg/m² Normal (< 25)	%	Obese (> 25)	%	Total	N	Odds Ratio (95% CI)
Total number of pregnancies	0.006						324	
None*,1		25	28.0	64	72.0	89		1
1-2		11	18.6	48	81.3	59		1.70 (0.76, 3.80)
3-5		15	15.0	85	85.0	100		2.21 (1.90, 4.53)
≥ 6		6	7.8	70	92.1	76		4.56 (1.76, 11.82)
Pregnancy interval	0.029						321[2]	
None*,2		25	26	72	74	97		1
< 1 year		3	9.0	30	90.9	33		3.47 (0.97, 12.37)
> 1 year		29	14.9	165	85.1	191		1.94 (1.06, 3.54)
Return to pre-pregnancy weight	<0.0001						235	
None*,1		26	29	63	71	89		1
Yes		26	20.1	103	79.8	129		1.72 (0.91, 3.23)
No		6	5.6	100	94.3	106		6.88 (2.68, 17.64)
On contraceptive pill/ hormone therapy	0.23						324	
No*		45	19.2	190	80.9	235		1
Yes		12	13.5	77	86.5	89		1.52 (0.76, 3.03)
Duration of breastfeeding, mths	0.87						215	
> 12*		12	17.6	56	82.3	68		1
6-12		6	15.3	33	84.6	39		1.18 (0.40, 3.44)
up to 6 mths		16	14.8	92	85.2	108		11.23 (0.54, 2.80)
None		0		28	100.0	28		–

1. Reference group; includes single subjects and mothers with no children.
2. Reference group; includes single subjects, nulliparous mothers, and mothers with one pregnancy only

were 3 and a half times more at risk of becoming obese, whereas for those with an inter-pregnancy interval of more than one year the odds ratio was almost double (Table-5.26).

5.3.3.1.3. Return to Pre-pregnancy weight

Mothers were asked whether they were able to return to their pre-pregnancy weight after delivery. The ability to return to pre-pregnancy weight was an important factor in weight status for participants in this study. Only 51% of those who were obese (BMI >25.0) were able to return to their pre-pregnancy weight compared to 81% among the non-obese group ($p < 0.0001$). For the calculation of the odds ratio, single women and mothers with no children were used as reference group (none). The odds ratio showed the those that were unable to return to their original weight before getting pregnant after child birth were almost 7 times more at risk of becoming obese compared to the reference group (Table-5.26).

5.3.3.1.4. Use of oral contraception/hormonal therapy

To assess the relationship of the effect of hormones on BMI, the participants were asked if they were on any hormones as oral contraception or hormone therapy.
Ninety-five percent of those who were obese were on oral contraception or on hormonal therapy. However, the association was not statistically significant and the odds ratio showed that there was 50% more at risk compared to the reference group.

5.3.3.1.5. Duration of breastfeeding

Of those who breastfed, 15% were of normal weight and 85% were obese. The duration of breastfeeding did not significantly affect weight status in this group of participants. Among the obese group, 51% breastfed for a period of up to 6 months, 18% between 6-12 months, and 30% for more than 12 months. However, the association was not statistically significant.

Multivariate analysis were carried out on those variables that showed statistical significance at the 0.2 level in the univariate analysis among maternal characteristics. The odds ratios for returning to pre-pregnancy weight, adjusted for age, showed a strong association (Table-5.27). The table shows age and returning to pre-pregnancy weight the only 2 variables related to obesity after adjusting for the variables in the table. Thus, compared to those who did not have children, those women who returned to pre-pregnancy weight had over 4 fold risk of being obese, and those women who did not return to pre-pregnancy weight had over 18 fold risk of being obese. The association was statistically highly significant (p= 0.002).

Similarly, age remained highly associated with being obese. These women over 40 years have over 5 times the risk of being obese compared to those in their 20 age group (p = 0.005). It is worth noting that the association seen with total number of pregnancies at the univariate level has completely disappeared in the multivariate level. This is probably due to the fact that total number of pregnancy is strongly related to age.

Table-5.27 Multivariate analysis of maternal characteristics, Model I

Maternal factors	Odds ratio (CI)	P-Value
Age		0.005
20-29	1	
30-39	1.6 (0.73, 3.44)	
40 +	4.70 (1.71, 12.95)	
Total number pregnancies		0.81
None	1	
1-2	1.36 (0.62, 29.74)	
3-5	1.36 (0.55, 33.4)	
6+	2.01 (0.07, 53.52)	
To pre-pregnancy weight		0.002
None	1	
Yes	4.5 (0.33, 61.95)	
No	18.7 (1.25, 27.85)	
pregnancy interval		0.14
None	1	
< 1 year	0.27 (0.01, 6.35)	
> 1 year	0.15 (0.01, 2.82)	

Each odds ratio is adjusted for the other variable in the table.

The mean age for these women with no children being 29 years, those with 1-2 being 30, those with 3-5 children being 37, and those with 6 and over being 42 years.

The multivariate analyses were repeated *excluding* those women that were nulliparous. This is to assess the affect of successive pregnancies with the risk of obesity, and to establish other

Table-5.28 Multivariate analysis of maternal characteristics excluding mothers with no pregnancies.

Maternal Factor	Oddr ratio (95% CI)	P-Value
Age		0.006
20-29*	1	
30-39	2.06 (0.72, 5.95)	
40 +	8.41 (1.96, 36.08)	
Totla number of pregnancies		0.89
1-2*	1	
3-5	0.95 (0.33-2.72)	
≥ 6	1.24 (0.32, 4.81)	
To pre-pregnancy weight		0.003
yes*	1	
no	4.24 (1.62, 11.10)	
Pregnancy interval		0.37
< 1 year*	1	
> 1 year	1.82 (0.49, 6.77)	

* Reference category

maternal risk factors in pregnant women only. As can be seen from Table-5.28 there are no material differences from the previous analysis including all women, with age and returning to pre-pregnancy weight remaining statistically associated with the risk of obesity.

5.3.3.2. Model II

To further assess the relationship of reproductive and maternal factors and the risk of obesity in Model II of BMI categories, the chi squared test was used. The prevalence of obesity (BMI ≥ 30.0) increased with parity (Table-5.29). Of those participants with 1-2 pregnancies,

Table-5.29 Reproductive and maternal characteristics by normal, overweight, and obese categories (Model II) of adult Kuwaiti females 20-60 years, 1996-97.

Reproductive and Maternal Characteristics	p--value	BMI, kg/m² NormWt (18.5-24.9)	%	OvWt (25-29.9)	%	Obese (> 30)	%	Total	N
Total number of pregnancy	0.013								233[1]
1-2		10	17.2	20	34.4	28	48.2	58	
3-5		14	14.1	30	30.3	55	55.5	99	
≥ 6		6	7.8	12	15.6	58	76.3	76	
Pregnancy interval	0.011								225
< 1 year		2	6.2	6	18.7	24	75.0	32	
> 1 year		28	14.5	52	26.9	113	58.5	193	
Return to pre-pregnancy weight	0.0002								233
Yes		24	18.7	38	29.6	66	51.5	128	
No		5	4.7	24	22.8	76	72.3	105	
On contraceptive pill/ hormone therapy	0.272								173
Yes		22	13.3	41	24.8	102	61.8	165	
No		1	12.5	4	50.0	3	37.5	8	
Duration of breastfeeding, mths	0.23								241
None		0	_	10	36.0	18	64.0	28	
up to 6 mths		15	14.0	23	21.5	69	64.4	107	
6-12		5	7.6	15	39.5	18	47.5	38	
> 12		12	17.6	18	26.4	40	58.8	68	

1. The total number in this model is 233 as 2 underweight participants are excluded.

48% were obese. This increased to 55% with 3-5 pregnancies and 76% for those with 6 or more pregnancies. However, the trend was the opposite for the overweight category, i.e., those with 1-2 pregnancies had the highest prevalence compared to those with 3-5 or ≥ 6 pregnancies, 30% and 12% respectively ($p < 0.013$). A similar trend was also shown among the group under the normal category of BMI.

For the maternal factor inter-pregnancy interval, almost 90% of the subjects had more than 1year interval, nonetheless, almost 60% were obese. Again the relationship showed only borderline significance. More than half the participants were able to return to their pre-pregnancy weight after child birth and of those, more than half were obese compared to almost three quarters of those that did not. The relationship was statistically significant. More than 95% of the participants were either on the contraceptive pill or on hormone therapy; there was no statistically significant association between this group and the risk of obesity. Similarly, the duration of breastfeeding did not show any particular trend or statistical significance with the risk of obesity.

5.3.3.3. Model III

Again, the reproductive and maternal factors and their relationship with the risk of obesity were assessed using the normal and obese categories of BMI classification.

The association of two factors; namely, inter-pregnancy interval, and return to pre-pregnancy weight, continued to show statistical significance when analysed in the BMI categories normal and obese (Table-5.28). The odds ratio showed an increased risk of almost 7 times when the inter-pregnancy interval was less than one year and 3 times more when the interval was more than one year compared to the reference category. Similarly, those that were unable to return to their pre-pregnancy weight after childbirth were 6 times more at risk compared to those that did return to their original weight and to the reference group. Total number of pregnancies showed borderline significance.

Table-5.30 Reproductive and maternal characteristics by normal and obese categories (Model III) of adult Kuwaiti females 20-60 years, 1996-97.[1]

Reproductive and Maternal Characteristics	p--value	BMI, kg/m² NormWt (18.5-24.9)	%	Obese (> 30)	%	Total	N	Odds Ratio (95% CI)
Total number of pregnancy	0.06						171	
1-2*		10	26.3	28	73.6	38		1
3-5		14	20.2	55	79.7	69		1.46 (0.55, 3.56)
≥ 6		6	9.3	58	90.6	64		3.45 (1.14, 10.45)
Pregnancy interval	0.0034						167	
None*,2		25	36.7	43	63.24	68		1
< I year		2	7.6	24	92.3	26		6.97 (1.52, 32.04)
> 1 year		28	19.8	113	80.1	141		2.28 (1.12, 4.35)
Return to pre-pregnancy weight	<0.0001						171	
None*,3		26	40.6	38	59.4	64		1
Yes		24	26.6	66	73.3	90		1.72 (0.91, 3.23)
No		5	6.1	76	93.8	81		6.87 (2.68, 17.64)
On contraceptive pill/ hormone therapy	0.21						197	
No*		28	20.6	108	79.4	136		1
Yes		11	18.03	50	81.97	61		1.58 (0.75, 3.30)
Duration of breastfeeding, mths	0.74						177	
> 12		12	23.0	40	76.9	52		1
6-12		5	21.7	18	78.2	23		1.08 (0.33, 3.52)
up to 6 mths		15	17.8	69	82.1	84		1.38 (0.58, 3.24)
None		0	—	18	100.0	18		—

1. Overweight group are not included in this model.
2. Reference group; includes single subjects, nulliparous mothers, and mothers with one pregnancy only
3. Reference group; includes single subjects and mothers with no children.

* Reference category

Multivariate logistic regression analysis was used with the dependent variable BMI classified as Model III and the reproductive and maternal variables: total number of pregnancies, return to pre-pregnancy weight, inter-pregnancy interval, as well as age. Among the reproductive and maternal factors, the odds ratio for *age* and *returning to pre-pregnancy weight* shows an increasing trend and indicates that both are independent contributing factors to the risk of obesity among adult Kuwaiti women (Table-5.31).

Table-5.31 Multivariate analysis of maternal characteristics, Model III

Maternal factors	Odds ratio (CI)	P-Value
Age		0.004
20-29	1	
30-39	1.78 (0.73, 4.35)	
40 +	5.38 (1.83, 15.5)	
Total number pregnancies		0.63
None	1	
1-2	1.01 (0.05-20.26)	
3-5	0.94 (0.04, 22.2)	
6+	1.92 (0.07, 47.99)	
To pre-pregnancy weight		0.004
None	1	
Yes	2.91 (0.21, 41.0)	
No	17.5 (1.15, 26.89)	
pregnancy interval		0.09
None	1	
< 1 year	0.89 (0.3, 21.64)	
> 1 year	0.28 (0.02, 4.71)	

1. Each odds ratio is adjusted for the other variable.

* Reference category

Comparing those women who returned to pre-pregnancy weight to those who did not have any children, the odds ratio was 2.9, in contrast those women who did ***not*** return to pre-pregnancy weight, the odds ratio was 17.5. The trend was statistically significant (p = 0.004). The other variable that showed an association was age (p = 0.004).

Table-5.32 Multivariate analysis of maternal characteristics, excluding mothers with no pregnancy.

Maternal factors	Odds ratio (CI)	P-Value
Age		0.006
20-29	1	
30-39	2.06 (0.72, 5.95)	
40 +	8.41 (1.96, 36.08)	
Total number pregnancies		0.89
1-2	1	
3-5	0.95 (0.33, 2.72)	
6+	1.24 (0.32, 4.81)	
To pre-pregnancy weight		0.003
Yes	1	
No	4.24 (1.62, 11.10)	
pregnancy interval		0.37
< 1 year	1	
> 1 year	1.82 (0.49, 6.77)	

Mothers with at least one pregnancy were included in the multivariate analysis.

The multivariate analysis were repeated excluding those women that were nulliparous. This is was carried out to assess the effect of the association of successive pregnancies with the risk of obesity, and to establish other maternal risk factors in pregnant women only. As can be see from Table-5.32, there is no material difference from the previous analysis including all women.

5.3.3.4. Interaction of pre-pregnancy weight with other factors.

To further explore the relationship between returning to pre-pregnancy weight and the risk of obesity, analysis were carried out to investigate factors associated with return to pre-pregnancy weight. Table-5.33 summarises the results.

Table-5.33 The relationship of returning to pre-pregnancy weight in adult Kuwaiti females aged 20-60 with occupation, education, exercise, and duration of breastfeeding, 1996-1997. n=131

		Return to pre-pregnancy weight				
Factor	**P**	**Yes**	**(%)**	**No**	**(%)**	**Total**
Age	0.25					
20-29		23	(52)	21	(48)	
30-39		55	(50)	54	(50)	
40 +		51	(62)	31	(38)	
Occupation	0.11					
Non-working		45	(35)	48	(45)	93 (39.5)
Working		84	(65)	58	(55)	142 (60.4)
Level of education	0.76					
low		25	(19)	18	(17)	43 (18)
medium		68	(53)	61	(58)	129 (55)
high		36	(28)	27	(25)	63 (27)
Exercise	0.75					
yes		29	(22)	22	(20)	51 (21.7)
no		100	(78)	84	(79)	184 (78)
Total number of pregnancy	0.78					
1-2		29	(51)	28	(49)	
3-5		56	(56)	44	(44)	
≥ 6		43	(57)	33	(43)	
Pregnancy interval, years	0.78					
< 1		18	(55)	15	(45)	
>1		108	(57)	81	(43)	
Duration of breastfeeding, months	0.14					234
> 12		40	(31)	26	(25)	66 (28.2)
6-12		23	(18)	15	(14)	38 (16.2)
up to 6		56	(43)	46	(44)	102 (43.5)
None		10	(8)	18	(17)	28 (11.9)

It can be seen from the table that none of the factors are statistically related to returning to pre-pregnancy weight.

Multivariate analysis were carried out, controlling for the potential confounders shown on Table-5.33, the results show that returning to pre-pregnancy weight is an independent risk factor of being obese.

