PREVALENCE OF DIABETES MELLITUS, IMPAIRED GLUCOSE TOLERANCE AND CORONARY HEART DISEASE IN ADULT BAHRAINI NATIVES AND THEIR ASSOCIATION WITH RISK FACTORS

THE RESULTS OF A CROSS-SECTIONAL SURVEY DIABETES AND HEART HEALTH IN THE STATE OF BAHRAIN IN 1995

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by

FAISAL JAFFAR AL-MAHROOS

Epidemiology Unit
Department of Epidemiology and Population Sciences
London School of Hygiene & Tropical Medicine

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DEDICATION

This thesis is dedicated jointly to my loving wife Nawal Al-Shaker who has stood by me through all burdensome times giving me both love and support, and to my dear kids Ali, Mariam and Amal Al-Mahroos.

Statement of Authorship

The original idea for the study presented here came from the author of this thesis. With the support of his supervisor in all stages of the research, the author was responsible for the design of the study and development of data collection instruments. The author was personally involved in all the procedures performed in the fieldwork, by accompanying the fieldworkers to the study participants on a regular basis, supervising the preparations for the daily fieldwork, checking the work done by the whole team at the end of each day, and preparing collected material for dispatch to the laboratory. The author also assisted in the laboratory work. The entry of clinical and laboratory data, the cleaning of all data files, and the analysis of this study were all performed by the author. The interpretation of the results of the study and writing up of this thesis were also responsibility of the author of this thesis

ABSTRACT

Background:- Coronary heart disease (CHD) and non-insulin-dependent diabetes (NIDDM), appear to be common in the Arabian Peninsula, although reliable cause-specific mortality and prevalence data are not available. This study aimed to determine the prevalence of diabetes and CHD in Bahraini natives and associations with risk factors. The specific hypothesis to be tested was that diabetes and other metabolic complications of obesity would account for high CHD rates in this population.

Objective:- To determine the prevalence of cardiographic abnormalities and diabetes, and to evaluate the association between these abnormalities and the level of diabetes and CHD among Bahraini native population.

Design:- Total community cross-sectional survey with questionnaire, physical examination, and electrocardiography.

Main outcome measures:- Prevalence of diabetes and ischaemic abnormalities on electrocardiogram.

Methods and Results:- A systematic random sample of 1245 men aged 40-59 years and 883 women aged 50-69 years. was studied. Subjects were invited to the clinic for interview, physical and laboratory examinations. Venous blood samples were taken fasting and 2 hours after a 75 g oral glucose load. Mean body mass index was 27.3 kg/m2 in men and 28 kg/m2 in women. Only 13% of men and 1% of women walked at least 4 km/day. BMI was positively related to Sunni Arab ethnic origin, educational status and number of hours spent watching television, and inversely related to physical activity at work. Most obese participants did not rate themselves as overweight.

The overall prevalence rate of diabetes was 30%. In the age group 50-59 years prevalence was 29% in men and 35% in women. Prevalence of diabetes was lower in Shi'ite Arabs and Iranians than in Sunni Arabs: the odds ratio for diabetes in Shi'ite versus Sunni Arabs was 0.48 in men and 0.22 in women. Plasma cholesterol was 0.4 mmol/l higher in diabetic than in non-diabetic individuals, even after adjusting for obesity. In a multivariate logistic regression analysis adjusting for age, diabetes was associated with Sunni Arab origin, positive family history, obesity and raised plasma cholesterol in both men and women. In women post-menopausal status was an independent risk factor.

Prevalence of major Q waves (Minnesota codes 1-1 or 1-2) on ECG was 2.8% in men aged 40-59 years. Major Q waves were associated with smoking, hypertension and positive family history of CHD but not with diabetes or with plasma lipids. Positive family history of CHD was however associated with higher plasma cholesterol and triglyceride, and with lower HDL cholesterol. Associations of CHD with ethnic origin were accounted for by adjusting for smoking and plasma cholesterol.

Conclusion:- Prevalence of NIDDM in Bahraini natives is among the highest in the world. Obesity and physical inactivity do not fully account for the high rates in Bahrainis compared with Europeans, or for the ethnic difference. The association of NIDDM with raised cholesterol is an unusual finding which suggests that disturbance of both carbohydrate and lipid metabolism may be present in this population. The high prevalence of NIDDM is likely to result from an interaction of genetic susceptibility with environmental factors.

Prevalence of CHD is higher than in similar surveys in the UK. The lack of association of CHD with raised plasma lipids and diagnosed diabetes in this study may be because of the limitations of a cross-sectional study. The association of positive family history of CHD with raised triglyceride and cholesterol suggests that these risk factors would predict CHD in a prospective study.

On the basis of these findings, recommendations are made for measures to prevent and control NIDDM and CHD in Bahrain. Obesity is the most important target variable to control to prevent NIDDM. Measures to increase physical activity and to communicate awareness of the health consequences of obesity might help to achieve this. To reduce the risk of CHD, measures to discourage smoking, lower plasma cholesterol and improve control of hypertension are needed, especially for people with diabetes.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

CHAPTER 2

CHAPTER 6

CHAPTER 8

LIST OF ABBREVIATIONS

AMI	Acute myocardial infarction
ARs	Admission rates
BD	Bahraini Dinar
BMI	Body mass index
BP	Blood pressure
CFRs	Case fatality rates
CHD	Coronary heart disease
CI	Confidence interval
CVD	Cardio vascular disease
DM	Diabetes mellitus
ECG	Electro cardio gram
FBS	Fasting blood sugar
GCC	Gulf Co-operative Council
HDL	High density lipoproteins
ICD	International Classification of Diseases
ICU	Intensive care unit
IDDM	Insulin dependent diabetes mellitus
IHD	Ischaemic heart disease
Kg	Kilogram
LBBB	Left bundle branch block
LDL	Low density lipoproteins
MI	Myocardial infarction
MLR	Multiple logistic regression
NA	Not available
NIDDM	Non insulin dependent diabetes mellitus
OR	Odds ratio
P	Proportion
PHD	Public Health Directorate
P-value	Probability
SD	Standard deviation
SE	Standard error
SMC	Salmaniya Medical Centre
TC	Total cholesterol
UAE	United Arab Emirates
UK	United Kingdom
WHO	World Health Organisation
WHR	Waist hip ratio
WHTR	Waist height ratio

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The studies illustrated here were arranged and designed with Dr Paul McKeigue, who was my supervisor throughout this work and first persuaded me to investigate the epidemiology of diabetes and coronary heart disease in Bahrain. I was very fortunate to have been supervised by him, from 1994 until submission of this thesis, who gave me priceless scientific foundation. To him I am indebted, for his meticulous supervision and guidance in my thesis.

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Chapter 1

INTRODUCTION

1.1 INTRODUCTION

Coronary heart disease (CHD) has become a major health problem in Bahrain and other Arabian Peninsula countries. Although reliable data on trends in mortality are not available, it appears that CHD is becoming more common in the developing world (Dadu 1988).

Improvements in nutrition and living standards in developing countries have led to a decline in the importance of communicable diseases (Omran 1971), and a transition to increasing morbidity and mortality caused by chronic non-communicable diseases (Jamison and Mosdy 1991), the so-called "epidemiological transition".

The challenge is to develop strategies to prevent the emergence of an epidemic of cardiovascular diseases (CVD) similar to that in more industrialized countries. The first step is to examine current levels of mortality, morbidity and risk factors among populations in the developing world.

This information can be used as a baseline against which future trends in mortality and risk factor levels can be assessed, and to define possible preventive strategies. In the Arabian Peninsula, Bahrain and Kuwait are the only countries reporting adult cause-specific mortality data to the World Health Organization (WHO 1990).

The risk factors associated with CHD have been examined in various epidemiological studies in the Arabian Peninsula (Al-Owaish and Mathew 1982; Hamadeh 1993; Ahmed et al. 1993; Amine et al. 1988). Most of the information available is based on hospital case series, rather than on community-based studies.

During the last 30 years, several studies on the prevalence of diabetes in various ethnic and age groups of men and women have been published. Reported prevalence ranges from 0.02% (Mouratoff et al. 1969; Sagild et al. 1966) to about 40-50% (Bennett et al. 1971; Zimmet et al 1976).

The highest prevalence has been found in populations that, within a few generations, changed in food habits and socio-economic standard in combination with less physical activity. By such a new lifestyle an earlier hidden, genetic tendency for diabetes seems to have been unmasked (Zimmet 1982).