As a review of the analysis of the determinants of weight gain and obesity in adult Kuwaiti women, the data have shown that the most important contributing factor is increase in *age*. The other factors, i.e., total number of pregnancies, marital status, and physical disability showed statistical significance to the development of obesity when using univariate analysis. However, multivariate analysis which included age, appears to completely dilute the influence of these variables with no real evidence of a statistical association. Nonetheless, it has been consistently shown that the maternal variable *returning to pre-pregnancy weight* is an independent and statistically significant contributing factor to the development of obesity in adult Kuwaiti females and the relationship persists even after controlling for the potential confounders including age.

When the association of this variable with other determining factors such as socio-demographic (age, occupation, education), life style (exercise), and maternal factors (total number of pregnancies, pregnancy interval) was assessed further, multivariate analysis were carried out after controlling for all the previously mentioned factors. The results of this analysis indicated that the two variables age and returning to pre-pregnancy weight remained important risk factors of obesity ($P < 0.001$ for age and $P < 0.004$ for returning to pre-pregnancy weight).

In summary, increase in *age* and *returning to pre-pregnancy weight* are the main contributing factors to obesity. Nonetheless, other factors may have shown a higher level of statistical significance had the sample number been bigger.

5.3.4 Central Fat Distribution

Abdominal/central obesity is a pattern of fat distribution. Hence, to determine the contributing factors to the development of central obesity in this sample, the relationship of central obesity, by using waist circumference (cm), with age and the maternal characteristics: total number of pregnancies, returning to pre-pregnancy weight, and inter-pregnancy interval were analysed. The socio-economic, lifestyle factors, and the two maternal variables: on the contraceptive pill/hormone therapy were not analysed because they did not bear any level of significance when analysed within the three models of BMI (I, II, and III). The results are shown in Table-5.34.

Table-5.34 Age and maternal characteristics of adult Kuwaiti females by waist circumference (cm)[1].

Maternal Characteristic	P-Value	Waist Circumference in cm, (%)			Total
		< 80	80-87	≥ 88	
Age	< 0.001				
20-29		29 (30)	16 (16)	53 (54)	98
30-39		10 (8)	17 (14)	97 (78)	124
40+		9 (9)	6 (6)	85 (85)	100
Total number of pregnancies	<0.001				
1-2		7 (12)	14 (24)	38 (64)	59
3-5		10 (10)	14 (14)	76 (76)	100
>6		4 (5)	3 (4)	69 (91)	76
Returning to pre-pregnancy weight	<0.001				
Yes		14 (11)	22 (17)	93 (72)	129
No		6 (6)	9 (8)	91 (86)	106
Pregnancy interval	<0.001				
< 1 year		3 (9)	4 (12)	26 (79)	33
> 1 year		17 (9)	26 (13)	151 (78)	194

1- Waist circumference cut-off values adapted from Han et al, 1995.

Seventy-three percent of the total sample had a waist circumference of ≥ 88 cm, which categorises them in the very high risk group which corresponds with the point at which the health risks are such that medical consultation and weight loss should be urged (Lean et al, 1995). Waist circumference increased with increasing parity ($p<0.001$). However, more than 70% of those who were able to return to their pre-pregnancy weight were among the high risk category (≥ 88 cm) compared to 86% of those who did not. For the variable inter-pregnancy interval in both groups, i.e. those that had less than one year or more than year inter-pregnancy interval, nearly 80% were in the high risk group. Multivariate logistic regression analysis were carried out with the dependent variable waist circumference and age and the maternal factors but, as the majority of the subjects' waist circumference measurements fell into the high risk group, there were no differences between the groups.

5.4 HEALTH DISORDERS ASSOCIATED WITH OBESITY

5.4.1 Selected Diseases

Table-5.35 Prevalence of selected diseases among normal (BMI =18.5-24.9), overweight (BMI = 25-29.9), and obese (BMI ≥ 30.0) categories of BMI.

		BMI, kg/m^2							
Characteristic	**P**	**NormWT (18.5-24.9)**	**%**	**OvWt (25-29.9)**	**%**	**Obese (>30)**	**%**	**Total**	**%**
Diabetes Mellitus[1]	<0.0001								
Yes		1	2	13	22	44	76	58	18
No		54	20	74	28	136	52	264	82
Hypertension[2]	<0.0001								
Yes		8	10	11	13	63	77	82	25
No		47	20	76	32	117	48	240	75
Osteoarthritis	<0.0001								
Yes		5	5	22	22	73	73	100	31
No		50	23	65	29	107	48	222	69
Bronchial Asthma	0.05								
Yes		2	7	5	17	23	76	30	9.3
No		53	18	82	28	157	54	292	90.7
CHD	0.87								
Yes		2	17	4	33	6	50	12	4
No		53	17	83	27	174	56	310	96
Du/Gu ulcer	0.16								
Yes		2	8	5	19	19	73	26	8
No		53	18	82	28	161	54	296	92
Gall Bladder stones	0.17								
Yes		—	—	1	13	7	87	8	3
No		55	18	86	27	173	55	314	97

1. Number of subjects in whom diabetes was reported and in whom diabetes was not reported but a high fasting glucose was found.
2. Hypertensive if mean systolic blood pressure ≥ 140mm Hg, mean diastolic blood pressure ≥90 mm Hg or they were being treated for high blood pressure, with or without medication.

Table-5.35 shows the distribution of selected diseases which included NIDDM, hypertension, osteoarthritis, CHD, bronchial asthma, duodenal/gastric ulcer (DU/GU), and gall bladder stones, among the participants that were grouped into normal (18.5-

24.9) overweight (25-29.9) and obese (≥30.0) categories of BMI. The results show 31% had osteoarthritis ($p < 0.0001$), 25% had high blood pressure ($p < 0.0001$), and 18% had NIDDM ($p < 0.0001$).

The prevalence of NIDDM in this sample is 18% (n=58). There were 47 self-reported cases of NIDDM; however, of those only 9 (3%) had their blood glucose levels controlled. The remaining 38 patients had high blood glucose levels (not controlled). Furthermore, there were 11 newly discovered cases of diabetes within the sample. Both the newly discovered diabetics and the uncontrolled NIDDM patients were referred to the clinic physician for further management.

Less than 10% of the participants had bronchial asthma, CHD, duodenal/gastric ulcer, and gallbladder stones.

5.5.2 Risk Factors.

In this study, efforts were taken to assess the risks of CHD among the studied sample. It has been already suggested that obesity is an independent risk factor to CHD and its associated metabolic consequences increases the risk further (Sunyer, 1991; Flier, 1994; Ledoux, 1997, Grundy, 1998). CHD risk factors among the participants are summarised in Table 5.33. These include three basic characteristics: 1) lifestyle-smoking and exercise; 2) hypertension (controlled and not controlled), and 3) metabolic abnormalities (blood sugar-diabetes mellitus- and lipid profiles). These characteristics can have a detrimental effect on health in general but specifically on the cardiovascular system.

Participants were considered to have high blood pressure if mean systolic blood pressure (SBP) ≥ 140 mm, mean diastolic blood pressure (DBP) < 90 mm Hg or they were being treated for high blood pressure, with or without medication. Participants were considered to have NIDDM if they have "ever been told by a doctor that they have diabetes" or their fasting blood sugar was ≥ 6.4 mmol/L.

The total number of participants was 322; 2 were excluded because their BMI was less than 18.5. However, Table-5.33 shows;

1) n=182 in the biochemical blood analysis of HDL and LDL; this was the result of to shortage of reagents at the main laboratory of the hospital

2) n=310 for measurement of SBP and DBP; 12 participants failed to attend the clinic for blood pressure measurement

3) n=316 in FBS, SC, and ST analysis; 6 participants did not complete blood biochemistry analysis

4) n=319 only for data on exercise and smoking; 3 had missing information related to these items in the questionnaire.

The results, in Table-5.34, show that 25% (N= 82) of the participants knew that they were hypertensive and of these, 77% were obese and 13% were overweight. Nearly 18% of the participants were diabetic and of those nearly 76% were obese and 22% were overweight.

The results also showed that 49 participants had FBS > 6.4 mmol/L. These subjects were patients with NIDDM; however, the overall number of NIDDM patients was 58. Only 9 subjects with NIDDM were controlled, and there was an additional 11 new cases of NIDDM.

Hypertensive and non-insulin dependent diabetic patients whose blood pressure or fasting blood sugar were abnormal were referred to the clinic physician for further assessment

Of those that exercised regularly, nearly 50% were obese and 27% were overweight, and 4% of the participants were regular smokers. However, the associations were not statistically significant ($p < 0.13$ and $p < 0.45$).

Table-5.36 CHD risk factors among the participants by normal, overweight and obese categories of BMI.

Characteristic	p	BMI, kg/m² NormWt (18.5-24.9)	%	OvWt (25-29.9)	%	Obese (>30)	%	Total	%	N
Diastolic BP, mm Hg	0.005									310
<90		54	19	83	29	153	52	290	94	
>90		_	_	2	10	18	90	20	6	
Systolic BP, mm Hg	0.001									310
<140		50	`19	79	30	133	51	262	85	
>140		4	8	6	13	38	79	48	15	
Hypertension	<0.0001									322
Yes		8	10	11	13	63	77	82	25	
No		47	20	76	32	117	48	240	75	
FBS, mmol/L[1]	<0.0001									316
<6.4		55	21	77	29	135	50.	267	84	
>6.4		_	_	9	18	40	82	49	16	
NIDDM[2]	<0.0001									322
Yes		1	2	13	22	44	76	58	18	
No		54	21	74	28	136	51	264	82	
Exercise	0.13									322
Yes		20	24	22	27	41	49	83	26	
No		35	15	65	27	139	58	239	74	
Smoking	0.45									319
Yes		4	33.3	2	16.6	6	50.0	12	3.8	
No		49	15.9	83	27.0	174	56.6	280	96.2	
SC, mmol/L	0.069									316
5.2-6.2		9	11	18	21	58	68	85	27	
>6.2		5	11	13	28	29	62	47	15	
TG, mmol/L	0.28									316
2.27-4.53		1	3	7	18	30	79	38	12	
≥4.53		1	11	3	33	5	56	9	3	
LDL,mmol/L	0.82									182
3.4-4.0		7	15	10	21	31	64	48	26	
>4.0		5	12	7	17	29	71	41	23	
HDL, mmol/L	0.31									182
< 0.9		1	6	3	19	12	75	16	9	
0.9-1.3		32	19	40	24	95	57	166	91	

1. The number of subjects who had high fasting blood glucose levels. These included 38 cases of reported diabetic patients and 11 new cases of diabetes.
2. The number of subjects in whom diabetes was reported, n=47, and the number of subjects in whom diabetes was not reported but a high fasting blood glucose was found, n=11.

Lipid profile analysis showed that 62% of the participants with serum cholesterol (SC) > 6.2 mmol/L were obese and 30% overweight. Approximately 3% of the participants had high TG and of those 56% were obese and 33% were overweight.
For LDL and HDL, only 56% (N=182) completed these tests. Twenty-three percent of the participants had LDL > 4.0mmol/L and 9.0% had HDL< 0.9 mmol/L.

It was of interest to the investigator to understand the rational behind the behaviour of the 143 subjects (44%) that failed to complete the blood analysis. The investigator wanted to determine the association between the BMI of those that completed the blood lipid profile compared to those that did not. Table-5.37 summarises the results. It was important to find out whether the participants who refused the blood examination were different from those who agreed.

Table-5.37 BMI of subjects that completed the blood lipid analysis compared to the BMIs of those that did not.

Blood lipid analysis	P-value	BMI, kg/m^2 (%)			Total (%)
		Normal (18.5-24.9)	Overweight (25-29.9)	Obese ($\geq$ 30.0)	
	0.46				
Subjects that completed		33 (18)	42 (23)	106 (58)	181 (56)
Subjects that did not complete		22 (15)	45 (32)	74 (52)	140 (44)

The figures indicate that there was no significant difference between the BMIs of the two groups (p < 0.46). Over half the subjects were in the obese category and less than one fifth were of normal weight in both groups. There are many reasons for failure of this group of women (n=142) to complete the blood examination; these women may have fallen ill, had no transport, or may have had family commitments. The main objective of this comparison analysis is to able to conclude that those that refused to complete the blood analysis were not different from those that did, and thus the results of the blood analysis can be represent the whole sample.

5.5 PERCEPTION OF HEALTH AND WEIGHT STATUS

5.5.1. Participants' perception of health status

One of the main objectives of this study is to determine factors that may be contributing to the problem of obesity in adult women in Kuwait. In the questionnaire, and during the conduct of the interview, participants were first asked about their current health status, classified as very good, good, average, or poor. Table-5.38 summarises the results of participants' perception of their health status with age. Over 66% of the 20-29 years and of the 30-39 years age groups perceived their health status as good or very good compared to 33% as average or poor for both 20-29 and 30-39 age groups. Of the 40+ age group, however, only 51% perceived their health status as very good or good compared to 49% as average or poor ($p = 0.002$).

Table-5.38 Perception of health status of adult Kuwaiti females by age

	Health Status (%)				
Age, years	**Very good**	**Good**	**Average**	**Poor**	**Total**
20-29	33 (33.6)	32 (32.6)	29 (29.6)	4 (4.1)	98 (30.3)
30-39	31 (24.6)	52 (41.3)	38 (29.7)	5 (3.9)	128 (39.1)
40 +	9 (9.0)	42 (42.0)	40 (40.0)	9 (9.0)	100 (30.6)
Total	73 (22.5)	126 (38.9)	107 (33.0)	18 (5.5)	324 (100.0)

Table-5.39 presents the distribution of the participants' perception of health status according to their BMI categories: normal (BMI = 18.5-24.9), overweight (BMI = 25-29.9), and obese category (BMI $\geq$ 30.0).

Table-5.39 Perception of health status by normal, overweight, and obese categories of BMI, N=322.

BMI	Health Status (%)				
	Very good	Good	Average	Poor	Total
Norm wt (18.5-24.9)	16 (29)	22 (40)	15 (27)	2 (4))	55 (17)
Ov Wt (25-29.9)	29 (33)	34 (39)	20 (23)	4 (5)	87 (27)
Obese (≥ 30.0)	28 (16)	69 (38)	71 (39)	12 (7)	180 (56)
Total	73 (23)	125 (39)	106 (33)	18 (5)	322 (100.0)

1. Categories of BMI: Norm wt= normal weight; Ov wt = overweight, obese= includes classI (30.0 -34.9), class II (35.0 - 39.9), and class III (≥ 40.0) categories of BMI.

While a small proportion (16%) of the obese (class I to III) perceive their health to be very good, twice the number of overweight and normal weight subjects perceive themselves as having very good health (33% and 29% respectively) ($p = 0.0015$).

Table-5.40 summarises the results of the participants perception of health status by the non-obese (BMI < 25.0) and obese (BMI ≥ 25.0). Of those that were obese, 39% perceived their health status as good, and 34% as average ($p < 0.0014$). In the non-obese group, however, 40% perceived their health status as good, and 28% as average.

Table-5.40 Perception of health status of adult Kuwaiti females age 20-60 by obese and non-obese adult Kuwaiti females age 20-60, 1996-1997. n=324

BMI[1] Category	Health Status				
	Very Good	Good	Average	Poor	Total
Non-obese[2], (%)	16 (28)	23 (40)	16 (28)	2 (4)	57 (18)
Obese [3], (%)	57 (21)	103 (39)	91 (34)	16 (6)	267 (82)
Total (%)	73 (23)	126 (39)	107 (33)	18 (5)	324 (100.0)

1. BMI classified according to Garrow J, (1981).
2. Non-obese (BMI < 25.0) includes underweight and normal weight.
3. Obese (BMI ≥ 25.0) includes overweight, and class I, II and III obesity.