Diabetes mellitus has become a major health problem in Bahrain and other Arabian Peninsula States (Bahrain Health Information Center 1992; Al-Owaish and Mathew 1978; Al-Roomi et al 1994). Few studies have been published about diabetes among population of Arabian Gulf States.

Diabetes appears to be more common in metropolitan than in rural people (Al-Owaish and Mathew 1978; Musaiger and Abdulaziz 1986). Diabetes mellitus is an important risk factor for coronary heart disease CVD, and the death rates from diabetes are not known among patients from Bahrain and other Gulf States. On the other hand, mortality rate from CHD has shown an increase and is now the leading cause of death among adults in Bahrain and Kuwait (WHO 1990; Bahrain Health Information Center 1992; Al-Mahroos 1992).

1.2 DEMOGRAPHY OF BAHRAIN

The State of Bahrain, loosely means 'two seas', consists of a group of islands with a total area of approximately 693.5 square kilometers. It lies roughly halfway down the Arabian Gulf (Fig 1.1). On its west, about 24 Km a way is the linked to Bahrain through a causeway. To Bahrain's south is the western coast of Qatar peninsula. The main island of Bahrain is covering an area of 595 square kilometers. Manama, the capital of Bahrain, is to the north-east of the island and is linked with the island of Muharraq on the north east and with the island of Sitra on the east coast by two separate causeways.

The State of Bahrain declared independence in 1971. Since then the country has made rapid economic progress under the leadership of H.H. Shaikh Isa Bin Salman Al-Khalifa, the Amir of Bahrain. Islam is the dominant religion. Though Shi'ite Muslims make up more than two-third of the population (Shi'ite 70% and Sunni 30%) (Arab Net. 1996).

1.2.1 History of Bahrain

Bahrain was once part of the ancient civilization of Dilmun and served as an important link in trade routes between Sumeria and the Indus Valley as much as 5000 years ago. Since the late 18^{th} century, Bahrain has been governed by the Al-Khalifa family, which created close ties to Britain by signing the General Treaty of Peace in 1820.

A binding treaty of protection, known as the Perpetual Truce of Peace and Friendship, was concluded in 1861 and further revised in 1892 and 1951. This treaty was similar to those entered into by the British Government with the Persian Gulf principalities. It specified that the ruler could not dispose of any of this territory except to the United Kingdom and could not enter into relationships with any foreign government other than the United Kingdom without British consent.

The British promised to protect Bahrain from all aggression by sea and to lend support in case of land attack. After World War II, Bahrain became the center for British administration of treaty obligations in the lower Persian Gulf. In 1968, when the British Government announced its decision (reaffirmed in March) to end the treaty relationships with the Persian Gulf Sheikdoms, Bahrain joined the other eight states (Qatar and seven Trucial Sheikhdoms, which are now called the United Arab Emirates) under British protection in an effort to form a union of Arab emirates.

By mid-1971, however, the nine sheikhdoms still had not agreed on terms of union. Accordingly, Bahrain sought independence as a separate entity and became fully independent on August 15, 1971, as the State of Bahrain (Arab Net 1996).

Bahrain, or Dilmun as it was known in antiquity, has always been, because of its strategic position and its plentiful freshwater springs, an important trading center. The Bahrain of the twentieth century complements the rich heritage of the past. The famous Bahraini natural pearl industry was eclipsed by the Japanese artificial version at about the same time oil was discovered in the Gulf in Bahrain. The first Bahrain oil well still to be seen today, came on stream in 1932.

Some of the major achievements of Bahrain are the reduction of its dependence on oil production and development of a large workforce skilled in diverse fields. Hence the economy of the State is not entirely dependent on oil production. Bahrain has diversified industrial base and is a major banking center in the region with a large number of reputed international banks having their offshore banking services on the island. The country is served by an excellent telecommunication system which offers services both in the voice and data communications area.

The archipelago of Bahrain has increased its population size 5 times within the last 50 years. Its annual population growth rate is 3.5%. Its 508,037 inhabitants live on 406 sq. km, for a population density of 731 persons/sq. km. Despite high population growth, Bahrain has maintained a balance between population and development (International Conference for Population and Development 1994).

It is experiencing high fertility and low mortality, placing it in the second stage of the demographic transition. Considerable immigration contributes to the high population growth. Even though Bahrain has a large population size, housing is not a problem. Illiteracy has dropped to 21% from 61% in 1971. Public education is available to both males and females.

The government supports and encourages women to become part of the labor force to implement progress of the economy of the state. Bahrain raises little of its own food and is very dependent on food imports. Its inhabitants consume a good amount of fish, milk, eggs, and meat. Most women (56%) in Bahrain use contraception. The government acknowledges problems that may arise due to its high population growth.

The government supports development programs emphasizing education and women's role in socioeconomic development. Bahrain's rapid economic and technological development and diversification during the 1970s required a large supply of foreign workers. In this population, there are four ethnic groups: two ethnic groups within the Islamic religion denomination (Sunnis, and Shi'ite), and two ethnic groups by race (Arab and Iranian roots). The modern history of Bahrain begins in 1783 with the establishment of the Al Khalifa shaikhdom in the islands (Al-Khalifa AK and Rice M 1993). The Al Khalifa shaikhdom that came to be established in Bahrain in 1783 was an Arab principality like so many others that arose at the time to fill the political vacuum left behind by the recession of Ottoman or Persian imperial power.

The Al Khalifa family decent from Anaza tribes in the Central Arabia, and they are part of the Utub coalition. Among these Utub were the Al Khalifa and their tribal followers (Sunni Arabs), who established a first base for themselves in the Qatar peninsula before they proceeded to secure a firmer base in insular safety of Bahrain.

Bahraini natives are classified into four groups:

i) Sunni Arabs:

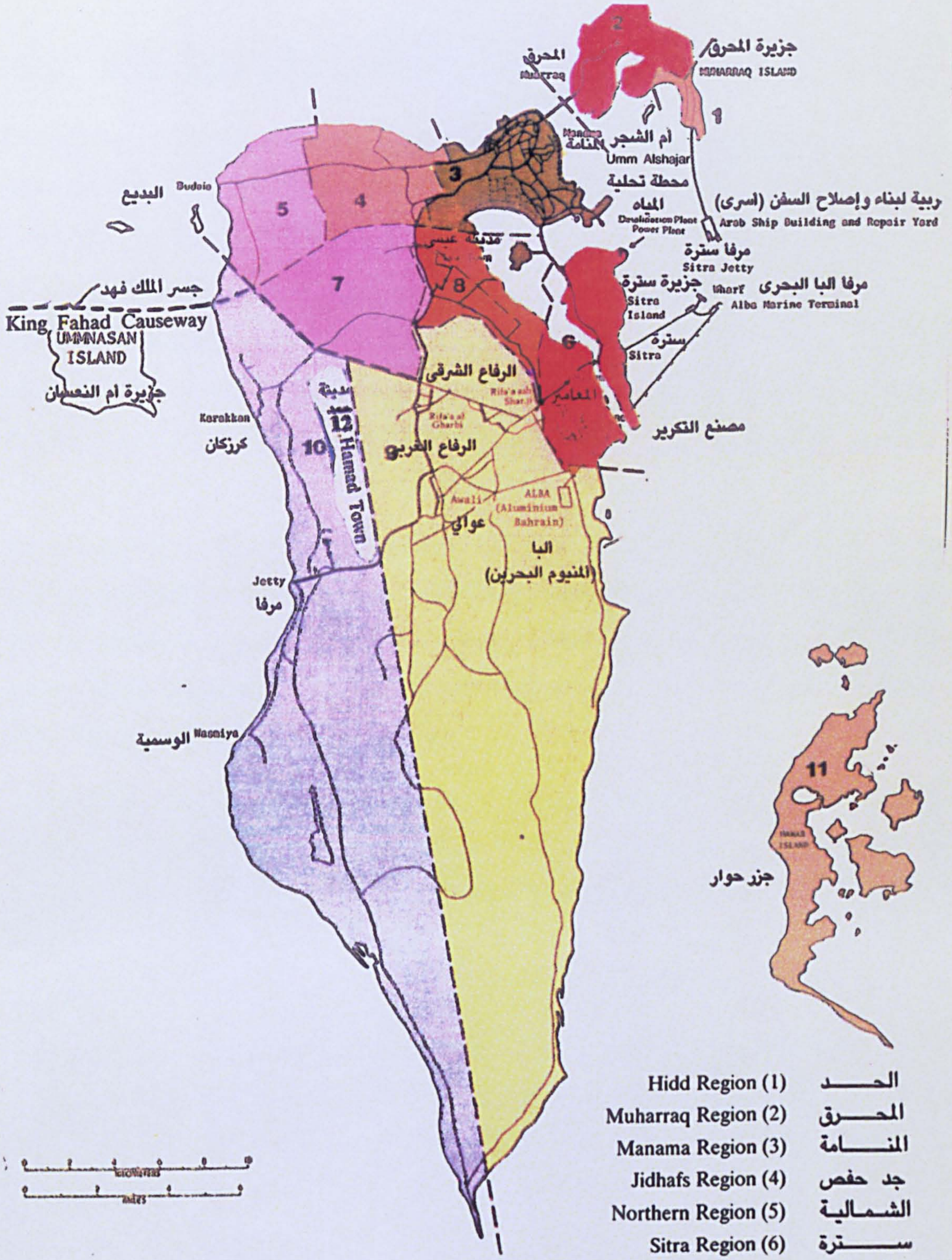
The native Bahraini population consists of two main ethnic groups: Sunni and Shi'ite, the Sunni are two groups also: the Sunni Arabs who descend from Arabian Peninsula (Dickson HP 1956), and the Utub who migrated out of central Arabia in the late seventeenth century to Bahrain.

ii) Shi'ite Arabs:(Al-Baharnah)

The Shi'ite group of the population of Bahrain (The Baharnah) described in the past by Ibn al-Mujawir (7th/13th century) states that on the island that he calls Uwal there were 360 villages, all but one being Imami Shi'ah (Al-Mujawir IB 1962). In a paper given at the Arabian Seminar in 1979, M.A. Taajir makes out a case for descent of the Baharnah from the Arab Banu Abd al-Qays of Rabiah (Amin A 1967).

iii) Iranian:

The Iranian migrated during the 20th Century. Most are Sunni (Al-Huwala) but minority are Shi'ite.



Hidd Region (1)	الحـــد
Muharraq Region (2)	المحـــرق
Manama Region (3)	المنـــامة
Jidhafs Region (4)	جد حفص
Northern Region (5)	الشـمـالية
Sitra Region (6)	ســـترة
Central Region (7)	الوسـطى
Isa Town Region (8)	مدينة عيسى
Riffa Region (9)	الرفـــاع
Western Region (10)	الغـــربية
Hawar Islands (11)	حـــوار
Hamad Town (12)	مدينة حمد

Figure 1.1 Map of the State of Bahrain with all regions defined in this study

1.2.2 The health care system in Bahrain

The health care system in Bahrain is comprehensive, free of charge, and easily accessible health services serve all citizens and residents in the Island. The Government of Bahrain is strongly committed towards achieving "Health for all" by the year 2000.

The Ministry of Health has adopted the strategy and policies of "primary health care" (PHC) as the tool for achieving health for all. The extensive network of health centers provides a wide variety of services, such as curative and preventive services, family orientated services, community health, immunization, family planning, drug allocations, disease control, school health, health education and dentistry.

Maternal health services have contributed to low maternal mortality levels. Life expectancy at birth is around 73 years. Some of the experiences in developing a system of PHC in Bahrain are reviewed. In November 1968, the first consultant for health planning came to Bahrain. Many of his far sighted visions continue to be applicable today. The plan covered the 1968-85 period.

It was defined as the responsibility of the State in order to ensure the availability of health care to everyone in the country. The second consideration was financing. A first step has been taken to impose a type of insurance premium on all companies that have more than 50 employees to pay a small yearly fee per individual for what is termed primary health care. The income generated from this constitutes 10% of the budget toward health care.

Now, having generated some earnings, it is time for the government to become more generous. The third consideration was the provision of comprehensive health care. The State of Bahrain must be responsible for all stages of health care delivery: primary, secondary, and tertiary.

To provide good tertiary care, it is necessary to coordinate activities with neighboring countries in the Gulf area. The fourth area of concern involved shifting the emphasis from the individual to the family as a social unit. This was an important shift. Since the family was taken as a unit, it was felt that PHC must be comprehensive, taking into consideration the needs of men, women, and children, and their interrelationships and their environment.

The following personnel are being incorporated into the health center: public health inspectors, public health nurses, and health educators. Future plans include the Salmaniya Medical Center becoming a teaching center. To expedite this program, a new curriculum is being expedited. Family physicians are the ones that can make health care succeed or fail, especially in the future when resources may be limited and PHC will have to encompass more than it does today. A goal is to integrate Bahrain fully into the Gulf region so that the patient feels that the whole region provides his/her medical care.

1.2.3 Demography of Arabian Peninsula

The population of the Arabian Peninsula is about 24 million (Bahrain Central Statistical Organization 1992). Expatriates form one third of the total population and most of them are males from south Asia and far eastern countries (Fig 1.2). In the early 1980s, the six Arabian Gulf States (Bahrain, Kuwait, United Arab Emirates, Qatar, Oman and Saudi Arabia) founded a Cooperative Confederacy to cooperate in political, economic, social, military and health care. This is known as the "Gulf Cooperative Council" (GCC).

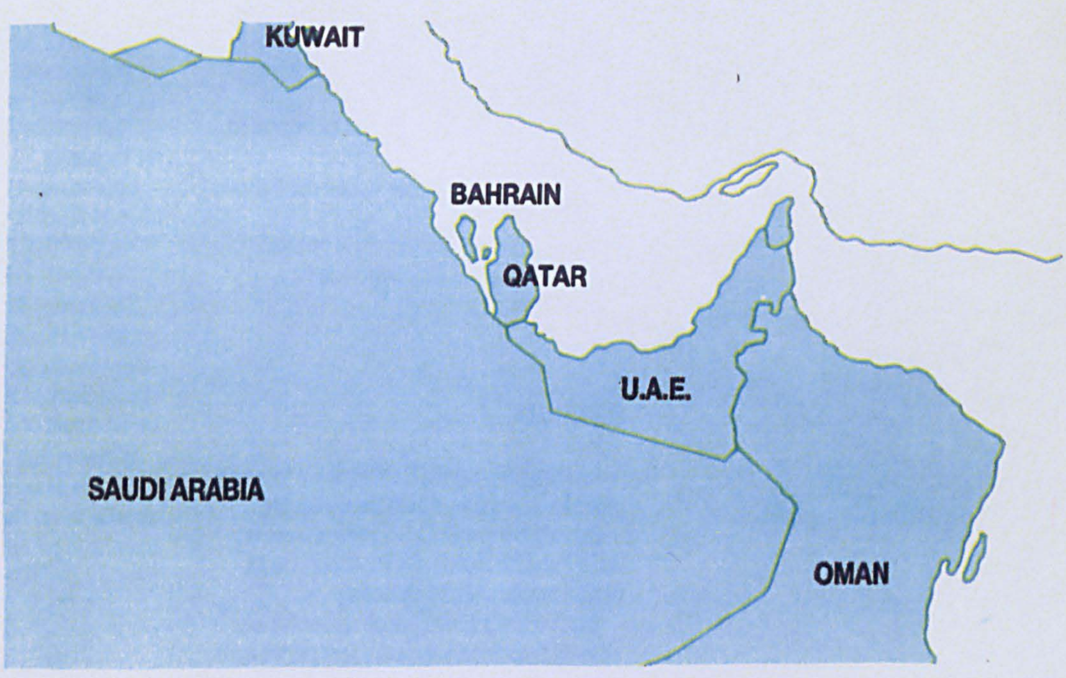


Figure 1.2 Map of the Arabian Peninsula States

The discovery of oil in the Gulf region led to rapid changes in socio-economic conditions and pattern of life. The tremendous changes in the quality of education and health have been influential effect on the trend of mortality rates in these countries. Crude mortality rates in the Arabian Peninsula reported from 1960 to 1992 show rapid declines (Table 1.1).

Table 1.1 Crude death rate per 1000 population in the Arabian Peninsula countries

Country	Death rate per 1000 population 1960-1964 (%)	1980-1984 (%)	1990-1992 (%)
Kuwait	9.0	4.1	2.2
Bahrain	13.8	5.8	3.9
Qatar	16.7	9.2	3.9
United Arab Emirates	17.3	7.1	3.9
Oman	26.1	16.7	4.9
Saudi Arabia	21.3	12.6	4.9

1.2.4 Socioeconomic development of Bahrain

For centuries pearl fishing was the main economic activity in Bahrain. Then, in 1932, after several years of landscape, oil was discovered. By 1938, the small island country was the 12th largest oil producer in the world. Since then the economic life of the country has been changed.