Thus those that were obese were more likely to have average or poor health (40%) than their non-obese counterparts (32%) and were less likely to indicate that their health was very good (22%) versus (28%). In other words, the obese were 1.7 times more likely to report poor health.

Chi-squared was used to assess the association between perception of health status (categorised as very good, good, average, and poor) and the variables age and BMI. The association was statistically significant with age and BMI ($p < 0.001$). This means that the older the participant, the more likely they were to report poorer health status as well as those who are with a higher BMI.

The participants' health status in relation to some of the diseases was also determined. Table-5.41 shows that 23% of the participants, overall, reported very good health status. None of the groups of those who had specific diseases approached the same level of satisfaction with health.

Table-5.41. Perception of health status of adult Kuwaiti females age 20-60 years who reported having selected diseases. N=324

		Health Status				
	P-value	Very good	Good	Average	Poor	Total
Number(%)		73 (23)	126 (39)	107 (33)	18 (5)	324(100.0)
Hypertension[1]	<0.0001	10 (12)	25 (30)	40 (48)	8 (10)	83 (25)
NIDDM[2]	<0.0001	6 (10)	15 (26)	28 (48)	9 (16)	58 (18)
CHD	<0.0001	—	1 (8)	8 (67)	3 (25)	12 (4)
Bronchial Asthma	0.11	3 (10)	12 (40)	11 (37)	4 (13)	31 (10)
Osteoarthritis	<0.0001	6 (6)	41 (41)	43 (42)	11 (11)	101 (32)
Gastric Ulcer/ Duodenal Ulcer[3]	0.42	4 (15)	9 (35)	10 (38)	3 (12)	26 (8)
Gall stones	0.77	1 (13)	3 (37)	3 (37)	1 (13)	8 (2)

1. Systolic ≥140 mm Hg, diastolic ≤90 mm Hg, and/or self reported hypertensives on treatment.
2. Numbers of participants in whom diabetes was reported and subjects in whom diabetes was not reported but high fasting blood glucose was found.
3. Participants who had duodenal or gastric ulcer

* Figures in parenthesis are percentages

Overall, 5% reported poor health. The prevalence of hypertension was almost 25% in this sample of adult Kuwaiti females. Fifty-eight percent of them rated their health as average or poor ($p < 0.0001$). Nearly two thirds of those with NIDDM, 64%, rated their health as average or poor. Of those that had CHD, (n=12), more than 90%, rated their health as average or poor ($p < 0.001$). Thirty-two percent of the participants had osteoarthritis. Compared to the whole sample who perceived their health status as very good (23%), only a quarter of those with osteoarthritis rated their health status as very good, and 11% rated their health status as poor compared to 6% in the whole sample. Among the participants with bronchial asthma 10% and 4 % rated their health as average or poor respectively, although it was not statistically significant. Among participants with duodenal/gastric ulcer and those with gall stones, half the participants (50%) from each group rated their health as average or poor; however, the association was not statistically significant.

5.5.2. PERCEPTION OF WEIGHT STATUS

In the questionnaire, questions on perceptions of weight status were formulated in such a way to assess the participants' awareness on obesity, and if they consider themselves obese compared to the categories of BMI classification.

Participants were asked to assess their current weight status into underweight, normal weight, overweight, obese, and very obese categories of BMI. A summary of the findings of the perceptions of current weight status with actual weight status, as defined by Garrow (1981), is presented in Table-5.42. At the time of collection of the data the recent WHO Report on obesity was not yet published.

5.5.2.1. Participants' perception of current weight compared to actual weight.

Table 5-42 summarises the participants' perception of their weight into 5 categories: underweight, normal weight, overweight, obese, and very obese. While less than 1% of the participants had a current weight that put them in the underweight category, approximately 6% of the participants categorised their weight as underweight. This included participants whose current weight put them in the overweight and class I and II obese categories. For those participants whose actual weight is of the normal category, 63% (n=34) correctly perceived their current weight with their actual weight, whereas 19% (n=10) underestimated their weight status 19% (n=10) overestimated their weight status. Of those that were overweight, nearly 60% (n=52) correctly perceived their current weight to their actual weight; however; 33% (n=29) underestimated their weight and over 8% (n=7) over estimated their weight. Of those whose BMI $\geq$ 30.0, i.e. obese, n=180, 28% correctly matched current and actual weights; whereas, 64% underestimated their current weights. Overall, 48% of the subjects underestimated their current weight to actual weight compared to 43% who correctly matched the two weights. Less than 10% overestimated their weight.

Table-5.42. Participants' perception of their current weight in relation to their actual BMI (1996-1997).

Actual weight (BMI)		Participants' perception of current weight[1]				
Kg/m^2	UWt	NormWt	OvWt	Obese	Very obese	Total
Uweight: $\leq$ 18.5	**2**	0	0	0	0	2 (0.6)
Normal: 18.5-24.9	10	**34**	7	3	0	54 (16.7)
Oweight: 25-29.9	3	26	**52**	5	2	88 (27.2)
Class I: 30-34.9	2	3	54	**20**	14	93 (28.7)
Class II: 35-39.9	1	2	23	13	**9**	48 14.8)
Class III: $\geq$ 40	0	1	5	11	**22**	39 (12.0)
Total	18 (5.6)	66 (20.3)	141 (43.5)	52 (16.0)	47 (14.8)	324 (100.0)

1. UWt = underweight; NormWt = normal; Ovwt = overweight

A significant difference was found between the mean of the actual weight and the perception of current BMI, $p < 0.0001$, (Table-5.47).

5.5.2.2. Participants' perception of appropriate weight compared to actual weight

Participants were asked about their perception of appropriate weight. That is, they were asked to report what weight they thought was appropriate for them. They gave this weight in kilograms. The weight was converted into BMI for each individual. (Table-5.43). Of those who were underweight (n=2), both gave appropriate weights within the normal category.

For those who were of normal weight, 93% (n=49) gave appropriate weights within the normal range and 5% (n=3) in the overweight category. One participant gave a weight that would have put her in the underweight category. Thus for those with normal weight the vast majority gave appropriate weights which were within the normal range.

Table-5.43 Participants' perception of appropriate weight (Kg converted to BMI groupings) compared to their actual BMI.

	Perceived appropriate weight					
Actual weight	**UWt**	**Normwt**	**Ov Wt**	**Ob I**	**Ob II & III**	**Total**
Uweight: ≤ 18.5	**0**	2	0	0	0	2 (0.6)
Normal: 18.5-24.9	1	**49**	3	0	0	53 (16.7)
Oweight: 25-29.9	1	51	**34**	0	0	86 (26.9)
Class I: 30-34.9	0	44	44	**3**	0	91 (28.8)
Class II: 35-39.9	0	11	30	7	**0**	48 (14.9)
Class III: ≥ 40	1	6	22	7	**2**	38 (12.1)
Total	3 (0.9)	163 (50.5)	133 (41.2)	17 (5.3)	2 (0.6)	318 (100.0)

Uwt = underweight; NormWt = normal; Ovwt= overweight; ob I= class I obesity; ob II = class II obesity; ob III = class III obesity

For those who were overweight (n=86), 59% provided weights that put them in the normal category; however, 39% (n=34) considered an appropriate weight which would put them in the overweight category. In other words heavier was considered appropriate by these participants. One participant whose current weight is in the overweight category provided a weight that would have classified her as underweight. No one in the overweight category chose as an appropriate weight that would put them in the obese category.

For those whose actual weight was in the obese I category, 48% chose weights within the normal range; however the other 48% chose weights that would put them in the overweight category. Four percent (n=3) gave weights that were consistent with the current weights (obese class I).

For those in the obese class II category, 23 % (n=11) provided weights that were in the normal category; 63% (n=30) provided weights that would place them in the overweight category and 15% (n=7) would put them in the obese class I category.

For the obese class III participants, 16% (n=6) provided weights within the normal range; 58% (n=22) provided weights in the overweight category and 24% (n=9) were in the obese category.

Of those who perceived their appropriate weights to be normal, only 30% (n=49) matched what they perceived as an appropriate weight for them with their actual weight. Thirty-one percent mismatched; their actual weight was in the overweight category. Furthermore, over a third of the same group were unable to match what was appropriate with what their actual weight was. They were obese.

Among those who thought being in the overweight category was appropriate for them, 26% (n=34) correctly matched their actual weight whereas nearly 75% mismatched; they were obese. Finally, of those who thought that being in the obese (class I) category was appropriate, only a quarter were able to match the appropriate with the actual weight compared to approximately 75% who mismatched; they were among class II and III obesity.

Participant's perception of an appropriate weight that was in the normal range decreased for participants that were in the higher weight categories: 93% of those in the normal range chose weights in the normal range, 59% of those who were overweight chose weights in the normal range, 48% of those who were obese chose weights in the normal range but for those who were in obese class II only 23% chose weights in the normal range and for those in the obese class III only 16% chose an appropriate weight in the normal range.

When perception of appropriate weight (in kilograms converted, using actual height, to BMI) with actual weight were examined, only 27.7% gave responses that were similar to their actual weight categories. In other words only 28% considered their actual weight to be appropriate for them.

What is interesting here is that while only 16.7% of the sample were of normal weight, 50.5% of the sample gave appropriate weights in the normal range. However, 41.2% provided weights that were in the overweight category and 5.9% in the obese categories. One percent of the participants chose weights that were in the underweight category. These results indicate that there is a preference among a significant group (48%) for weights that have negative health implications.

A significant difference was found between the means of perception of appropriate weight and current actual weight $p < 0.0001$ (Table-5.47).

5.5.2.3. Participants' perceptions of current weight compared to their perceived appropriate weight.

Participants' perception of their current weight was compared with perception of their appropriate weight and reported in Table-5.42. The objective of developing this table was to determine whether participants were able to match what they thought was an appropriate weight for them in comparison to how they perceived their current weight. Overall, one half of the participants (51%) chose an appropriate weight that would put them in the normal weight category according to BMI classification. A quarter of this group have perceived their current weight to be normal, 45% have perceived it to be overweight, and another quarter have perceived it to obese.

Table-5.44. Participants' perception of current weight compared to their perceived appropriate weight.

Perception of appropriate weight		Participants' perception of current weight[1]					
		UWt	Normwt	Ov Wt	Obese	very obese	Total (%)
Uweight:	≤ 18.5	1	0	2	0	0	3 (0.9)
Normal::	18.5-24.9	11	40	73	21	18	163 (51.2)
Oweight::	25-29.9	6	19	58	28	22	133 (41.8)
Class I:	30-34.9	0	4	6	2	5	17 (5.3)
Class II & III :	35-39.9	0	0	0	0	2	2 (0.6)
Total		18 (5.6)	63 (19.8)	139 (43.7)	51(16.0)	47 (14.7)	318 (100.0)

1. UWt = underweight; NormWt = normal; Ovwt = overweight

However, the problem is among those who chose a weight (which they thought of as appropriate) that was in the overweight or obese category, these made up 48% of the total sample. Among those that chose an appropriate weight that would put them in the overweight category, 14% perceived their current weight to be normal, 44% perceived it to be overweight and 38% perceived it to be obese. An even more serious problem is if subjects provided an appropriate weight for herself that placed her in the obese category; 7% of the respondents made up that group.

Participants were then asked what in their opinion contributed to their weight gain after marriage. Participants could choose more than one answer as the reason for the gain in weight. Fifty percent of the respondents blamed pregnancy for the gain in weight, nearly 20% from marriage, 16% from lack of exercise, 8% from overeating, and 4% said that they either have always been obese or that they did not know

A significant difference was found between the mean of the perception of appropriate weight and perception of current weight $p < 0.0001$ (see Table-5.45).

In summary, *half* the participants chose a weight (appropriate) that would put them in the normal weight category according to BMI classification. However, only a quarter of this group perceived their current weight as normal; out of the rest, 45% perceived their current weight to be overweight and another 24% as obese (BMI $\geq$ 30.0). Almost half of the participants (48%, n=152), provided appropriate weights for them in the overweight or obese categories. Of these, 15% perceived their current weight to be normal, 42% perceived their weight to be in the overweight category and 39% perceived their weight to be in the obese categories. This group did not appear to have any concept of what was a normal weight for height.

5.5.2.4. Participants' perceptions of husbands' opinion on weight compared to actual weight (Table-5.45).

Participants were asked about the perception of their husband's opinion of her actual weight. They were asked to classify the opinion into the following categories: underweight, normal weight, overweight, obese, and very obese.

Twenty-nine percent reported perceptions of their husbands' opinion that were consistent with the current weight category of the participant. While only 2 participants (< 1%) were underweight, 3% of the participants (n=9) believed that their husbands considered that they were underweight. The 2 participants who had an actual weight in the underweight category thought that their husbands considered their weight normal.

Of those that perceived their husbands' opinion on their weight to be of the normal category (n = 10), *only* 18% were of normal weight, 37% were overweight and 42% were obese (BMI $\geq$ 30.0). Of those who perceived their husbands' opinion on their weight to be overweight, *only* 24% were actually overweight; 70% were obese.

Finally, of those who perceived their husbands' opinion on their weight to be obese, 80% *were* obese and 26% were overweight.

Table-5.45 Participants' perception of husbands' opinion of weight compared to participants' actual BMI.

		Participants' perception of husbands' opinion on weight[1]					
Actual BMI, kg/m²		**UWt**	**NormWt**	**OWeight**	**Obese**	**Very Obese**	**Total**
Uweight:	≤ 18.5	0	2	0	0	0	2 (0.8)
Normal:	18.5-24.9	8	19	3	1	0	31 (13.3)
Oweight:	25-29.9	1	38	13	13	0	65 (27.8)
Class I:	30-34.9	0	19	22	19	4	64 (27.4)
Class II :	35-39.9	0	15	8	6	6	35 (15.0)
Class III:	≥ 40	0	8	8	10	10	36 (15.4)
Total		9 (2.8)	101 (31.2)	54 (16.7)	49 (15.1)	20 (6.2)	233 (100.0)

Uweight : underweight; Normal: normal; Oweight: overweight.

In summary, 61% of the participants reported that they thought that their husbands would categorise their weight into categories that were less than their actual weight categories (Table-5.45).

A significant difference was found between the mean of perception of husbands' opinion and actual BMI (Table-5.47) ($p = 0.001$).

To determine the statistical significance between perceived and actual weight, a score system is developed whereby the difference between perceived weight and actual

Table-5.46 Scores (1-6) corresponding to BMI categories.

Actual / Perceived (categories of BMI)[1]	Score
$\geq$ 18.49	1
18.5-24.99	2
25-29.99	3
30-34.99	4
35-39.9	5
$\geq$ 40	6

Underweight = >18.5; Normal =18.5-24.9; overweight=25 - 29.9; class I obesity =30-34.9; class II obesity = 35-34.9; class III= $\geq$ 40. WHO classification, 1997.

weight scores are tested using paired t-test. The score system is based on coding the categories of BMI according to WHO (1998) with values from 1 to 6 as shown below in Table-5.46.

The score value, which is the difference between the actual and perceived, was tested using paired t-test. Table-5.46 is a summary of the scores, obtained from the differences between the perceived and actual body weights, in the four previous tables.

The means of the variables were compared (Table-5.47). The CI (95%), paired t-test, and p-value were calculated. The data shows that the differences between means were at the level of $p < 0.001$ of significance which indicate that participants perceptions of current weight, appropriate weight, and husbands' opinion on weight compared to actual weight was not consistent, i.e., what the participants perceived as their weight was not consistent with their actual or current weight.

Table-5.47. Comparison of Actual BMI and Perceived BMI Means

Perception	N	Mean	CI at 95%	t-value/P
1. Actual BMI (grouping)	324	3.76	3.63-3.90	11.47/ .0001
Perceived weight (grouping)	324	3.13	3.02-3.25	
Difference :				
Actual BMI- Perceived weight		0.63	0.52-0.74	
2. Actual BMI (grouping)	323	3.77	3.63-3.90	20.17/ .0001
Perceived appropriate weight	323	2.49	2.42-2.57	
Difference:				
Actual-Perceived		1.27	1.15-1.39	
3. Actual BMI (grouping)	324	3.76	3.63-3.90	18.80/ .001
Perceived husband opinion on weight	324	2.06	1.89-2.24	
Difference:				
Actual-Perceived		1.70	1.52-1.86	
4. Perceived current weight (grouping)	324	2.49	2.42-2.57	
Perceived desirable weight (grouping)	324	3.14	3.02-3.26	
Difference:				
Actual-Perceived		-.6440	.52-.77	-9.99/.0001

CHAPTER VI

DISCUSSION

Weight gain has always been known to man to be a sign of good health and prosperity. Surplus energy stored as adipose tissue in the body depots has proved to be an efficient and practical way of making energy available for utilisation by the body whenever it is needed. Today, however, profound changes have occurred in our lives in association with improved living standards that have lead to a markedly reduced need for utilisation of stored energy and even for moderate levels of activity. Consequently, the prevalence of weight gain and obesity are also rising and becoming a major public health problem in many countries of the world. Table-6.1 summarises data on the prevalence of obesity in some developed and developing countries.

Table-6.1 Prevalence of obesity (BMI $\geq$ 30.0, kg/m^2) in selected countries

			BMI $\geq$ 30.0	
Country	Year	Age	Male	Female
Australia	1989	25-64	11.5	13.2
England	1995	16-64	15.0	16.5
Sweden	1988/89	16-84	5.3	9.1
Brazil	1989	25-64	5.9	13.3
Canada	1986/92	18-74	13.0	14.0
USA	1991	20-74	19.7	24.7
Iran	1993/94	20-74	2.5	7.7
Cyprus	1989/90	35-64	19	24

Report of a WHO Consultation on Obesity. Geneva, 1998.

6.1. Obesity in Countries of The Middle East

Of the countries that have also been affected by these changes are the countries of the Middle Eastern Region. Within the last thirty years, most countries of the Middle

East have experienced marked demographic, socio-economic, and life style changes. Traditional dietary habits have been modified due to the combined effect of westernised diets and population mixture, as well as the changes in lifestyle that encourage sedentary habits. These changes have lead to a profound alteration in the health and nutritional status of the concerned populations. Morbidity and mortality rates from infectious diseases and under-nutrition have decreased, to be replaced by rapidly rising rates of chronic non-communicable diseases such as NIDDM, CHD, and cancer. Furthermore, the sedentary life that has resulted from this improved socio-economic status, has led to an increase in the prevalence of overweight and obesity among populations in the Middle East (Table-6.2).

Table-6.2 Prevalence of overweight and obese women in selected Arab countries

Country	Age group, (years)	BMI kg/m² (%) Overweight (25-29.9)	BMI kg/m² (%) Obese (≥ 30)	Source
Bahrain,	30-77		49%	Musaiger et al, (199
Qatar	17-67	30	33.6	Musaigher et al, (19
Saudi Arabia	18-74		65	Madani et al (1994)
	28-48		32	Al-Rehaimi et al (1
	20 +	31.5	40.5	Ogbeide (1995)
United Arab Emirates	15-70	33	38	Musaigher et al, (19
Oman		27.6		Amine EK (1996)
Kuwait	20-60	73	42	Al-Isa (1995)
Egypt		30.8		Darwish et al (1994
Lebanon	18-35	33	22	Baba N,(1992)

However, to be able to assess and compare the problem of overweight in populations, one has to, as much as possible, examine the problem in countries with similar socio-economic, demographic and environmental background. The Annual Report of The World Bank (1997) has provided such data and grouped Kuwait, Singapore, Israel, Hong Kong, and the United Arab Emirates (UAE) under economies classified by the United Nations and regarded by them as developing.

Although the World Bank has grouped these countries under one heading, they do differ in their cultural, social and behavioural characteristics, which probably plays a significant role in the increasing prevalence of obesity. Kuwait and UAE are the only two countries among the group that share similar traditional, cultural and socio-demographic characteristics (Table-6.3). The prevalence of obesity in these two countries, as well as in the other countries of the Gulf Region, is comparable and markedly elevated.

Table-6.3 Prevalence of obesity in adult females in countries of developing economies

Country	Year	Age (years)	BMI $\geq$ 30.0 kg/m^2
Kuwait[1]	1994	18-70	44%
UAE[2]	1992	17+	38%

1. Al-Isa, 1995.
2. Musiager, 1992.

6.2. Characteristics and Prevalence of Obesity in Kuwait

In this study, 324 adult Kuwaiti women between the ages 20-60 were randomly selected from 3 out of 5 governorates of Kuwait. In contrast to previously conducted studies to determine the prevalence of obesity among Kuwaiti females where the sample consisted of clinic walk in subjects, the sample in this study was community based. To ensure that this sample is representative of the adult Kuwaiti women population, it was first assumed that the prevalence of obesity in adult Kuwaiti females is 33%. Then, the sample size was calculated (Kirkwood, 1988); i.e.

$$2 \times 1.96 \sqrt{p(1-p)/n} < 0.1$$

Where P = the assumed prevalence, i.e., 0.33

And n = the required sample number

Solving this equation results in n = 342.

The results have shown that over half the women had a BMI $\geq$ 30.0, and more than one quarter were overweight, i.e. BMI between 25.0 and 29.9. This is consistent with other studies done in Kuwait and in other Gulf countries (Al Awadi, 1990; Al-Rehaimi, 1992; Musaiger, 1994; Al-Isa, 1995). However, this prevalence is much higher than prevalence of adult women of the developed countries such as the USA, UK and Sweden (Seidell, 1995; WHO, 1998). Body weight increased with age in the three classes of obesity reaching the highest values in the 40 years and over.

As weight gain occurs slowly over time, the causes must be insidious. It has been postulated that there are three main causes as to why weight gain occurs with age (Grundy, 1998). Firstly, resting metabolic rate decreases probably as a result of reduction in muscle mass; secondly, food intake may increase; and thirdly, as people get older, they tend to get progressively more sedentary. Less than one fifth of the subjects had a normal BMI, more than a quarter belonged to the overweight category, and over half the sample were of the obese BMI category. Furthermore, the percentages of those that were overweight and obese increased with age. This is consistent with several studies that have showed a similar relationship between increasing prevalence of weight gain and obesity with age (Rissanen, 1987; Khawaja, 1987; Flier, 1994; Seidell, 1995; Al-Isa, 1995; James, 1995; El-hazmi, 1997, Macdonald, 1997, Jebb, 1997, Grundy, 1998). The data also showed that among those that were not working, the majority were of the obese category, however it has also shown that of those that were obese more than half belonged to the working women. This probably suggests that factors other than occupation are influencing the prevalence of obesity among women. Nonetheless, information from the Ministry of Planning (1997) has indicated that more than half the adult Kuwaiti women are working; this probably suggests that the majority of the jobs are relatively sedentary and are of the type that do not require physical activity. Similarly, the prevalence of obesity was highest in those in the lower level of education, which is comparable to data from other countries, i.e. the higher the level of education the lower the prevalence of obesity (Rissanen, 1991; James, 1995; Al Isa, 1997). Among the married category, more than a quarter were overweight and well over half were obese compared to those that were of the single.

6.2.1. Socio-demographic Characteristics

The socio-demographic characteristics of the sample were consistent with the mid-year population census of Kuwait (Ministry of Planning 1997, Kuwait). In the sample, nearly 40% of the participants were between 30-39 years. However, according to the census of the Ministry of Planning, there were 150,806 women between the ages 20-60 years, of these 40% were between 20-29 years and 28% were between 30-39 years. The population of Kuwait is young because more than 60% of them are below the age of 40. Our findings show that almost three quarters of the sample were married women and nearly half of these were between 30-39 years. The results of this study are consistent with the 1997 census. Two thirds of the participants were working and nearly half were between 30-39 years. The 1997 census cannot be compared with these results because in the census they have included women from the age of 15 and those above the age of 60. More than half the participants were at the medium level and 31% at the high level of education; this is probably because more than 40% of women in this sample were between the ages 30-39 years. These results are not consistent with the 1997 census, which reported that half the Kuwaiti women population over the age of 15 and over is at the high level of education. One third of the participants had 3-5 pregnancies, and of those more than half were between 30-39 years. Furthermore, one quarter of the women had 1-2 pregnancies and the majorities were between 20-29 years.

6.2.2. Anthropometry

A careful analysis indicates that the sample that was selected for the investigation is broadly representative of the general population of Kuwaiti women. Height measurement of adult Kuwaiti females in this study showed that the younger age group were taller than the age group 40 and over. It is expected that, with improvement in health services, food availability, and nutrition awareness, the new generation would be taller than their predecessors would. This secular trend is consistent with similar studies in the Gulf States. However, compared with other populations of the same age, such as Canada or USA, the Kuwaiti population is shorter (Gibson, 1990). This is probably the interaction of other factors such as genetics, the environment and lifestyle. Similarly, the mean weight for this sample is much higher than that found in other populations, and more importantly classifies this population as class I obesity according to the WHO classification of BMI. There are several studies done on overweight and obesity in the region (Musaiger, 1992, Musaiger, 1994; Madani, 1994) but data on anthropometry is very limited. The anthropometric findings of this study were largely consistent and comparable to studies done on Saudi women (Al Rehaimi, 1992; Rasheed, 1994). However, when the results were compared to studies done in Sweden and the United Kingdom, the average Kuwaiti women were shorter and all those anthropometric measurements that were related to and indicative of obesity were markedly higher.

In this study Durnin and Womersley's equations (1974) have been used to estimate body fat and body density. Many of the authors regarded these equations to be limited and specific to the population from which they are derived. However, these age and gender specific equations were used to obtain a rough idea of the extent of the excess adiposity in the women in the region who were being studied. It was not surprising that both body density and percent body fat were high. In fact, when the percent body fat was calculated using the equation by Brozek (1963) it further showed that the mean body fat was 40% and over, which according to the classification by Nieman (1995) puts the women in all the three age groups in the *overfat* category. Skinfold measurement results have also shown that the means for the various skinfolds at all the sites are high. For instance, compared to the US percentiles for sub-scapular and triceps skinfolds (Frisanch, NHANES II; 1976-1980), the means of sub-scapular and triceps skinfolds in this study are above the 80th percentile of the US for both of these measurements. The mean of the sum of the four skinfolds in the three age groups were greater than 139 mm which is indicative of a percent body fat diagnostic of *obese/overfat* category. The mean waist circumference was high resulting in an elevated WHR; the sub-scapular triceps ratio (STR) was also high. Thus, the overall pattern was indicative of central obesity.

The relation between obesity and CHD has been reviewed in several studies (Bjorntorp, 1984; Lapidus, 1984). It was found in the Framingham study (Hubert,

1983) and in a Norwegian study (Waaler, 1984) that obesity was a risk factor for CHD independently of age, systolic blood pressure, serum cholesterol concentration, systolic blood pressure, cigarette smoking and glucose intolerance. In this study, although electrocardiograph (ECG) recordings were not used to predict CHD, our data showed statistically significant associations between women who were overweight and obese and the risk factors of CHD such as high diastolic and systolic blood pressures, hypertension, NIDDM, and abnormal plasma lipid profiles.

6.2.3. Body Fat Distribution

The results show that the mean WHR and WC in this group of adult Kuwaiti females is 0.87 and 96 cm respectively. These figures are higher in comparison to other populations in the west. For instance, in a study on community derived random sample of 1014 British women, the mean WHR was 0.80 and the mean WC was 82.0 cm (Han et al, 1995). Furthermore, the mean WHR and WC on a population-based study of 16007 men and women from five Canadian provinces, aged 18 to 74 years was 0.84 and 85.2 cm respectively (Ledoux et al, 1997). Compared to European women reported in the literature, the women in this study from Kuwait are 6% higher in the measurement of WHR and 12% in the WC.

In the study on the distribution of adipose tissue and the risk of CHD and death, Lapidus et al (1984) found that although general indices of obesity such as BMI or sum of skinfold thicknesses predicted myocardial infarction in women, the WHR was a stronger predictor. The WHR, in contrast to body mass index and the sum of skinfold thickness, predicted angina pectoris, stroke, and total mortality. Most of these predictions were independent of age, body mass index and either systolic blood pressure, serum cholesterol concentration, or smoking habits. This in agreement with other studies which showed, that among other factors, the patients' age and abdominal fat distribution can be used as indicators of the probability of CVD risk (Han et al, 1995, Lean et al, 1995; Ledoux et al, 1997; Mendlein et al, 1997).

Intra-abdominal or central body fat distribution poses a greater CHD risk than peripheral fat distribution. The study by Han et al in 1995 on waist circumference action levels in the identification of CHD risk factors have concluded that there was a close relation between waist circumference and CHD. They have also indicated that, compared with people with waist circumferences below a cut off of 94 cm in men and 80 cm in women (which they classified as action level 1), those with waist circumferences between action level 1 and 2 (waist circumference between 94 -101 cm in men and 80-87 cm in women) are one and a half times to twice as likely to have one or more major CHD risk factors, those with waist circumference above action level 2 are two and a half to 4 and a half times as likely to have one more major risk factors. In this study the range of WHR was from 0.71 to 1.02 cm, however the 50th percentile for the three age groups was above the cut-off point which increases the risk of CHD.

Body fat was shown to be strongly associated with other anthropometric measurements such as waist circumference, WHR, BMI ($p < 0.001$) as well as with age ($p < 0.04$) but not with hypertension, NIDDM, or the lipid profiles. Moreover, one of the measurements used to assess the degree of fatness is percent body fat and 90% of the subjects in this study sample were in the overfat category (> 33%). Analysis of the data has shown that 100% of those with NIDDM and 95% of those with hypertension were in the overfat category. In addition, of those whose blood lipid profiles (SC, TG, LDL, HDL) classify them as high risk for CHD, at least a quarter were in the overfat category.

6.3. Determinants of Increasing Prevalence of Obesity

Overweight in individuals in any population is the result of long term positive energy balance. It cannot simply be explained by over-consumption of food or physical inactivity. Many epidemiological studies have shown that weight gain is the result of several inter-related factors (Seidell, 1995); namely:

(1) Demographic:

- a- Age (overweight increases with age)
- b- Gender (higher rates in women than men)
- c- Ethnicity (large variations between ethnic groups)

(2) Socio-cultural factors

a- Educational level (varies; some countries high level of education is associated with higher BMI)

b- Income and occupation (varies; some countries high level of income, occupation or profession is associated with higher BMI)

c- Marital status (BMI usually increases after marriage)

(3) Biological factors

a- Parity (BMI increases with increasing number of pregnancies)

(4) Behavioural factors

a- Nutrition (BMI increases with increasing fat content of the diet)

b- Smoking (smoking lowers body weight and cessation of smoking increases body weight)

c- Physical activity (those who lead a sedentary life or become inactive are more usually heavier than those who continue to engage in physical activity).