The discovery of oil in the 1930s gave Bahrain a headstart which enabled it to launch schemes for economic diversification and social betterment well before the other Gulf States. Beginning with building materials, Bahrain then proceeded to manufacture paper, petro-chemicals, aluminum and clothing.

Bahrain is also a major center for financial, banking, and other services in the region. The Bahrain installations of ship repairing and engineering are among the largest and most advanced of their kind in the world, providing repair facilities for ships of every heaviness playing the waters of the Gulf. In recent years, great strides have also been made to expand the agricultural sector and to revive the pearl fishing industry.

Aspects of demographic transition and migration in Bahrain are examined (Deming et al. 1980). The study of population in Bahrain benefits from censuses taken since 1941 and relatively good statistics on birth and migration in recent years. The level of development in Bahrain is found to have been sufficient to stimulate a fertility decline.

Comparing these results with the influence of family planning programs, it is found that family planning services had low visibility and government policies on most population issues were during the 1965-1976 period. Bahrain's island status and small physical population may influence perceived limits of growth.

Despite a decline in agriculture and a declining water table, these ecological factors do not appear to have limited growth during 1965-1976. Immigration added substantially to the native Bahraini population to fill the labor force needs of the country during the 1970s. The country's location, its maritime tradition, and its increasing role as a communications and service center have made Bahrain a cosmopolitan place. This cosmopolitan character, rather than the island's physical limitations, may have facilitated the demographic transition. Extensive migration to Bahrain is responsible for an increasing proportion of population growth and complicates the analysis of mortality and fertility.

Although the rate of natural increase has been declining in Bahrain, the advantages of slower growth have been delayed by the net immigration of foreigners. The case study of Bahrain illustrates the importance of economic and social development for demographic change and the need to consider immigration for a complete understanding of population trends.

1.3 NATURE OF CARDIOVASCULAR DISEASES AND DIABETES

1.3.1 Cardiovascular diseases

Cardiovascular diseases (CVD)taken together account for a major proportion of all deaths during adulthood in both developed and developing countries. The global burden of disability and death attributable to cardiovascular diseases in adulthood is enormous (WHO 1983). In the developing countries, CVD account for a smaller proportion of all deaths than in the developed ones, but the greater contribution of cardiovascular deaths in developing countries to mortality worldwide means that the total number of deaths from these diseases is even greater there than in the developed countries.

The broad categories of conditions of concern include atherosclerotic CVD especially CHD and cerebrovascular disease. Severe atherosclerosis, together with its complications, is the pathological process that underlies most cases of CHD and its alterable manifestations, including sudden deaths, myocardial infarction, stable and unstable angina pectoris, congestive heart failure, and other major disturbances of cardiac function.

As repeatedly emphasized by WHO, coronary heart disease in particular, in the second half of the Twentieth Century, has become epidemic in most industrialized countries and moreover threatens to overwhelm the developing ones.

Cardiovascular disease, cancer, and other non-communicable diseases account for an increasing proportion of deaths (Table 1.2). Remarkable decline on symptoms, sign, ill-defined conditions started from 1974 up to 1992. Improvement in primary health care, and immunization coverage have been effective in prevention and control of communicable diseases.

Table 1.2 Common leading causes of mortality for all ages in Bahrain from 1974 to 1992.

Year Diseases	1974 (%)	1979 (%)	1982 (%)	1985 (%)	1990 (%)	1991 (%)	1992 (%)
Circulatory	29	26	33	34	31	30	31
Respiratory	12	6	6	6	7	9	7
Injury	11	13	12	10	8	8	8
Neoplasm	8	10	9	12	12	10	11
Digestive	8	2	2	3	3	3	3
Infectious	6	6	2	2	1	1	1
S,S,ill-defined*	21	18	19	17	9	10	8

Source: from Directorate of Public Health in Bahrain
****Symptoms, Signs, Ill-defined conditions***

The trends of cardiovascular diseases (ischaemic heart, congenital, heart failure and stroke), account for an increasing proportion of deaths rates in Bahrain. In, contrast a remarkable decline on communicable diseases and symptoms, sign, ill-defined conditions started from 1974 up to 1992 (Fig 1.3). Improvement in primary health care, and immunization coverage have been effective in prevention and control of communicable diseases.

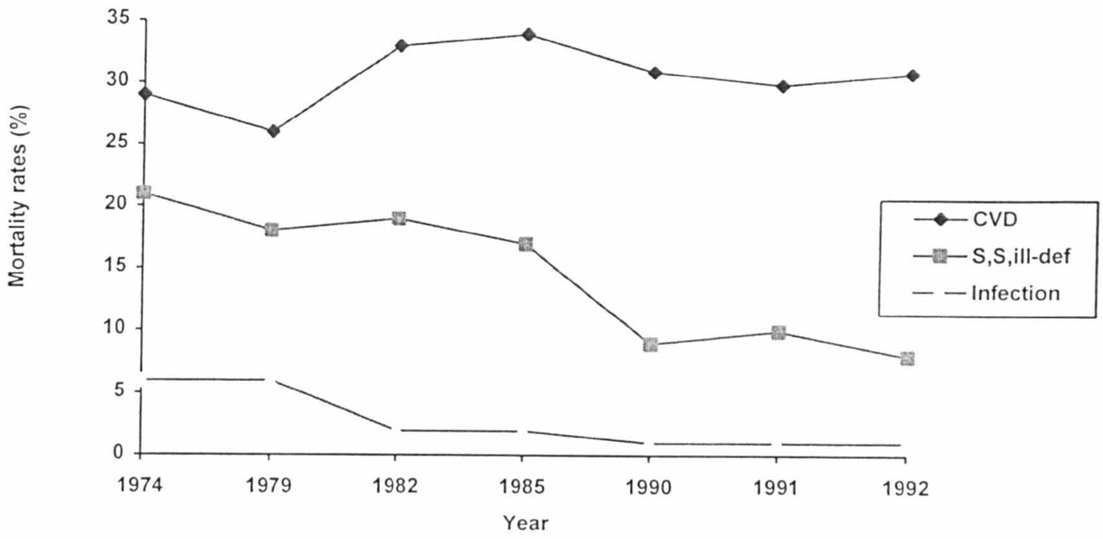


Figure 1.3 Trends in mortality of cardiovascular diseases, infection and symptom, sign, ill-defined among all ages in Bahrain between 1974 and 1992.

1.3.1.1 Risk factors

The current list of possible risk factors for CHD is long and includes environmental factors (e.g. temperature, rainfall, water quality, maternal nutrition) as well as a number of personal characteristics (e.g. blood pressure, smoking, physical activity and blood lipids). Increasing age and male sex are important risk factors, through being male and getting older are not necessarily associated with an increased risk factors only in communities where CHD is prevalent at a measurable level.

1.3.1.2 Nutrition

Several studies have determined that correlation exist between CHD and the amount of fat and saturated fat in food; there is evidence that the same is also true for dietary cholesterol (WHO 1990; Nestel 1991). The evidence for an inverse relationship between CHD and intake of vegetable oils is less convincing because of the variation in the fatty acid content of such oils (Wood and Oliver 1992).

However, dietary fatty acids are heterogeneous in their metabolic effects, only some benefiting plasma lipid levels, arterial thrombosis and cardiovascular risk in general. In this context, it is important to evaluate the effects on all relevant cardiovascular risks when assessing the benefits of an individual fatty acid.

1.3.1.3 Smoking

Current cigarette smokers of whatever tenderness carried a three-fold risk of heart attack compared with men who had never smoked, and even ex-smokers still carried a two-fold risk. When 'smoking years' were used to compare risk between the top and bottom fifths, a 5.1 relative risk was found (Shaper and Elford 1992). Prevalence rates of regular cigarette smoking vary considerably among children and young people by age, sex and country (Wynder et al. 1981).

1.3.1.4 Lipids

Lipoproteins interactions are a key features of lipoprotein metabolism. The significance of raised plasma cholesterol (and more specifically raised LDL cholesterol) and of reduced HDL cholesterol as major CHD risk factors is generally accepted. However, some patients develop premature CHD with apparently normal LDL cholesterol.

The re-evaluation in recent years of the importance of dyslipidaemia (abnormal plasma lipids) in CHD has revealed a wide range of commonly occurring abnormal lipoprotein phenotypes (or patterns) which are at least as important as hypercholesterolaemia. This has focused attention on the atherogenicity of new classes of lipoproteins besides LDL, as well as the LDL group itself (Nestel 1990).