Weight gain leading to obesity occurs when energy intake from habitual diet chronically exceeds energy expenditure, largely determined by the level of physical activity. In this study, data on energy intake from habitual diet was not assessed, however the Food and Agricultural Organisation (1990) has published data on the food consumption patterns of the Middle East countries (Table-6.4).

Table-6.4 Contribution (percentage) of nutrients to Daily Energy Supply (DES) in the Middle East countries

	Low-income countries	Intermediate-income countries	High-income countries
Carbohydrates	55-75	60-70	59-60
Fats	15-20	20-25	29-30
Proteins	10-12	10-11	10-12
Complex carbohydrates	60-70	50-60	45-50
Sugar	3-12	9-12	10-15
Animal fat	4-7	4-10	11-15
Cereals	60-80	45-65	35-40

FAO (1990)

In general, the food situation in the Middle East has markedly improved during the last three decades, and the changes in food habits are not always the same universally. The countries of this region have been divided into categories based on per caput Gross National Product (GNP) and the Daily Energy Supply (DES) derived from The Food and Agriculture Organisation (FAO) Food Balance Sheets (1990). In the high-income countries, the traditional diet has changed to a more westernised diet, with an excess intake of energy-dense foods rich in fat and free sugars and poor in complex carbohydrates (Musaigher, 1994), with the daily energy intake exceeding 3000 kcal/caput. In the intermediate-income countries the average per caput calorie supply is between 2700-3000 kcal. Sugar consumption has increased and fat content has reached a level of 20-25% of the DES. The low-income countries have the same food consumption characteristics as many poor countries of the world. The daily caloric supply is 2000-2300 kcal and cereals contribute 60-80 % of the total calorie intake.

Table-6.5 Comparison of fat intake per caput per day in selected countries.

Country	Fat per caput per day (grams)[1,2]
France	140
United Kingdom	140
Sweden	130
Italy	140
Denmark	160
Kuwait	100

1. Seidell C. Obesity in Europe, 1995.
2. FAO (1990).

Fat intake per caput per day (in grams) of the Middle East countries within the high-income group (FAO, 1990) when compared to that of some of the European countries in Table-6.5 shows that fat consumption in all the European countries is higher than those of countries, like Kuwait, in the Middle East (Seidell, 1995).

6.4. Determinants of Obesity in Kuwait

The percentage of participants with a normal body weight (BMI = 18.5-24.9) was 17%.

The distribution of overweight among the three age groups was almost equal, being slightly higher between ages 20-29 years and decreased gradually as age increased. However, weight and obesity increased with age reaching the highest values in the 40 years and over category. In addition, the distribution of obesity was determined by comparing class I, II, III obesity with the overall group of participants whose BMI $\geq$ 30.0.

As weight gain occurs slowly over time, the causes are probably insidious. It has been suggested that there is a tendency for weight gain to occur with increasing age. This weight gain is not accompanied by more muscle mass in most cases; in fact, muscle mass usually declines with ageing (Visser, 1995). Most of the increment in weight thus occurs in adipose tissue (Visser, 1995). When young adults gain weight, extra muscle mass may develop to support the increased adipose tissue weight, but because ageing itself is usually accompanied by loss of muscle mass, body fat probably accounts for most of the weight gained with ageing (Visser 95; Grundy, 1998). The National Institute of Health (1979) conducted a study on weight gain in adult American population and had shown that the average American adult gains approximately 10 kg between 20-50 years in most cases. Similarly, a study on the relationship between age and the prevalence of obesity and overweight in Saudi population (unpublished data of El Hazimi et al) highlight the significant increase in the prevalence of obesity and overweight with age. It has been postulated that there are three main causes as to why weight gain occurs with age (Grundy, 1998). Firstly, resting metabolic rate decreases probably as a result of reduction in muscle mass, food intake may increase, and as people get older, they tend to get progressively more sedentary.

In this study, analysis of the data has shown that age is the most statistically significant determining factor of the risk of becoming obese among adult Kuwaiti females. It has been shown in several studies to be an independent factor contributing to weight gain and obesity. Not only that, it even influences the relationship of other factors that appear to play a role such as occupation, marriage and parity. In this study, for example, those subjects that were non-working were twice as likely to be obese and those that were at the lower level of education were 7 times more likely to be obese than those that were working or at the higher levels of education, respectively. Multivariate analysis has further defined the strength of the association because when the above two contributing factors were controlled for age, the statistical significance disappeared. It is most probably because the non-working and low education level groups were among the older age group compared to their less obese counterparts. When the data concerning the third determining factor, marital status, were then analysed comparing the single group to the married group, there was 3 times the likelihood of being obese if women were among the married group. However, age again turned up as an influential factor. This is because the women in the married group were older; this has helped explain the masked effect of age on marital status and has further reduced the likelihood of being obese from 7 to 2 times compared to single women in this study ($p < 0.06$).

In this study SES is based on level of education and occupation. The results indicate that more than two thirds of those that were working and more than three quarters of those with low level of education were within the obese category (BMI $\geq$ 30). However, when this group of obese Kuwaiti women are examined carefully, the data indicate that more than half of these women are working. The data also indicate that nearly 40% are at the medium level and 43% are at the high level of education. This clearly indicates that obesity in Kuwaiti women is not confined to those in the low SES. Review of the literature on the association of obesity and SES in the west suggests an inverse relationship. A study on a population of 1462 middle-aged women in Goteborg, Sweden was conducted to assess this relationship (Noppa et al, 1980). The results confirmed the inverse relationship between SES and obesity and also showed that the differences found between a woman's obesity level, her social class, and that of her husband indicate that the social class of husbands is a much stronger predictor of obesity in women than their own. Further research was carried out and interest was focused on factors that may explain the SES-obesity relationship. Lower SES individuals may eat more calories or eat a higher fat diet. They may exercise less and may engage less often and less successfully in efforts to control weight. Healthier behaviour in higher SES persons might be due to more exposure to information about healthy lifestyles, to greater access to opportunities to engage in healthy behaviours because of residence, employment, or economic advantage, and normative expectations regarding personal appearance and lifestyle (Jeffrey et al, 1991). These results are also in agreement with another study that examined overweight and obesity in relation to SES and several other factors. The objective was to explain the social gradient in obesity among middle-aged women in a Western society. These factors included unhealthy lifestyle {smoking, physical inactivity (at work and at leisure), alcohol consumption, unhealthy dietary habits, intentional dieting, psychological stress (lack of self esteem, poor coping, poor quality of life, lack of social support, and job strain), and reproductive history. The results suggested that low social class position and obesity were related to unhealthy dietary habits, and psychosocial stress (Wamala et al, 1997).

Among lifestyle factors that were analysed to investigate those factors that may be associated with the risk of obesity were whether indulging in regular physical exercise, having a home assistant, the amount of TV watched per day, and lastly if subjects were suffering from physical disability (excluding congenital deformities and accident/trauma induced disabilities) that would limit their activity level. Out these 4 determining factors, physical disability and, to a lesser degree, exercise showed a statistical significance. However, once again, when further analysis was carried out controlling for age, the statistical significance disappeared for all the factors, with the exception of physical activity where it was borderline ($p < 0.04$). Multivariate analysis were carried out to determine the extent of the effect of age on physical disability, it was shown that the mean age of those that did not have physical disability compared to those that did emphasised the effect of age as an influential factor. Thus, those that reported to have a physical disability were older, 38 years, compared to those who did not, 34 years.

Previous studies have investigated the role of sedentary life style factors such as leisure-time activities and TV watching have concluded that reduction in physical activity may contribute to the increase in prevalence of obesity. TV watching was suggested to be a major source of inactivity especially in children which may contribute to the risk of developing obesity in adolescence and adulthood (Dietz, 1985, 1991; Gortmaker, 1996). In this study the results showed no statistically significant association between TV watching and the risk of obesity. However, there is enough data that has proved otherwise and it may be because the sample number is small and/or the design of the questionnaire on this section needs to be re-constructed. Similarly, housework is a form of physical activity and in Kuwait almost all homes have at least one housemaid. It is probably more likely than not that having a maid is a contributing factor to the risk of obesity but our results showed that the relationship was not statistically significant. Our findings show that only one fifth of the sample population exercise regularly, and yet of those that exercised regularly the prevalence of overweight and obesity ranged from 25% to more than 50%. Reductions in leisure time activity may contribute to the prevalence of obesity. The 1991-1992 Navajo Health and Nutrition Survey, which included interviews and examinations of 303 men and 485 women between the ages of 20 to 91 years, was the first population-based examination of CHD risk factors in this tribe. The results showed that the change in lifestyle, from being an active lifestyle to a sedentary one, has markedly increased the prevalence of obesity and increased the risk of CHD risk factors. Furthermore, physical inactivity and general sedentary life style attitudes may well be a habit subjects get accustomed to from an early age, as children and adolescents, from the immediate surroundings such as family, school or friends. It has been shown that physical activity in childhood and adolescence appears to be on the decline (US Department of Health and Human Services, 1996) while watching television and playing computer games has replaced time usually spent in outdoor activities (Grundy, 1998). This is consistent with the results of the study which assessed the influence of environmental factors on the prevalence of obesity which were reported in the results of two National Health Nutrition Examination surveys (NHANES) conducted in 1976-1980 and again in 1981-1991 in the US (Kuczmarski et al, 1994). The first study showed that the prevalence of obesity was at 25%. However, less than 10 years later this rate increased to 33%. It was indicated that the increase was not confined to the obese population. It included all weight classes, with an increase in the body weight of all Americans that averaged 3.6 kg. It was suggested that this increase in the prevalence of obesity over this short period of time cannot be entirely blamed on genetic susceptibility and that the primary responsibility must lie on the environmental changes of populations (Stunkard, 1996).

Physical activity is an important component of total energy expenditure ranging from 20-50% of the total energy expended (Jebb, 1997). Although high fat diet and high-calorie foods are abundant and readily available in the United States, survey data suggests that dramatic increases in energy intake alone do not account for the increased prevalence of overweight among adolescents and adults. Declining levels of physical activity may account for much of these changes (CDC, 1994). Several researchers have indicated their results were in agreement with other studies that there was an inverse relationship between physical activity and BMI , in both sexes (Kromhout et al, 1988; Jeffrey et al, 1991, Ferro-Luzzi, 1996). However, other studies did not find a significant association between physical activity at leisure and at work and BMI (Wamala et al, 1997). The investigators suggested that this could be attributed to under-reporting of participants. It has been observed that obese subjects, more than overweight or normal weight subjects, have a tendency to underestimate their food intake, and overestimate the energy they expend in physical activities (Lightman et al, 1992).

Antenatal and postnatal weight gain and an increased prevalence of overweight and obesity in multiparous women are well documented (Rissanen, 1991). Obesity is common among multiparous women (Pettigrew, 1997), and this will be more obvious if pregnancy was accompanied by short inter-pregnancy interval. Our findings showed that obesity increased with increasing number of pregnancies. Al-Awadi et al (1989) found similar results whereas Rissanen et al's study (1991) on weight change and overweight in Finns found that childbearing did not result in permanent weight gain in the well-educated women but did so in other women. Our findings show comparable results; that is, there was a greater increase in overweight and obesity among those women that belonged to the low and medium level of education with increasing number of pregnancies compared to those that were in the high level of education. Several cross-sectional and longitudinal studies have been conducted to investigate the relationship of maternal and reproductive factors and weight change and the long-term public health implications for women. A cross-sectional study that investigated this relationship on a sample of 17688 non-pregnant women aged 25-48 showed parity to be closely related to adiposity and prevalence of obesity. This was part of a multiphasic screening examination of women who took part in this study in various parts of Finland in 1966-72. The relationship was independent of other factors such as marital status, occupation, smoking habits, and geographical area (Heliovara et al, 1981). It has also been reported that some women put on more weight with each successive pregnancy and that 15% of those women taking part in this study remain at a weight five or more kg heavier at one year postpartum compared to their pre-pregnancy weight. These results are in contrast to the longitudinal study that assessed the effect of pregnancy on the body mass index (Rookus et al, 1987). The change in the body mass index from pregestation through 9 months postpartum in 49 pregnant women was compared with the change in the body mass index during the same period of follow-up in 400 non-pregnant women. The observations suggested that there was not a significant difference in the change in BMI between the two groups than that expected from ageing. It was also suggested in this study that maternal obesity might be the result of the changed life-style associated with having children rather than factors related to the pregnancy itself. This is consistent with another study that investigated parity related weight change in women which indicated a strong association between ageing and weight gain and a weak association between parity and both weight and overweight in women (Brown et al, 1992). In this study it was suggested that the association between greater parity and weight gain could be related to food availability, physical activity and stress levels, income and other environmental changes that may accompany an increasing number of children in the household. These findings are in agreement with those of Rossner and co-workers (1992).

The results of our study indicated that the maternal factor, returning to pre-pregnancy weight, was an independent and statistically significant risk factor to being obese in this group of adult Kuwaiti women. This is in agreement with a retrospective, repeat-pregnancy study that examined the change in maternal body weight from the beginning of the first successful pregnancy to the beginning of the second of 243 mothers (Harris et al, 199). Their results showed that pre-pregnancy BMI determines long-term weight gain which occurs during pregnancy and the post-partum period. Those mothers who gained more weight from their first pregnancy gained more weight from one pregnancy to the next. This suggests that pregnancy may be associated with a permanent increase in maternal body weight simply because it is a period of positive energy balance during which some women gain excessive amounts of weight. However, this is in contrast to the work by Ohlin and workers (1990) who assessed the relationship between weight change and pre-pregnancy weight. The results suggested no significant association.

Weight gain in pregnancy reflects 1) fat deposition, a physiological adaptation, 2) increase in water, due to expansion of the plasma volume and total body water, 3) the growing foetus, as well as 4) increases in the size of the uterus and breasts. Some of this excess weight may be retained in the postpartum period (Pettigrew, 1997). Total number of pregnancies and inter-pregnancy interval showed statistical significance to the risk of developing obesity which also increases the risk of obesity. Age has again proven to influence the degree of statistical strength of the maternal factors and their relationship to the risk of obesity. In the case of total number of pregnancies, age increases with increasing parity. This not underestimating the normal physiological process of fat deposition, nonetheless age proved to be an additive factor. As far as inter-pregnancy interval is concerned, our results showed this factor to be a risk to obesity but when multivariate analysis were carried out, controlling for age, this association again disappeared. More studies are needed to determine the significance of this relationship but with may be a bigger sample. The extra layers of fat that are normally deposited during pregnancy and the period of lactation are risk factors to weight gain if they are not utilised and the risk becomes greater if another pregnancy takes place.

Overweight women have been found to have a higher risk of gaining weight after successive pregnancies than lean and normal weight women. It has been suggested that many women have higher body weight in the beginning of a subsequent pregnancy compared with a previous one and that excessive weight gain in one pregnancy will often lead to obesity in the next one. It has also been suggested that age is a major contributing factor and that it may have a greater effect than parity itself on weight (Rookus, 1987; Ohlin, 1990,). In a study, which assessed the relationship between parity and subsequent weight gain and overweight in 41184 women between the ages of 18-50 years, the results indicated that a strong association between ageing and weight gain and a weak association between parity and both weight and overweight in women (Brown, 1991). The results of another study which examined changes in adiposity in relation to pregnancy on 2788 women, 53% of whom were black, showed that among primiparous women there were marked increases in WHR when compared to nulliparous women in both race groups. The team of investigators also warned that such persistent changes in WHR suggest that parous women may be at heightened risk for CVD as a consequence of central adiposity. However, it was argued that reproductive history alone would not appear to account for the high rates of obesity especially amongst black women; an other factors may be responsible such as dietary habits during pregnancy and in the post-partum period (Smith et al, 1994).

There is increased interest in the influence of maternal nutrition on intra-uterine foetal growth and the impact of this relationship on morbidity and mortality later on in life.

This study has not investigated this relationship. However, the results have shown that, among adult Kuwaiti women, the prevalence of obesity is high (56%) being predominantly of central distribution (mean WC=98 cm), high prevalence of NIDDM and hypertension, 25% and 18% respectively. Furthermore, although the analysis assessing the relationship between overweight and obesity with lifestyle factors among the selected group of adult Kuwaiti females did not show statistical significance, the indications are that the general lifestyle is sedentary. Review of the data from studies investigating the influence of maternal nutrition on foetal growth have shown positive correlation between birth weights and adult weight and height, but not BMI (Allison et al, 1995), an inverse relationship between central fat deposition and birth weight (Jackson et al, 1996), a positive correlation between low birth weight and earlier onset of IDDM (Khan et al, 1994), a positive correlation between hypertension and maternal weight before and during pregnancy but not with birth weight (Laor et al, 1997).

If we compare the data from this study and those from the literature on intrauterine nutrition, it can be said fairly confidently that the appropriate risk factors to the development of disproportions in growth between the mother, foetus, and the placenta are present in this study group. These are important markers for increased risk for the development of NIDDM, hypertension, and CHD. Hence, there is a need for much more detailed information on the relationship between maternal nutrition, birth weight and adult morbidity in the Kuwaiti population.

6.5. Health Risks of Obesity

Obesity has physiological, behavioural, and medical consequences, the nature and severity of which are influenced by the degree of obesity. Furthermore, the health risks of obesity increase with its severity; it has been suggested that health risks reach significance at a BMI > 27.0 (Pi-Sunyer, 1991). Risks include CHD, hypertension, NIDDM, dyslipidemia, chronic hypoxia and hypercapnia, sleep apnoea, degenerative joint disease and gall bladder stones. The distribution of body fat is directly related to these health risks. There is conclusive evidence at present indicating a direct relationship between intra-abdominal fat accumulation and the risk of CHD, hypertension, stroke, and NIDDM independently of total body fat.

NIDDM has become a major health problem in Kuwait with an increasing prevalence. This increase may reflect the rapid economic development of the country over the last few decades. This resulted in a change in the health profile of the population, from a moderately active population, where people led a hard and difficult life up to the late forties and early fifties to ensure a decent living for the support of their families to a profoundly sedentary lifestyle. The results have shown that the prevalence of NIDDM in this sample of adult Kuwaiti females age 20-60 years is 18% (this information is based on self reported diabetics and FBS $\geq$ 6.4 mmol/L, and therefore it is the percentage of those affected within the sample) This rate is comparable to the prevalence in some of the countries of the Gulf region; namely 14% in males and females 30-64 years of age in Oman and in a cross-sectional survey of 51-60 year old males and females in Saudi Arabia, the prevalence was 40% (Al-Nuaim, 1995). However, this prevalence is considerably high when compared to some of the industrialised countries such as USA 7%, Italy 10% and China 10%. Interestingly, Will et al (1997) found in their study 'Diabetes Mellitus Among Navajo Indians' that 14.4% of Navajo adults aged 20 years and above to have NIDDM. Furthermore, of those who did not have a medical history of diabetes, 6.8% were discovered to have NIDDM and another 13.6% to have impaired IGT using WHO criteria. Hence, 21.2% of the adult Navajo population ages 20 and over had NIDDM, with one third having their disease newly diagnosed. The research group have suggested that this increase in prevalence be probably related to the change in life style and food habits among the Navajo Indians. In another study, a sample of 1058 male and female subjects in the Caribbean, Barbados, Jamaica, and St. Lucia, were conducted to determine the prevalence of obesity. The results showed that obesity (defined as BMI $\geq$ 32.3 kg/m^2) was high among women, 34.6 %, 15.6 % and 16.1% respectively. It was also shown that obesity was associated with a parallel in crease in the prevalence of hypertension and DM. (Forrester et al, 1996). A study in East Finland has assessed the association of obesity and distribution of obesity with glucose tolerance in a population-based study which included 396 non-diabetic men and 673 women aged from 65 to 74 years (Mykkanen et al, 1992). The results showed that obese men and women (BMI$\geq$ 27 kg/m^2) had higher levels of fasting and post-prandial blood glucose levels as well as high insulin levels. The results also showed that central obesity per se rather than its distribution was associated independently of obesity with high fasting glucose and insulin levels.

According to the Health Statistics Department in the Ministry of Health, Kuwait (1979), the prevalence of NIDDM was reported to be 6%. A recent survey (1995) was conducted in two health areas of Kuwait, Capital and Hawaly, to estimate the prevalence of NIDDM in the adult population aged 20 years and above. A total of 3500 people were screened for the presence of diabetes based on fasting plasma glucose values and on performing oral glucose tolerance test (OGTT). The results showed that 12% of those screened had NIDDM, with a serious figure of 24% in the 30-50 age group. Another 6.9% were found to have impaired glucose tolerance (IGT) making the total prevalence rate at 18.9% (unpublished data).

Colditz et al (1990) conducted a study to determine the relation of body mass index with the risk of clinical NIDDM from a cohort of 113,861 women aged 30-55 years in

1976 with a 8-year follow up. The authors concluded from the results that, at even average weight, women are at increased risk of clinical NIDDM and that the relation between body mass index and the risk of diabetes is continuous.

Epidemiological studies reveal that obesity is associated with an increased mortality and morbidity from cardiovascular disease, and the association persists even when age, blood pressure, smoking history, cholesterol, and diabetes are controlled for (Flier, 1994; Hubert, 1983). Obesity is also associated with known cardiovascular risk factors such as diabetes and hypertension that contribute additionally to the risk of cardiovascular disease.

Obesity is a strong risk factor for coronary heart disease in middle-aged women. Even mild to moderate overweight is associated with a substantial elevation in coronary risk. Weight gain during adulthood further increases the risk. As much as 70 percent of the coronary disease observed among obese women and 40 percent of that among women overall is attributable to overweight and is therefore potentially preventable (Manson, 1990). Our results have shown that only 4% of the women were suffering from CHD and of those more than three-quarters were either overweight or obese. The Health and Vital Statistics department of the Ministry of Health in Kuwait (1996) has reported CHD to be the major cause of death among both sexes. Although obesity is unlikely to be the major cause of mortality, it is probably one the strongly contributing risk factors besides smoking, hypertension and dyslipidemia. Long term prospective studies have reported that obesity is an independent risk factor for CHD morbidity and mortality (Willet, 1991) and that body weight was ranked as the third most important predictor of CHD among females after age and dyslipidemia (Hubert, 1983). These findings are in agreement with similar studies from other countries. A 15-year follow-up study of 16,000 men and women in Eastern Finland has shown that obesity is an independent risk factor for CHD mortality in men and contributes to the risk of CHD in women (Jousilahti, 1996).

In this study the prevalence of systolic blood pressure was 15%, of diastolic blood pressure 16%, and hypertension 25%. A previous study in Kuwait, Al Awadi et al (1994), identified patients by history and put the prevalence of hypertension at 19%.

In other Gulf states, two studies were done in Saudi Arabia with different prevalences; one in 1990 where the prevalence was found to be 21% and the other in 1993 where the prevalence was much higher, i.e. 32% (Ahmed et al). In other states, the prevalence of hypertension was 28% in Bahrain and 14% in UAE (Musaigher, 1996). The association between hypertension and obesity is well documented (Johnson, 1975; Reisin, 1978; Ramsay 1978; National Centre for Health Statistics, 1983). Obese subjects are at higher risk of developing high blood pressure than are lean subjects (Public Health Service, 1979; Pi-Sunyer 1991); for example, the relative risk of hypertension for overweight US adults aged 20-75 years is three fold that for non-overweight adults. Data from population-based studies have argued that other factors including weight gain as possible predictors of hypertension. In one study the effect of obesity on hypertension was investigated (Haynes, 1998). It was suggested that several mechanisms have been implicated in the association between obesity and hypertension including salt-retention, insulin resistance and sympathetic activation. The National Health and Nutrition Examination Surveys (NHANES) II data showed that the higher the prevalence of hypertension in North American Blacks cannot be attributed to obesity alone, and also emphasised the greater relative risk of hypertension in younger obese subjects compared with older subjects (Van Italie, 1985). Furthermore, other studies suggest that weight control may reduce the incidence of hypertension in those with high to normal blood pressure. However, in almost all these studies intervention involves other aspects of diet and lifestyle (Stamler et al, 1989), although calorie reduction appears to be more effective than sodium restriction (Trials of Hypertension Prevention Collaborative Research group, 1992).

Our results have shown that the relationship between obesity and having osteoarthritis was statistically significant ($p < 0.0001$), and the prevalence increased with increasing BMI. Obesity and osteoarthritis have been linked in several cross-sectional studies where this degenerative disease has affected many joints but more specifically the weight bearing joints such as the knee-joint. It has also been shown that the link between obesity and the disease was stronger in women than in men (Felson, 1988).

Nearly 44% of the subjects failed to complete the blood examination. The researcher compared the BMI of the group that did not complete the blood examination to those that did to determine whether there was any difference that could explain the behaviour of failing to complete the blood examination. The analysis showed that there was no statistically significant difference between the BMIs. Therefore, the analysis of the relationship of the blood lipid values of those that completed the blood examination to the various characteristics and factors can be representative of the whole sample. Blood lipids are often elevated in association with obesity (Pi-Sunyer, 1991). In this study our findings show that hypercholesterolemia was 1.5 times greater, LDL was 2.5 times greater, and HDL was 1.8 times lower in the obese compared to the non-obese. Several studies reported similar conclusions (Simpson, 1982; Al Awadi, 1990) that there were higher concentrations of cholesterol and triglycerides in those with BMI > 28.0 than in those with BMI < 25.0. In addition, high-density lipoprotein (HDL) concentrations are lower in obese individuals (Kannel, 1979), and low HDL concentrations are a risk for coronary artery disease, independent of the concentration of low-density lipoprotein (LDL) cholesterol (Yaari et al, 1981).

6.6. Perception of Health and Weight Status

6.6.1. Perception of health status

As individuals get older, they are more at risk of developing disease and the risk increases when predisposing factors, such as hereditary factors, co-exist. This perhaps explains the responses of the perceptions of the participants in this study. The younger the participants the better the perception of their health status. This is evident in two thirds of the respondents between the ages 20-40 years who perceived their health status as being very good and good in contrast to nearly half those over 40 years who perceived their health status as average or poor.

Weight gain and obesity are usually associated with a sense of unsatisfaction (Gingras, 1998). To assess how participants perceive their health in association with weight they were divided into obese and non-obese groups. When the study group was divided into non-obese (BMI < 25.0) and obese (BMI $\geq$ 25.0), according to

Garrow's classification (1981), the results have shown that 83% of the participants were obese. Of those with BMIs less than 25.0, 68% classified their health status as either good or very good compared to 58% of those who were obese. There is a difference between the two responses, i.e. those with BMI< 25.0 compared to those with BMI $\geq$ 25.0.

Table-6.6 Overall percent of perception of health status with BMI

	Health Status	
BMI	**Very good or good (%)**	**Poor (%)**
Overall	62	6
Appropriate (18.5-24.9)	68.5	3.7
Overweight (25.0-29.9)	72.4	4.5
Obese (>30)	53.8	6.6

The complications and health implications of weight gain and obesity occur over time. Thus the absence of overt health problems reinforces that they are in very good or good health. Health risks is not the same as how one feels now because one may feel well or fine but one may have lifestyle health risks; in other words they may not know what it is like to be physically fit and to be of an appropriate weight. The responses may possibly reflect lack of awareness of the risks of weight gain and obesity that starts earlier on in life. Table-6.6 summarises and compares the participants' weight status by the perceptions of health status.

The results show that the percent of participants' perception of health as poor increased with increasing BMI. One of the conclusions in The Framingham Study (Kannel, 1979) was that obesity risk was more acute in the younger age group, and that the health risks of obesity increased as BMI increased reaching a significant risk at a BMI$\geq$ 27.0 (Pi-Sunyer, 1991). Risks include hypertension, insulin resistance and diabetes mellitus, cardiovascular disease, hypertriglyceridemia, low high-density-lipoprotein cholesterol, and high total and low-density- lipoprotein cholesterol. There is an increased mortality from endometrial cancer in women (Build and Blood Pressure Study, 1959; McCue, 1979). Chronic hypoxia and hypercapnia, sleep apnoea, gout and degenerative joint disease can occur with more severe obesity.

Table-6.7 Summary of the percentage of respondents' perceptions of health status by non-obese and obese categories, adjusted for age.

Age	Perception of health status		Total
	Very good and good	Poor	
Overall	61. %	5%	66%.
20-29			
Non-obese	76%	3%	79%
Obese	62%^	4%	66%
30-39			
Non-obese	67%	0.0	67%
Obese	69	5%	74%
40 +			
Non-obese	43%	14%	59%
Obese	52%	9%	61%

Non-obese = BMI < 25.0; Obese = BMI >25.0

Using the overall percentage as reference of normal, Table-6.7 clearly shows that the participants' perception of poor health status increased with increasing BMI. In addition, in the age category 20-39 years, the perception of health status expressed as poor was greater in the obese group.

The results show that the overall percent of those that classified their health status as very good or good was 62% (Table-6.8). The presence or absence of the selected disease influenced the participants' perceptions of their health. Only 35% of those that had hypertension, 47% with INDDM, 15% with CHD, 52% with bronchial asthma, 48% with arthritis, 55% with gastric/duodenal ulcer, 56% with gall stones perceived their health status as very good or good.

Six percent of the total sample perceived their health status as poor. However, four times as many participants with CHD, two times as many participants with hypertension, NIDDM, bronchial asthma, arthritis, and gall stones, 1.6 times as many with and gastric and duodenal ulcer classified their health status as poor.

Table-6.8 Percentage of participants' perceived health status and disease.

Selected Diseases	Perception s of Very good or good (%)	Perceptions of Poor
Overall Number	62	6
Hypertension	35	13 (2x)
DM	47	11 (2x)
CHD	15	23 (4x)
Bronchial asthma	48	11 (2x)
Arthritis	48	11 (2x)
Gastric/duodenal ulcer	55	10 (1.6x)
Gall stones	55	11 (2X)

* Figures in parenthesis indicate how many more times subjects with a selected disease perceived their health status as poor compared to the overall number

It obvious from the results that the respondents did not have a clear concept of healthy weight. Only 16.7% of the respondents had an appropriate weight for height.

It appears from this data that the concept of what is appropriate weight for height is overestimated amongst the females aged 20 to 60 in Kuwait. It also appears that the perception of body image may not be clear to some of the respondents when 4.7% of those who were not underweight considered themselves to be underweight. Of these 33.4% were actually overweight or obese.

The results indicate that there is not a clear concept of what is a healthy weight for height. Body image formation is a complex process. This study did not attempt to delve into the body image. However, the data collected does indicate that almost half (48%) of the respondents tended to underestimate their body size. There are three common themes encompassed in body image formation. These include 1) social cultural pressure, 2) comparisons between self and others and 3) individual attitudes and the importance of appearance. In the Kuwaiti context, the social cultural pressures may lead to increased adiposity as being heavy used to be a symbol of beauty and prosperity. As noted, 83% of the participants were overweight or obese. Thus comparisons between self and others would certainly reinforce that overweight or obese were the usual rather than the exception. Attitudes towards appearance may not be determined by body size as the use of loose clothing masks body size.