1.3.1.5 Insulin resistance

Evidence that there may be a special metabolic syndrome characterized, in particular, by insulin resistance and associated with increased CHD risk has been compiled over the last 25 years (Fontbonne A et al. 1991; Welborn TA and Wearne K 1979). It may to some extent explain the high incidence of CHD in ethnically different societies and populations (Reaven G and Chen Y 1988).

Insulin resistance is characteristically seen in association with central obesity, and centrally located body fat has a relatively high rate of basal lipolysis, leading to elevated levels of free fatty acids, which may themselves cause insulin resistance (Bjorntorp P 1991). Obesity may be also associated with a reduction in insulin-stimulated blood flow, which could result in insulin resistance (Laakso M et al. 1990).

A single prospective study of the development of the metabolic abnormalities of the insulin-resistance syndrome suggests that elevation of insulin concentrations may proceeds the development of lipid, lipoprotein and blood pressure abnormalities (Haffner S 1992).

An estimate of the prevalence of this syndrome will have to await a more stringent specification of its characteristics. The insulin-resistance syndrome might provide a unifying explanation for the high rates of non-insulin-dependent diabetes mellitus and CHD in South Asians (McKeigue PM 1992).

1.3.1.6 Physical activity

Epidemiological studies published in the 1950s began to link physical activity to decreased incidence of myocardial infarction and sudden death. Physically active workers have been found to have fewer heart attacks than more sedentary fellow-workers (Morris JN et al. 1953).

In more recent studies, exercise outside work has been examined and it has been shown that physical inactivity, whether occupational, is associated with increased risk of CHD independently of other risk factors (Paffenbarger RS et al. 1982;.Paffenbarger RS et al. 1986; Leon AS et al 1987).

1.3.2 Diabetes mellitus

1.3.2.1 The nature of the problem

Diabetes can be detected in nearly all populations throughout the world, but the incidence and prevalence of insulin-dependent diabetes mellitus (IDDM) and non-insulin-dependent diabetes mellitus (NIDDM) and the comparative classification of these two major types of diabetes show huge differences between countries and between different ethnic groups within individual countries (Rewers M et al. 1988; King H and Zimmet P 1988).

1.3.2.2 Classification

The widely accepted classification of diabetes mellitus (Fig 1.4) recommended by the 1985 WHO Study Group, was based primarily on clinical descriptive criteria, and its retention is recommended for the present.

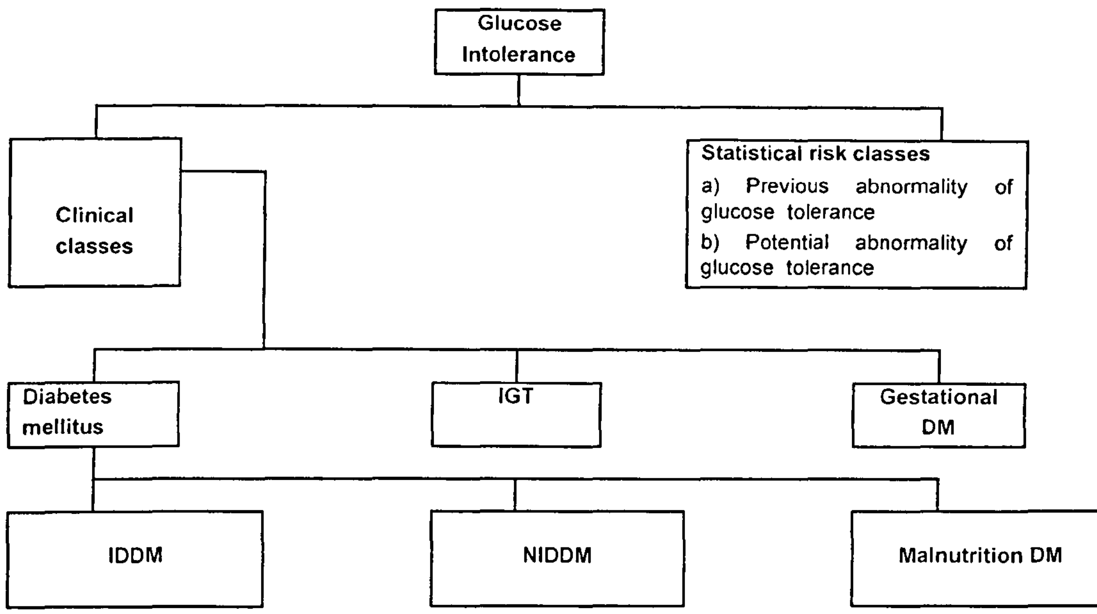


Figure 1.4 Classification of diabetes and allied categories of glucose intolerance

1.5 SUMMARY

The increase in the relative importance of adult health problems is often described as the 'epidemiological transition' and it results from three different processes. The proportion of adults in most developing world populations is growing as a result of a decline in fertility. The prevalence of lifestyle-related risk factors for major non-communicable diseases is rising. Substantial, if incomplete, success at controlling infectious diseases in childhood is leading to the emergence of adult non-communicable disease as a major residual problem.

Non-communicable diseases do become relatively more important as adult health improves, because incidence and case fatality rates for these conditions fall more slowly than those for communicable diseases and maternal causes.

The demography of Arabian Peninsula countries still resembles that typical of developing countries. However, crude death rates have declined sharply and CHD has now emerged as a major public health problem. This is supported by the limited data available from routine mortality statistics, hospital records, and clinical impressions.

Despite the high incidence of premature death in adulthood, little is known about the profile, aetiology and epidemiology of adult ill health in the developing world. Death registration is often incomplete or non-existent. Hospital statistics often cover only a small proportion of adults and there have been fewer population-based studies of adult health than child health.

Cardiovascular disease is the single largest cause of death in Bahrain, being responsible for a quarter of all deaths. It is especially prevalent as a cause of death in middle-aged people, accounting in the age group 45-64 for 40% of deaths in men and 10% of deaths in women.

There are no community surveys of important risk factors for coronary heart disease particularly plasma cholesterol, physical activity and plasma insulin, the only data available is from in-hospital patients with CHD.

As reliable mortality data are not available, cross-sectional studies are the most useful way to assess rates of CHD in the these populations. Such surveys are able to measure prevalence of major Q waves on electrocardiograph (ECG), diabetes mellitus and other risk factors for CHD. Several measures that would help to improve the accuracy of mortality data depend on obtaining autopsies for sudden deaths outside hospital, setting up a system for follow-up inquiry in cases where death certificates have been filled incorrectly, and adherence to a coding system using the international codes.

Chapter 2

BACKGROUND

2.1 INTRODUCTION

There is a great need for cardiovascular disease and diabetes prevention in the entire population of the Arabian Peninsula. The greater the prevalence of risk factors found to be causally related to disease, the greater the power to reduce the disease burden in the community by reducing the levels of such pathogenic risk factors.

The term "risk factors" in relation to cardiovascular disease, and specifically coronary heart disease, was used for the first time in 1961 in a paper on the Framingham Study (Kannel WB et al. 1961).

The risk factors themselves, in particular high levels of serum cholesterol, hypertension and smoking, have been measured in prospective epidemiological studies since their discovery in the late 1940s (Keys WB et al 1963; Dawbwer TR, Meadowes GF, Moore FE 1951).

Non-insulin-dependent-diabetes mellitus is a cause for growing public health concern on both developed and developing countries. In many countries, it is now a leading cause of death, disability and high health care cost (Olivera EM et al. 1991; Jonsson B 1983; Gulliford MC 1995; Harris LE et al. 1993).

Various genetic and environmental/lifestyle factors influence diabetes aetiology and prognosis. Important differences in the frequency of diabetes and its complications have been reported between countries, ethnic and cultural groups (Bertorelli AM 1990; King H et al. 1989; Langer O et al. 1995; Haffner SM et al. 1993; Raymond NR et al. 1993; Simmons D et al.1992).

2.2 CORONARY HEART DISEASE IN THE ARABIAN PENINSULA

2.2.1 *Mortality rates of CHD*

In some states of the Arabian Peninsula where a certain number of deaths are not medically certified, data on cause-specific mortality are likely to be unreliable. The accuracy of the underlying cause recorded on the death certificate is likely to be poor where the proportion of deaths classified as "symptoms, signs, and ill-defined conditions" exceeds 5%. Although in Bahrain the trend of symptoms, signs, and ill-defined conditions is showing decline (Fig 1.3).

The uncertain quality of death certification information makes it difficult to draw conclusion about the real magnitude of CHD mortality in the Arabian Peninsula. It is possible that the rates in Bahrain and Kuwait are over estimated because outside hospital death certification has incomplete details about the deceased to support the cause of death, in addition postmortem investigation in both countries is very limited.

A review of deaths in five Kuwaiti hospitals in years 1987-88 found that the sensitivity and specificity for the diagnosis showed poor agreement between original and revised certificates. The cause of death from original death certificates by National Death Registry underestimated ischaemic heart disease by 14.5% (Moussa et al. 1990).

This validation study is not adequate, because most deaths from CHD occur outside hospitals and we cannot generalize from hospital-based deaths validation of accuracy for diagnosis in death certificates. Other Gulf States have no epidemiological data available concerning the accuracy of death certificates from CHD.

*Table 2.1 Death rate from all causes and CHD** by sex in Bahrain and Kuwait in year 1988*

	Bahrain			Kuwait		
Disease	Total	Men	Women	Total	Men	Women
All causes	715.8	757.7	660.5	615.6	674.9	526.3
CHD	193.3	202.2	173.9	121.0	156.3	71.6

** Age-adjusted according to World standard Population*
*** Coronary Heart Disease*

The ratio of age-adjusted mortality from CHD to age-adjusted mortality from all causes was 27% in 1988 which makes it the leading cause of death in comparison with other causes, and the ratio in Kuwait is only 20% (Table 2.1).

Age-adjusted mortality rates for coronary heart disease ICD-9, code (410-414) increased in Bahrain (Al-Mahroos 1992) from 1987 (181.4/100,000 in males, 109.3/100,000 in females both aged 15-75+ years old) to 1988 (202.2/100,000 in men, 173.9/100,000 in women) (Table 2.2).

The increase in mortality rates for coronary heart disease among women is twice the increase in men between 1987 and 1988. If this rise is true, it is probably older age-group is a reason in justify these variation in CHD mortality rates, besides the bias of diagnosis for CHD in the death certificates.

The age-adjusted mortality rates from CHD in Bahrain were higher than in Kuwait in 1988 (Table 2.2), although the life-style and socio-economic level are similar in Bahrain and Kuwait.

Table 2.2 Mortality rates from CHD (ICD 410-414) in Bahrain and Kuwait reported to WHO

	Bahrain		Kuwait	
Year	men	women	men	women
1985	NA***	NA	163.5	77.5
1986	NA	NA	156.5	70.6
1987	181.4	109.3	156.3	71.6
1988	202.2	173.9	NA	NA

** CHD coronary heart disease defined as : ICD-9 code 410-414*
*** Age-adjusted according to World Standard per 100,000 population*
**** NA=Not available*

The mortality from CHD among women aged 65 years and above was higher in women than men (4000/100,000 population) in 1988 (Table 2.3) This may be a chance result based on small members or there may be an overdiagnosis of CHD mortality which would need further assessment. Moreover, the decline in the proportion of "symptoms, sign, ill-defined conditions", perhaps has led to increases in the rates of CHD mortality.

Table 2.3 Death rates* from CHD (ICD 410-414) and in Bahrain between 1987 and 1988.

	1987		1988	
Age-group	**Men**	**Women**	**Men**	**Women**
35-44 yr	68.1	NA	49.0	NA
45-54 yr	224.9	79.6	140.8	92.4
55-64 yr	447.1	266.7	401.9	202.9
65-74 yr	818.2	724.1	928.5	676.4
75+ yr	3000.0	2133.3	4000.0	5428.6

** age-specific death rates per 100,000 population among men and women aged 35- 75 years old and above*

The deaths outside hospitals without postmortem may lead to overestimation of CHD mortality. The CHD mortality rates in Kuwait are high but lower than the rates reported for Bahrain. In comparison with other countries, the age-adjusted death rates in Bahrain & Kuwait are resembling to those in the UK and USA (Table 2.4).

Table 2.4 Age-standardized* mortality rates from CHD in different countries in the year 1987

Country	Sex	Age-specific rates				Age-adjusted
		35-44y	45-54y	55-64y	65-74y	Rate/100000
Russia	M	86.1	254.6	630.2	1835.3	501.4
	F	8.3	47.8	237.1	1184.1	234.6
England & Wales	M	39.9	193.8	619.2	1450.1	441.5
	F	6.0	35.8	192.2	631.9	143.4
Bahrain	M	68.1	224.9	447.1	818.2	304.4
	F	0.0	79.6	266.7	724.1	184.1
USA	M	37.1	154.9	446.0	1040.7	303.3
	F	8.1	40.2	156.3	491.2	117.9
Kuwait	M	37.2	154.7	460.0	940.5	292.5
	F	6.0	35.8	192.2	631.9	143.4
Japan	M	5.0	20.9	62.9	192.5	48.8
	F	1.1	4.9	20.4	96.5	19.8

** Age-adjusted according to World Standard Population*

*** CHD Coronary Heart Disease (ICD 401-414)*

It is necessary to distinguish death rates from CHD among Arab citizens and expatriates of Bahrain and Kuwait (Bahrainis and Kuwaitis), as most migrants to Arabian Peninsula are from South Asia, who are known to be a group at high risk for CHD (McKeigue et al.1988). The trend in age-adjusted and age-specific mortality rates from all causes in Kuwait, have shown decline between 1975-79 and 1980-84 (992.1/100,00 population and 891.2/100,000 population respectively (Table 2.5).

Table 2.5 Trend in men mortality from 1975-1979 to 1980-1984 in Kuwait.

Age-grp	1975-1979			1980-1984		
	CHD	Neoplasm	Injury	CHD	Neoplasm	Injury
35-44y	50.2	29.7	102.7	34.4	22.2	64.2
45-54y	201.9	100.9	117.4	158.4	80.7	103.1
55-64y	528.7	293.0	165.6	391.1	275.6	146.7
65-74y	1172.4	706.9	258.6	1014.7	764.7	264.7
Age-Adjusted	188.7	106.9	98.4	151.5	110.3	92.2

Age-adjusted according to World Standard population

Mortality from noncommunicable disease among men in Kuwait has shown marked decline, except for cancer where there has been a minimal increase. Data on trends of age-standardized CHD mortality in the Arabian Peninsula are not reported except Kuwait, where mortality rates from CHD from 1974 to 1984 have shown a decline from 188.7 to 151.5 per 100,000 population (WHO 1990). Between 1984 and 1987 there was a limited decline in mortality from CHD in Kuwait.

The age-adjusted mortality rate from CHD, rose from the early 1980s (151.5 per 100,000 population in men) to 1985 (163.5 per 100,000 age-adjusted in men), then following that, the rates shows a minimal decline (Table 2.6).

Table 2.6 Age-standardised† death rates of selected causes, by sex in Kuwait.

	men				Women			
Year	inf.*	Neop*	CHD	All	Inf.*	Neop	CHD	All
1985	22.5	119.4	163.5	812.0	25.8	77.8	77.5	616.7
1986	21.8	94.0	156.5	727.2	15.4	88.1	70.6	582.7
1987	20.1	83.5	156.3	615.6	16.1	65.9	71.6	526.3

†Age-adjusted according to the World Standard Population age structure (per 100,000) by direct standardisation.

** Infectious diseases* ** Neoplasms* *CHD= Coronary Heart Disease (ICD 410-414).*

These slight declines in mortality rates from CHD in Kuwait might be attributed to improvements in data surveillance and advancement in medical services especially in primary care (effective treatment of hypertension), secondary (improved treatment of symptomatic CHD such as more extensive use of beta-blockers, more coronary care units and coronary bypass surgery). There are no data available about trends in CHD mortality in other Arabian Peninsula States.

2.2.2 Morbidity from CHD

Morbidity from CHD is believed to have risen in some regions of the developing world, such as the Arabian Peninsula. Most published data are limited to hospital case-series. This may not be a reliable guide to disease rates in the population (Ahmed AF et al. 1993; Ahmed AF et al. 1989; Al-Gindan YM et al. 1990; Al-Owaish RA and Mathew Z 1982; Al-Roomi KA et al. 1994; Alwan AA 1993).

Statistical data on morbidity from cardiovascular disease in Saudi Arabia and some other countries in the Gulf are scarce or patchy and were not collected in a uniform manner. The age-adjusted admission rates in Bahrain for acute myocardial infarction (AMI) rose from 1987 till 1991 for both men and women. In addition, the rates of case fatality are same for men and women (Al-Mahroos 1992) (Table 2.7).

The increasing hospital admission rates for AMI observed in Bahrain could be due to increased recognition of AMI. The use of serum CK-MB isoenzyme subtractions increased dramatically between 1985 and 1991. A second possible explanation for the increase in admission rates is that there has been a change in physician practice regarding hospitalization of patients with chest pain, together with changes in patient behavior. That is, patients may have been more likely to present to hospitals and to be admitted for the evaluation of chest pain since 1989 than before.