6.6.2. Perception of weight status

Continuous pressure from peers, husbands or boy friends, the immediate family and the mass media pose a burden on women to attain a certain body image. Women, more than men, try to improve their body image with the aim of having a slim figure. Several ways have been employed to achieve this goal. However, the most important factor in this situation is how the person in question perceives their body image and based on this she would try to lose weight, gain weight or just maintain the current weight. In Industrialised countries the social pressure on women is towards maintaining a slim figure. In developing countries the trend has been catching up but there are still beliefs and traditions that might be a little different.

Many consider having a thin or slim figure denoting a sign of ill health. The belief that being fatter is more beautiful and is preferred by their husband's preference is important still exists. Relatively, a large proportion of the adult female population do not exercise regularly. Many participate in health clubs but only for a short period of time. At the same time, although no data is available, but it can be said that probably more than three quarters of the adult female population abide by the Islamic Shreaa (Islamic rules) for clothing. These clothing are in the form of loose, long dresses with a separate head cover to conceal the hair. Normally, weight gain is felt when conventional clothes become tight around the waist, chest, and/or hips. However, with the form of clothing that are currently used, i.e., loose and wide, women are not as aware or warned because the feeling that clothes are getting tight does not occur.

Table 6.9 Summary of the perceptions of appropriateness of current weight by adult Kuwaiti females (aged 20-60) versus their actual weight when compared to WHO classifications.

	Perception of current weight category		
Actual Weight	Underestimation %	Correct %	Overestimation %
Underweight	—	100	—
Normal	18.5	62	18.5
Overweight	33	59	8
Class I	63	22	15
Class II	81	19	—
Class III	44	56	—
	48	43	9
Total (N=324)	N=154	N=139	N=31

Almost half the participants not only misclassified their weight but also underestimated their current weight as compared to their actual weight. This means that this group of Kuwaiti women do not know how much they should weigh and what being overweight or obese means. This is similar to the perceptions seen in two previous studies; one study by Musaigher (1993-94) on the knowledge and attitude of university students towards obesity in UAE. The UAE study showed that 30% of the students underestimated their weight. The other study was on weight, body image, and weight control practices of Navajo Indians (White, 1997) which showed that 19% of the participants underestimated their current weight to their BMI classification. It also showed that the older the group of women the more they preferred a heavier body image as being ideal for health.

The results are not surprising because when the participants were asked about the perception of their health status, the majority of those that perceived their health status as very good and good were obese with a BMI $\geq$ 30.0. This can only mean that this group of women are psychologically satisfied and mentally content with their weights. This is confirmed further when the participants' perception of appropriate weight was compared to their current BMI; only a quarter of the sample knew what they should weigh Nearly three quarters of the participants expressed an appropriate weight that was less than their actual weight. Moreover, when perception of appropriate weight was compared to their current weight, only a third of the participants' perceptions were consistent and more than half were not. It has always been shown that women overestimate their health status when compared to their actual weight.

Many participants perceived a heavier body image model as more elegant and beautiful and that a lighter weight, even if this were the correct weight, was not acceptable since it was considered too thin (personal communication- from participants that were interviewed).

Husbands' opinion on the participants' weight is a very important factor in encouraging her to lose, gain or maintain weight. When the participants' perception based on their husbands' opinion of their body weight was determined, more than 60% of the reported husbands, perceptions that were an underestimation of the participants' current weight. That is, the participants' perceptions of their body weights were lower than what they really are. Only 10% reported perceptions which indicated weights greater than what their actual weights are.

In general, it is difficult to be sure about the peoples' responses on body image and perceptions of body weight. Many give an exaggerated perception of current body weight or appropriate body weight to probably justify their present body weight. Similarly, to be certain that the married subjects are reporting their husbands' exact opinion on their (the wives') body weight may not entirely accurate. Some women may have never had any opinion from their husbands on body weight, which is not uncommon in some societies such as the Bedwan communities in Kuwait, more in the older generation than the younger ones. Men in these communities do not generally comment on their wives' appearance. Other women may not be truthful about it; and others still give a certain response to leave a good impression on the person asking the questions. Perceptions on body weight is a sensitive topic for both men and women. A carefully designed questionnaire aimed at assessing the husbands' and the wives' perceptions on each others' weight may give a more accurate account on the opinion of their weights especially when each is interviewed alone.

CHAPTER VII

POLICY IMPLICATIONS AND RECOMMENDATIONS

At present, there is substantial evidence to suggest that the prevalence of overweight and obesity is increasing worldwide at an alarming rate (WHO, 1998). Both developed and developing countries are affected. Furthermore, the problem appears to be increasing markedly in children as well in adults and only then will the true health consequences become fully apparent in the distant future. The health consequences of obesity are many and varied, ranging from an increased risk of premature death to several non-fatal but debilitating complaints that reduce the quality of life and eventually threaten the chances of survival. Obesity is a major risk factor for chronic non-communicable diseases such as NIDDM, CHD, and cancer. In many industrialised countries it is associated with various psychosocial consequences as well.

There can be no doubt that obesity is a serious public health problem. It develops gradually overtime and once developed is difficult to treat. Hence, prevention of weight gain offers the only truly effective means of controlling obesity. Obesity is a complex and still poorly understood disease. Its aetiology is the product of an interaction of genetic, biological, and environmental factors. However, the marked increase in the rates of increase in obesity globally cannot be based on biological factors alone. Furthermore, to label obese people as overeaters and/or physically inactive will not solve the problem. In addition, in most developed and some developing countries the general lifestyle and environment encourages sedentary practices conducive to a positive energy balance. This has helped in the development of behavioural changes towards eating and lifestyle in general. The number of fast food outlets have profoundly increased the majority of which provide high fat, energy dense appealing foods. Large sums of money are spent on advertising for food products that are either high in fat, sugar and/or salt. Cars are used for short distances in preference to walking, lifts and escalators instead of the stairs even when only going up one floor.

It has been shown that interventions that have focused on education for behaviour change have had limited success in controlling obesity. Therefore there is a desperate need to re-focus on obesity prevention efforts to ensuré greater attention to producing an environment which supports improved eating and physical activity habits throughout the entire community. This will require a comprehensive and integrated range of strategies. The implementation of such an approach will require the acceptance that the management of obesity is not just the responsibility of individuals, their families or health professionals but requires a commitment from all sectors of society. Until this is achieved, the effective prevention and management of obesity will remain problematic.

To achieve the goal of obesity prevention and management, those responsible for the planning process should be cautious so that young people, and especially girls, do not misunderstand the message and acquire undue fear of fatness and prefer to have slim figures which are pushed strongly by the media. In many societies, an exaggerated focus on thinness has been accompanied by an increased prevalence of eating disorders such as anorexia nervosa and bulimia.

7.1. Obesity in Kuwait

Obesity is an increasingly common health problem in Kuwait. In a cross-sectional study of a randomly selected sample of 327 Kuwaiti females ages between 20-60 years (1997), the mean BMI was 31.8. This mean BMI is categorised as class I obesity according to the latest review of the classification of obesity by WHO (1998). The links between obesity and ill-health are well established (Health Education Authority, 1995; Garrow, 1991) and there is growing evidence that reduction of even small amounts of weight may confer health benefits (Brownell, 1991; Goldstein, 1992). The government should adopt preventive policies, effective plans and recommendations to reduce the prevalence of obesity in the population sub-groups. As a long term objective, these preventive measures will help in the reduction of the associated chronic non-communicable diseases.

7.2. Prevention and Management of overweight and obesity.

7.2.1. Specific Measures for high risk groups

1- This study has shown that returning to pre-pregnancy weight is an independent risk factor to obesity in adult Kuwaiti women. Therefore, attention should focus on preventive plans that can be easily implemented, monitored and assessed in ante-natal and post-natal clinics. In maternity clinics, health educators and dieticians should provide advice on the appropriate weight gain associated with pregnancy, and the health risks associated with any increase in weight above this level. The more the gain in weight, the more difficult will be the efforts to lose the excess weight. The weights of the mothers, ante- or post-natal, should be measured and recorded during each visit. Support and advice should be given to the mothers to prevent any extra increase in weight. Also, healthy food patterns should encouraged stressing the health benefits of maintaining low fat diet, 30% of total energy intake, and increased consumption of fruits and vegetables. Suitable physical activities, such as walking, should be encouraged. Assessment of such preventive plans can be achieved because long term monitoring is feasible.

Mothers should be encouraged to breastfeed by providing information on the proper technique and the health benefits of breastfeeding for the mother and child. Although results of studies conducted on the energy cost of breastfeeding and its association with overweight and obesity has been conflicting, the health and psychological benefits of breastfeeding, both for the infant and the mother, should be emphasised and encouraged. Qualified dieticians with recognised/standardised training programs should be provided at health clinics in general in ante-natal and post-natal clinics. A new policy that prevents the use of breastfeeding substitutes in maternity hospitals must be passed to encourage breastfeeding. The role of the health profession (doctors and nurses) should include support of breastfeeding.

2- The study has not investigated overweight and obesity in children, but we believe that the problem of unhealthy dietary habits and low levels of physical activity start from any early age. Therefore, prevention should be targeted at another important high risk group, children and adolescents. Previous studies have looked at overweight and obesity in children; the results of the study by Eid et al on 4,174 school children aged between 6-17 years, showed that 19 to 27% were overweight. In 1990, Al-Awadi et al demonstrated that 12% of children between the ages of 12-17 years were obese, females more than males. Therefore, preventive plans must start at an earlier age. The school curriculum should include material on healthy dietary habits suited to our environment and applicable in the school environment. The school administration, supported by the education authority, should provide nutritionally adequate snacks in the canteen and in the school shops. Physical education classes should be made compulsory as part of the overall curriculum. Intra-and inter- school sport activities should be initiated and encouraged by the education authorities, and parents support student participation.

7.2.2. General Preventive Measures

Health professionals, together with planners and decision makers, should be fully aware of the problem of obesity, its extent, and last but not least, its associated health consequences. When planning prevention policies, there is a need first to understand why obesity develops, secondly consider the most effective means of dealing with the causes, and finally whether these strategies would be effective. To be able to achieve these goals, a high level committee of health professionals, dietitians, planners, and other health related members of the government should be selected to assess the situation, analyse the most effective means of dealing with it, and set up preventive plans. Sub-groups are then appointed to supervise and monitor the implementation, regularly evaluate its progress, and report to the committee

7.2.2.1 At the government level

Members of the committee should be from different ministries; namely, ministry of education, health, finance, planning, trade, and information. The objectives should include:

Current situation:

a) qualified dietitians and public health educators are extremely limited in hospitals, primary health care centres as well as in diabetic, renal and mother-child care units.

b) the majority of health professionals are reluctant to manage and influence the lifestyle of patients with weight problems.

c) negative attitudes towards obesity and the obese also appear to be present in both the nursing and dietetic professions.

d) the academic standards of the new graduates (dietitians, health educators) is extremely inadequate to meet the standard and demand for managing obese patients and other nutrition related health problems

e) The university has been studying a proposal for setting up a faculty for providing a 4-year degree, or the equivalent, in dietetics and health education but financial resources have always been the limitation.

f) The majority of sport facilities are for men, and the majority are funded by the government. However, the available government funded sports facilities for women are very limited, and the rest are private health clinics.

Improving the situation

a) there is an urgent need for improved training programs of all health care workers involved in the management of obese patients. This is important not only to improve the level of knowledge and skills in the management of obesity but also to help overcome the negative attitude that many health professionals show towards obese patients.

b) the development of co-ordinated health care services for the management of overweight and obesity.

c) Set up a committee to organise and conduct studies to determine the nutrient intake, nutritional status of the population which would eventually determine daily nutrient requirements of the population sub-groups.

d) the development of time-limited plan, e.g. 5-year plan, aimed at reducing the prevalence of obesity and its associated health complications in all age groups.

e) setting up sub-groups to supervise training programs, monitor level of improvement, evaluate progress, report and give recommendations to higher committee.

f) the government should allocate funding to support the various programs and the sub-committees members that run it.

e) the provision of a faculty/college within the university for the appropriate education and training of dieticians, and public health professionals.

SUMMARY AND CONCLUSION

The results of the study of 324 randomly selected adult Kuwaiti women conducted between May 1996 to October 1997 has shown the following:

1- The prevalence of overweight (BMI = 25.0-29.9) and obesity (BMI $\geq$ 30.0) was 27% and 56% respectively. Anthropometric analysis have shown that the mean BMI was 32.0 with a predominantly central (abdominal) fat distribution. The means of WHR, WC, % body fat, and STR were 0.87, 96 cm, 40% and 1.0 respectively.

2- The mean age was 35 years, nearly 75% were married women, more than half were at the medium level of education and two thirds were working women.

3- Univariate and multivariate analysis were used to assess the association between soci-demographic factors (age, occupation, education, and marital status), life style factors (exercise, hours of TV watching/day, home assistant, physical disability), and reproductive and maternal factors (total number of pregnancies, inter-pregnancy interval, return to pre-pregnancy weight, contraceptive pill/ hormone treatment, and duration of breastfeeding) with the risk of weight gain and obesity in this sample of women. The results indicated that only two factors, namely, age ($p= 0.001$) and inability to return to pre-pregnancy weight ($p=0.004$) were independent risk factors for the risk of obesity even after controlling for the other variables and for confounders. WC increased with age ($p<0.001$), and there was a significant relationship with maternal and reproductive characteristics ($p < 0.001$).

4- The results also showed that when participants were asked how they perceived their current weight nearly half underestimated their actual weight and 40% perceived an appropriate weight to be within the overweight category of BMI. Furthermore, more than half the women's perceptions of their husbands' opinion on their weight underestimated their actual weight.

5- In this study, 33% of the participants had osteoarthritis, 28% had hypertension, 18% had NIDDM, and 4% CHD.

CONCLUSION

It is assumed that this study group is representative of the adult Kuwaiti female population. Therefore, the prevalence of obesity in women of 56% is a serious health problem and immediate action needs to be taken by all those concerned in the government. A health committee should be set up to take the responsibility of developing, on a short term and long term bases, a practical and population oriented plan for reducing the prevalence of obesity and its health implications in all sub-groups of the population, especially women and children.

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APPENDICES

Appendix-1

Health Districts in Kuwait

Health District	Selected Health Clinic, With Laboraotry[1], Within Health District	Remaining Health Clinics, Without Labortory Facility, Within Health District
Capital	Faiha, Nuzha, Deaya, Doha	Kaifan, Sahmaya, Rowda, Dasman, Khaldya, Mansourya, Kadsya, Showeik, Dhahya, Sheabe, Bneid Alghar, Odailya
Hawaly	Rumaithya, Salmya, Quorain	Hawaly, Sabah Al Salam
Ahmadi	Fahaheel, Ahmadi, Ruqua	Munquff, Fintas, Mahboula, Meseelah
Farwanya	Fardous, Andalous, Yarmouk, Khaitan, Farwanya, eleeb Shyouk	
Jahra	Jahra, North Sulaibikhat,	Sabbya

1- These health clinics were pre-selected because they had laboratory facilities.

Appendix-2

Random number generation

The numbers were printed on a paper; there were 5 to 6 columns of 6-digit numbers in each paper. The first number of the first column on the left hand side wae the first number to be used. When all the numbers in the same column were used, the first number in the second column was then checked and so on until all numbers have been used and the corresponding files selected. Those numbers that did not match the file numbers were automatically replaced until the precise sample number was completed from that health clinic.