The age-adjusted in-hospital case fatality rates (CFRs) of acute myocardial infarction exhibited a consistent decline between 1987 and 1990 among men in Bahrain, while women showed a rise in the same period (Table 2.7). This may be because of higher admission to hospitals of older women rather than men. With an increase in deaths before hospitalization, a concomitant decline in early hospital deaths might be expected to occur.

Table 2.7 Acute Myocardial Infarction(AMI)* admission** and case fatality rates (CFRs) by nationality and sex in Bahrain

	Bahraini				Non-Bahraini			
	men		women		men		women	
Year	ARs[1] (%)	CFRs[+] (%)	ARs[1] (%)	CFRs (%)	ARs[1] (%)	CFRs (%)	ARs[1] (%)	CFRs (%)
1987	145.1	48.5	123.2	9.3	123.9	12.8	121.1	10.0
1988	189.7	37.1	122.2	8.6	109.3	16.8	148.2	17.3
1989	204.4	22.9	86.1	20.1	138.7	11.4	105.4	28.5
1990	176.4	22.7	150.3	28.5	176.2	10.8	123.7	30.2
1991	182.8	--	114.1	--	89.6	--	115.5	--

** Defined (ICD-9, code 410)*
[+] CFRs case fatality rates defined by Number of deaths from AMI in a given period divided by Number of diagnosed cases of AMI in the same period and multiply by 100
*** Age-adjusted according to the World Standard Population*
[1] ARs Admission Rates per 10^5/year

In Kuwait, morbidity from both diabetes and CHD are common (Emara and Bisharatulla 1983). The 1987 AMI admission rates were higher in Kuwait than in the 1960s (WHO 1990). In spite of increasing rates of AMI morbidity, the rates of mortality showed decline in mid 1980s.

Over one and half years in early 1980s in Kuwait, 142 cases of AMI were admitted to the Coronary Care Unit in one of the general hospitals, which serves a population of about 200,000. The crude rate of admission of these cases was 71.2 per 100,000 population (Fatani H, Jan MY, Mirza S, El-Zubier A 1983). The only other published data are from Saudi Arabia: a proportional morbidity analysis of cardiovascular disorder in King Saud University Hospitals. The total number of admissions of all ages over one year period was 1147, of which 341 were for cardiovascular disorder (29.7%), these proportions are similar to those in Bahrain.

2.2.3 *Risk factors for CHD*

2.2.3.1 Diabetes mellitus and CHD

There have been striking increases in the prevalence of diabetes mellitus in many societies that have undergone marked changes in their lifestyle (Alzaid AA, Sobki S, De-Silva V 1994; Fujimoto WY 1996; Clausen JO et al. 1996; Herman WH et al. 1995).

Table 2.8 Odds ratio, 95% CI of some risk factors for CHD among hospital cases and controls

Risk factor	cases No (%)	controls No (%)	Odds ratio	P Value	95% C. I.
Diabetes					
Saudi[a]	28 (41)	16 (23)	2.2	0.02	(1.02,5.10)
Bahrain[b]	15 (22)	46 (9)	2.8	0.001	(1.39,5.55)
Kuwait[c]	27 (33)	37 (24)	1.6	0.12	(0.85,2.99)
Hypertension					
Saudi[a]	27 (42)	14 (21)	2.8	0.007	(1.22,6.54)
Bahrain[b]	31 (44)	63 (12)	5.7	0.000	(3.22,10.1)
Kuwait[c]	19 (33)	26 (31)	1.1	0.820	(0.50,2.37)
Smoking					
Saudi[a]	18 (26)	8 (23)	2.7	0.048	(1.10,7.0)
Bahrain[b]	26 (37)	141(27)	1.5	0.88	(0.90,2.73)
Kuwait[c]	54 (84)	10 (13)	7.7	0.000	(3.32,18.5)
Cholesterol[†]					
Saudi[a]	7 (12)	8 (12)	1.0	0.986	(0.30,2.61)
Kuwait[c]	11 (31)	16 (26)	1.3	0.587	(0.63,2.28)
Triglyceride					
Saudi[a]	19 (33)	6 (10)	5.0	0.000	(1.70,15.5)

[a] Ahmed et al 1993   [b] Al-Roomi et al. 1994   [c] Al-Owaish 1978
[†] Cholesteroldefined by total plasma cholesterol>6.2 mmol/dl
Diabetes defined: In Saudi[a] (Ahmed et al 1993), defined by fasting blood sugar (FBS) analysis
In Kuwait[c] (Al-Owaish 1978), defined by history, treating for DM and (FBS)
In Bahrain by history of diabetes

Notable among such populations are the Pima Americans of Southwest USA (Bennett et al. 1976) and the Nauruan islanders of the South Pacific (Zimmet et al. 1977). Diabetes mellitus has been found to be associated with CHD consistently both in European populations (WHO 1985a), and in relatively low prevalence countries like Arabs in Jordan (Baond 1983) and Sudan (Ahmed et al. 1989).

Diabetes mellitus has become a major health problem in Bahrain and other Arabian Peninsula states. There has been no published epidemiological survey of diabetes in the general population of Bahrain, Kuwait, Qatar, and United Arab Emirates using universal glucose tolerance testing and diagnostic criteria recommended by the World Health Organization (WHO 1985b).

A community-based survey of diabetes mellitus prevalence in the Arabian Peninsula was carried out in Oman, where age-standardized prevalence in men and women aged 30-64 years was found to be 14%, which is similar to that in the high prevalence populations of South Asian origin (King and Rewers 1993). The prevalence of diabetes in patients with CHD has been studied in Saudi Arabia, Bahrain and Kuwait which showed the condition to be common in both cases and controls (Table 2.8).

In another case-control study in Saudi Arabia, DM evaluated by the patients history or fasting blood sugar 7.7 mmol/l (140 mg/dl), was significantly more prevalent in the in-patient (41%) compared with the controls (23%) (Ahmed et al. 1993). Additionally in Riyadh, Saudi Arabia (Fawzy et al. 1983), a study reported previously diagnosed diabetes mellitus as the second most prevalent risk factor in patients with CHD, found in 24% of patients and 12% of controls. The disease is also of great public health concern in most of Arabian countries including Kuwait (Taha et al 1983), Bahrain (Al-Mahroos 1986), and Saudi Arabia (Fatani et al. 1987).

Diabetes was found in 41% of the total hospital patients in Kuwait: occurred in 51% of Kuwaitis and 31% of non-Kuwaitis (Emara and Bisharatulla 1983). In Al-Ain, the second largest town in the Abu Dhabi emirate, diabetes accounted for 6% of all general medical admissions to the hospital over a 5-year period between 1980-84 (Omer et al. 1985). Patients diagnosed with CHD made up 11% of all diabetics. Although reliable prevalence data are available now for Oman and Saudi Arabia, it appears that DM is now common throughout the Arabian Peninsula. The obesity among Arab women has shown significant correlation between the waist/hip ratio and plasma glucose concentration at 120 minutes (Emara et al. 1988). In Arabian Peninsula, NIDDM is reported to occur at a high prevalence and constitutes a major health problem. However, it was shown that the complications reported in other populations such as atherosclerosis are less frequent in Arab NIDDM patients (Kingston and Skoog 1986; Kingston 1983). The pattern and complications in diabetic patients in Saudi Arabia have been evaluated and show a significant relation with CHD morbidity (Boand 1983). The frequency of 11% with CHD is similar to the 10% reported by other studies for patients with DM in Saudi Arabia (Fatani et al. 1989). These estimates are lower than those reported in the WHO multinational study of vascular diseases in diabetes (WHO1985a).

2.2.3.2 Cigarette smoking and CHD

Although smoking prevalence is decreasing in the USA and Western Europe (Fiore et al. 1989; Pitman 1994) it may be increasing in developing countries (US National Center for Health Statistics 1975; WHO 1979; WHO 1982). In Bahrain, the proportion of smokers among patients admitted with AMI was found to be 82% (Hamadeh 1993). This is higher than that reported in other Arabian Peninsula States (Table 2.9), and other developing countries (Hakim et al. 1991). This difference is most likely due to the younger 40-49 years old population in this study. Furthermore, there are no controls for those known cases of CHD for comparison to assess the size of smoking habit among Bahrain general population. The proportion of smokers in non-CHD patients in another study in Bahrain (Al-Roomi et al. 1994), has shown lower percentages (27%) than CHD cases (37%) (Table 2.8).