For each health center there were lists of 6-digit numbers. All the numbers used were recorded in a special book for each center. Other information in the book included the contact telephone number, refusal or agreement to be included in the study and the reasons for replacement of a number by another.

Appendix-3

Summary of Selection and Refusal of Subjects

HEALTH DISTRICT CLINIC	TOTAL NUMBER CHECKED	NON-CORRESPONDING FILES	SELECTED FILES	REFUSALS DIRECT	INDIRECT
Farwanyah					
Yarmouk	181	132	11	11	27
Farwanyah	107	75	11	11	10
Jeleeb	736	650	22	16	48
Shyouk					
Fardous	542	396	49	43	54
Khaitan	300	234	20	14	32
Al-Andalous	182	133	16	12	21
Sub-Total	2048	1620	129	107	192
Capital					
Deyah	1154	1099	7	5	43
Nuzha	1974	1880	27	14	53
Doha	311	266	6	8	31
Faiha	590	536	20	8	26
Sub-Total	4029	3781	60	35	153
Hawaly					
Salmeyah	135	112	12	0	12
Rumaithyya	1040	756	49	18	217
Quorain	1080	856	77	31	116
Sub-total	2256	1724	138	49	345
NET TOTAL	8333	7125	327	191	690

Appendix- 4

Registry book

Code	Name	D.O.B.	Tel	R(R1,R2,R 3/OK)	Reason for refusal
12025	K.A.S.	2/5/64	2456680	R2	No interest

1 - Health district code
2 - Health centre code
025 - selected subject number 25, serially coded

R1 - subject refused to participate on telephone
R2 - subject refused to participate after having agreed on telephone
R3 - subject who does not complete all study procedures
R4 - procedures not completed, subject not responsible
OK - If all procedures completed.

Coding for refusal, e.g.
1 - Not interested
2 - No time
3 - etc...
This will be done later on in the study when different reasons for refusal are known.

Appendix-5

Coding of the serial number

The serial number consists of 5 digits. The first digit acts as a code and refers to the health district, the second refers to the heath clinic in the different regions, and the last 3 digits refer to the serial number of the subject. However, only those regions where the clinic facilities have laboratory facility are included in the study. This is the pre-selection criteria for choosing the health clinics.
Each health district is given a number (the first digit), thus;

Capital Health District	1
Hawaly Health District	2
Ahmadi Health District	3
Farwanya Health District	4
Jahra Health District	5

Each clinic in each of the health districts that were chosen to be in the study were also given a number. Therefore, in the example of the Capital Health District; the 4 regions are

Faiha	1
Deaya	2
Doha	3
Nuzha	4

For example, the serial number **13026;**

The digit **1** refers to the Capital Health District. The second digit **3** refers to the health clinic in the region Doha. The last 3 digits **026** refer to the serial number of the subject selected in this region, i.e. subject number **26.**

APPENDIX- 6

Consent Form

Investigator: Dr. Nawal Al Hamad

DETERMINANTS OF OBESITY AMONG ADULT KUWAITI FEMALES AND THE RELATIONSHIP OF OBESITY TO THE RISK OF CHRONIC DISEASE

Main Objectives:

1- To assess the true prevalence of obesity among adult Kuwaiti females aged 20 to 60 years.

2- To determine the identifiable contributing factors that predispose to this high prevalence of obesity among Kuwaiti women.

3- To delineate the characteristics and degree of severity of obesity in this group of women

4- To determine whether this high prevalence of obesity among Kuwaiti women is associated with high blood pressure, diabetes mellitus and an abnormal blood lipid profile.

I have read the information sheet concerning this study and I understand what will be required of me if I take part.
My questions concerning this study have been answered by the study investigator Dr. Nawal Al Hamad.
I understand that any time I may withdraw from this study without giving a reason and without affecting my normal care and management.
I agree to take part in this study.

Name and signature of participant: ....

Appendix-6

The Questionnaire

DETERMINANTS OF OBESITY IN ADULT KUWAITI FEMALES AND THE RELATIONSHIP OF OBESITY TO THE RISK OF CHRONIC DISEASES

In this study we are investigating the reasons why the prevalence of obesity is high in Kuwait and *trying to identify* the contributing factors. This questionnaire asks about your health and physical activities and some general questions about your background.

All your answers will be kept strictly confidential; they will be be used for statistical analysis. It will not be possible to identify individuals in any published results.

NAME: --

HOME ADDRESS: ---------------------------------------

TEL (HOME/OFF): -------------------------------------

DATE OF BIRTH: (___) (___) (___)
day month year

SECTION 1. SOCIODEMOGRAPHIC CHARACTERISTICS

Serial Number 1 to 5

1- Occupation
1- House wife, 2- Civil Servant, 3- Professional
4- Retired, 5- Student 6
6- Teacher, 7- Other

2- If retired, what was your previous job?
1- Civil Servant, 2- Professional
3- Teacher, 4- Other 7

3- Marital status
1- Single, 2- Married, 3- Divo 8

4- Level of education
1- Illiterate, 2- Primary, 3- Se 9
5- intermediate, 6- diploma

5- Family income (KD/month)
___________ KD 10 to 13

Do any of the first degree relatives (parents/siblings) suffer from CHD, DM, hypertension, or obesity?
6- Father

a- CHD		14
b- DM		15
c- Hypertension	1-	16
d- Obesity	1	17
e- Dead/ Alive	1-	18

7-Mother

a- CHD		19
b- DM		20
c- Hypertension	1-	21

d- Obesity 22
e- Dead/ Alive 1 23

8- Do any of your brothers or sisters, dead or alive, suffer or suffered from:
a- CHD 24
b- DM 25
c- Hypertension 1- 26
d- Obesity 1 27

9- Do you think you are
1- underweight, 2- normal weight, 3- overweight,
4- obese, 5- very obese 28

10- What weight do you think is appropriate for you?
.... Kg
29

11- What does your husband think of your weight?
1- underweight, 2- normal weight, 3- overweight,
4- obese, 5- very obese 30

12- Have you gained weight after marriage?
1- Yes, 2- No 31

13- If yes, how much weight in (Kg) did you gain after marriage?
1- > 5kg, 2- 5-10 Kg, 3- > 10Kg
32

14- In your opinion what is the reason behind putting on weight?
1- marriage, 2- Pregnancy, 3- Overeating, 4- Not enough exercise, 5-Both 3&4, 6- Have always been obese
33

15- What is the average weight you usually gain during pregnancy?
1- No gain, 2- >10 Kg, 3- 10-15 Kg, 4- >15 Kg
34

16- After delivery, are you able to return to your original weight before pregnancy?
1- Yes, 2- No
35

17. If yes, what contributed to your return back to your original weight?
1- Exercise, 2- Going on reducing diet, 3- 1&2,
4- Returned naturally, 5- Hou 36

18. Do you smoke?
1- Yes, 2- No, 3- Ex- smo 37

19. What do/ did you smoke?
1- Cigarettes, 2- Hubble bub 38

20. How many cigarettes pe 39
1- < 5, 2- 5 to 10, 3- 10 to 20, 4- > 20

21. For how long have you been smoking?
1- < 1 month, 2- 3 months t 40

SECTION 2. HEALTH

22. How do you categorize your health status ?
1- Very good, 2- Good, 3- A 41

23. How often did you see a doctor last year?
1- never, 2- 1 to 3 visits, 3- 3 to 5 visits, 4- > 5
42

24. Are you suffering from high blood pressure?
1- Yes, 2- No 43

25. If yes, are you on treatment for high blood pressure?
1- Yes, 2- No 44

26. Are you diabetic? 45
1- Yes, 2- No

27. If yes, are you on treatment for diabetes mellitus?
1- Yes, 2- No 46

28. Have you ever been told by a doctor that you had heart trouble ?
1- Yes, 2- No 47

29. What did the doctor say it was ?
1- Acute MI, 2- Angina, 3- H 48
Please specify

30. For how long have you been diagnosed?
1- > month, 2- 3 months to 1 49

31. Do you suffer from bronchal asthma?
1- Yes, 2- No 50

32. Do you suffer from duodenal/gastric ulcer?
1- Yes, 2- No 51

33. Do you suffer from arthritis?
1- Yes, 2- No 52

34. Do you suffer from gall bladder stones?
1- Yes, 2- No 53

35. Do you suffer from other health problems?
1- Yes, 2- No, 3- I dont know 54

36. Have you been operated on?
1- Yes, 2- No 55

37. If yes, what ?
1- Appendectomy, 2- Cholecystectomy,
3- Abdominal hernia, 4- Pep 56
5- other, please specify _________, 6- Tonsillectomy
7- Hemorrhoids, 8-Cesarian section,9- Hystrectomy

38. Are you taking any other medication (not oral contraceptive, antihypertensive, OHG, insulin, or hormones) either prescribed by a doctor or something that you buy yourself?
1- Iron, 2- MVT & minerals, 3- Thyroid tablets, 4- Aspirin,
5- Allergy tablets, 6-Antibodies, 7- Other

57

SECTION 3. PHYSICAL ACTIVITY

39. Do you do regular exercise in addition to daily living activities?
1- Yes, 2- No 58

40. If yes, what type of exercise do you do?
1- Walking, 2- Jogging, 3- Swimming, 4- Other
5- Aerobics 59

41. Do you do another specific type of exercise?
1- Yes, 2- No

60

42. If yes, please specify
1- Walking, 2- Jogging, 3- Swimming, 4- Other
5- Aerobics 61

43. Do you have any physical disability which hinders you from practicing exercise?

1- Yes, 2- No

62

44. How many hours/week, on average, do you spend watching TV?
________ hours

63 64

45. Do you have someone to assist you with the housework?
1- Yes, 2- No 65

46. How many hours per day on average do you spend doing the house work?
_______ hours 66 67

47. How many hours per week, on average, do you exercise?
____________ hours

68 69

SECTION 4. MATERNITY

48. Age at marriage in years
____ Yrs
99- I don't know 70 71

49. What is/was the interval, in months, between marriage and becoming pregnant?
1-< 1 month, 2- 3 to 6 months, 3- 6 months to 1 year
4- >1 year, 9- I don't know 72

50. What is the average interval, in months, between repeated pregnancies? (work out from children's ages and miscarriages if the mother is unclear)

1- 2 months, 2- 3 to 6 mon 73
4- > 1 yr, 5- I don't know

51. What is the average gain in weight, in Kg, during each pregnancy?

a- ___	kg 1st pregnancy	74/	75
b- ___	kg 2nd pregnancy	76/	77
c- ___	kg 3rd pregnancy	78/	79
d- ___	kg 4th pregnancy	80/	81
e- ___	kg 5th pregnancy	82/	83
f- ___	kg 6th pregnancy	84/	85
g- ___	kg 7th pregnancy	86/	87
h- ___	kg 8th pregnancy	88/	89
i- ___	kg 9th pregnancy	90/	91
j- ___	kg 10th pregnancy	92/	93

52- During pregnancy did you suffer from Diabetes Mellitus?
1- Yes, 2- No , 9- I don't know

53- What is the birth weight of your children?

a- First	____ kg	94
b- Second	____ Kg	95
c- Third	____ Kg	96
d- Fourth	____ Kg	97
e- Fifth	____ Kg	98
d- sixth	____ Kg	99
e- Seventh	____ Kg	100
f- Eighth	____ Kg	101
g- Ninth	____ Kg	102
h- Tenth	____ Kg	103
i- Eleventh	____ Kg	104
i- Twelvth	____ Kg	105

54. Do you think increasing your weight improves the course of the pregnancy?
1- Yes, 2- No, 9- I don't k 107

55. Did you have any food cravings during any of your pregnancies? If yes, what?
1- Salty foods (pickles), 2- Sweet foods, 3- Other
Please specify ______________ , 4- No cravings
5- Fruits, 6- Dairy products,7- fish
8- Meat, 9- I dont know 108

56. Are you on hormone (estrogen, progesterone) therapy?

1- Yes , 2- No

57. Is the menstrual period r 109
1- Yes, 2- No, 3- Stopped

58. At what age did the monthly period completely stop?
________ yr. 110/ 111

59. Did you experience any 112
1- Yes, 2- No

60. Did any of the new borns have any diseases or accidents at birth?
1- Yes, 2- No 113

61. What is the number of pregnancies that you had?
______________ 114/ 115

62. Are you on the contracep 116
1- Yes, 2- No

SECTION 5. BREASTFEEDING PRACTICES

63. How long (in months),on average, did you breastfeed your children?
_____________ months 117 118

64. How long do you think a mother should breatfeed her child?
_____________ months 119

65. In your opinion, breast m 121
1- more nutritional, 2- the same, 3- less nutritional
than bottle milk for the child.

66. What are your source(s) of information on breastfeeding?

1- Mother, 2- Friends, 3- TV/ magazines
4- Books/education, 5- Other, specify ________
6- Doctor, 7- Experience 122

67. Following the first delivery, what were your feelings towards breastfeeding prior to initiation? 123
1- Anxiety, 2- Shyness, 3- Confidence, 4- Inconvenience
5- Other, specify____________ 9- I don't know

68. Did you experience any problems with the initiation of breastfeeding?
1- No problems, 2- Pain, 3- Poor flow, 4 - Other,
5- Cracked nipple, 6- Mastiti 124
7- Inverted nipple

69. What effects did breastfeeding have on you?
1- Physically tiring, 2- Loss of weight, 3- Breast engorgement or to sag, 4- Other, 5- Gain weight, 6- Insufficient flow
7- Embarrasment 125

70. Are you aware that breastfeeding has a contraceptive effect?
1- Yes, 2- No, 9- I don't 126

71. Are you aware that weight gain during pregnancy is partly for breastfeeding?
1- Yes, 2- No, 9- I don't k 127

72. Are/were there special groups of foods consumed (e.g. to increase milk flow) during lactation?
1- Yes, 2- No
If yes, 3- Dairy milk. 4- Veg/fruits, 5- carbohydrates,
6- Meat group, 7- liquids, 9- 128

73. The source of advice to consume these special foods is from
1- Mother, 2- Friends, 3- TV, magazines
4- Formal education, 5- Other, 6- Doctor, 7- Experience,
8- Family, 9- Dietitian 129

74. Are/were there special groups of foods avoided (e.g. that affect milk flow)

during lactation?
1- Yes, 2- No, 3- Hot chllis, pickles, spices, onion
4- legumes, 5- Tea, coffee, Fizzy drinks,
6- fruits, veg, juices, 7- Wate 130
8- Fish, 9- Meat, 10- Other (sweet, rice, laban
eggs, lemon)

75. The source of advice to avoid these special foods is from
1- Mother, 2- Friends, 3- T 131
4- Formal education, 5- Other, specify ________

SECTION 6 - DIET

76-How often do you eat red meat?
1- Every day, 2- 3 to 6/week, 3- 1 to 2/week
4- Rarely or never, 9- I don 132

77- What do you normally use for cooking?
1- Vegetable oil, 2- Ghee/b 133

78- Do you regularly use
1- Full cream milk 134
2- Half cream milk
3- Skimmed milk

79- How often do you eat sw 135
1- Every day, 2- 3 to 6/week, 3- 1 to 2/week
4- Rarely or never, 9- I don't know

80- How often do you eat fruits and vegetables?
1- Every day, 2- 3 to 6/week, 3- 1 to 2/week
4- Rarely or never, 9- I don 136