Table 2.9 Prevalence of risk factors in male and female with CHD in the Arabian Peninsula

Country	No M/F	Smoking (%)	High BP (%)	Diabetes* (%)	Cholestrol (%)
Bahrain[a]	85/15	82%	28%	13%	10%
Saudi[b]	43/25	24%	42%	41%	32%
Saudi[c]	221/43	57%	27%	28%	21%
U.A.E[d]	307/12	70%	14%	16%	8%
Kuwait[e]	249/50	84%	19%	42%	16%

****Definition of diabetes in each study in this review:***

In Bahrain[a] (Hamadeh 1993), defined by history

In Saudi[b] (Ahmed et al 1993), defined by fasting blood sugar (FBS) analysis

In Saudi[c] (Al-Gindan 1990), defined by history

In United Arab Emirates[d] (Siddiqi et al. 1985), defined by history

In Kuwait[e] (Al-Owaish 1978), defined by history, treating for DM and (FBS)

The latest census survey in Bahrain for smoking habits showed remarkably lower prevalence rates in comparison with some developing countries and particularly very low rates among the younger population (Bahrain Central Statistical Organization 1991). The smoking rates were 19% Vs 26% for Bahraini men aged 12-69 years and non-Bahraini men respectively, and women have shown lower rates 6% Vs 3% for Bahraini and non-Bahraini women respectively.

The highest prevalence rates of smoking by specific age-groups in the general population of Bahrain have shown among men aged 30-39 year old, while the smoking habit shows very low rates of smokers among younger age-groups 12-19 years old.

In Saudi Arabia, a case-control study of CHD has shown that the proportion of present smokers as well as those who ever smoked more than one pack (20 filter cigarettes) per day in the cases were significantly more than in the controls (Taha and Bell 1980). The frequency of smoking as a risk factor for CHD in this study series (26.5%) is less than that reported from Riyadh (39%) (Fawzy et al. 1983), reflecting the well known geographical variation in risk factors even within the same country.

2.2.3.3 High blood pressure

The systolic and diastolic blood pressure of CHD patients is significantly higher than those of normal subjects in men and women in the Arabian Peninsula (Al-Owaish 1978; Hamadeh 1993; Ahmed et al 1993; Hakim et al. 1991; Al-Gindan 1990; Khoja 1993; Siddiqi et al. 1985).

The highest percentage of hypertensive CHD patients was recorded in Saudi Arabia (Table 2.9). Although the control of hypertension is less effective in reducing the incidence of CHD, than in reducing stroke, prevention and control of CHD needs to be stressed to reduce the incidence of CHD as a consequence of hypertension (Collins R et al 1996).

2.2.3.4 Serum cholesterol average

An elevated average serum cholesterol, above 5.2 mmol/l is considered to be a necessary condition for the occurrence of CHD on a mass scale. The mean serum cholesterol for men age 45-69 years was 5.5 mmol/l in the U.S.A (US Department of Health and Human Services 1980) and 6.3 mmol/l in Britain (Thelle et al. 1983).

Hypercholesterolaemia in the Arabian Peninsula's populations does not seem to be a common problem as a risk factor for CHD from a review of these papers. The average of serum cholesterol recorded in some Arabian countries showed almost the same picture of mean serum cholesterol among men and women (Table 2.10).

Table 2.10 Mean serum cholesterol in Arabian Peninsula

Year	Place	Population sample	Age range	cholesterol Men	cholesterol Women
1978[a]	Kuwait	AMI-hospital cases	20-60y	5.7	5.9
1983[b]	Bahrain	AMI-hospital cases	20-60y	5.3	5.1
1984[c]	Kuwait	AMI case-control			
		Kuwaitis	18-45y	4.5	
		Lebanese	18-45y	4.9	
		Indians	18-45y	5.2	
1988[d]	Saudi A	All in-patient		5.2	5.4
1990[e]	Saudi A	Random sample general population			
		Healthy people	20-60	4.7	4.5
		Diabetics	20-60	5.6	5.7
		CHD cases	20-60	6.3	6.4
1992[f]	Saudi A	CHD cases	50-60	4.9	
		Non-CHD controls	50-60	5.0	

[a] *(Al-Owaish and Methew 1982)* [b] *(Hamadeh 1993* [c] *(Tahan et al. 1986)* [d] *(Inam et al. 1991)*
[e] *(Siddiqi et al. 1985)* [f] *(Ahmed et al 1993)*

Case-control studies have been published from Arabian Peninsula (Al-Owaish 1978; Al-Roomi et al. 1994; Ahmed et al 1993) showed no significant association between CHD cases and controls. The prevalence of abnormal serum cholesterol needs a survey in the general population of the Arabian Peninsula.

2.2.3.5 Over weight and obesity

There are few known official data on the prevalence rate of obesity in the general population in Bahrain and other Arabian Peninsula States (Amine and Al-Awadi 1990; Binhmed et al 1991). Changes in traditional risk factors for CHD possibly explain the increase in mortality from CHD. Increased prevalence of obesity (Musaiger 1990) among middle-aged women may reveal part of the increase mortality from CHD. In Bahrain, the proportion of AMI patients who were obese (BMI >30) was lower than in community controls and multivariate analysis did not demonstrate a positive relationship between BMI and developing AMI in Bahrain (Al-Roomi et al. 1994). The prevalence of obesity among adult females in Bahrain is 40% (Amine and Al-Awadi 1988), and 17% in Oman (Bowman and Rosenberg 1989).

The prevalence of obesity was studied among 1072 Saudi patients attending a primary health care center (Binhemd et al. 1991). Of the total group, 51% of the men and 65% of the women were considered overweight, using body mass index (Kg/m^2) of greater than 25 kg/m^2 as the criterion. The prevalence of obesity as (BMI >30) among adult males and females was 25% and 48% respectively.

This could be due to a rapid change in the lifestyle and socioeconomic standard which has become a main role in this important risk factor for many chronic noncommunicable diseases like diabetes mellitus and coronary heart disease. Several factors are contributing to the prevalence of obesity in Bahrain and Arabian Peninsula. Physical activity of the population has significantly diminished with the availability of housemaids, private cars, television and other sophisticated house appliances (Amine and Al-Awadi 1990).

The types of food and fat intake has changed in the population of the Arabian Peninsula, specially during 1970s because many expatriates migrated to the region for work and most of them came from South Asia. Some Indian food is high in fat like Biryani rice and Samosa. This style of food has become very popular among Arabs of the Gulf States.

In addition, changing traditional food pattern (main dishes were composed of fish) in Bahrain, Kuwait and other Arabian Peninsula populations. Fast food rich in fat such as hamburger, fried chicken, and fried potato has became very prevalent in Bahrain and Kuwait (Al-Awadi and Amine 1989). Lack of exercise is influencing the prevalence of obesity as well as changes in food consumption.

2.2.4 Conclusion

Coronary heart disease should be considered as a priority area when allocating resources for the public health strategies for Arabian Gulf states. National data suggest that in both sexes and in both nationality groups, mortality rates from CHD in Kuwait have been declining since the mid-1970s, but increasing in Bahrain. Associated with these high death rates, a rise in CHD morbidity is indicated by admission rates for diagnosed myocardial infarction and other types of CHD.

Non-insulin dependent diabetes mellitus seems to be highly prevalent among the adult Arab population in the Gulf region, which has an influence on the development of CHD. These high rates of diabetes are apparently associated with obesity. Smoking rates are very high and reducing them is an absolute priority. However plasma cholesterol levels are already quite low and need to be surveyed in adult general population.

Prevention and control of NIDDM, cigarette smoking, and reducing plasma cholesterol concentrations in young people may influence the risk of coronary heart disease mortality and morbidity. Control of blood pressure may control the risk of stroke occurrence but will be less effective in reducing premature death from coronary heart disease.

A survey of the prevalence of diabetes and CHD risk factors in the general population of the Arabian Peninsula is necessary. A recommendation to the ministries of health in these countries to update and publish their annual statistical reports of mortality and morbidity to WHO, with split rates by nationalities residing in these countries, is needed to enable the researchers and clinical epidemiologists to assess and appraise the impact of CHD problems in the Arabian Peninsula.

2.3 SCOPE OF DIABETES IN THE ARABIAN PENINSULA

2.3.1 Impact of diabetes on morbidity

Non-Insulin-Dependent diabetes mellitus (NIDDM) constitutes about 85% of all cases of diabetes in developed countries (Glatthaar et al. 1988), and the majority of cases in some developing countries, especially those with a high prevalence of diabetes (Dowse and Zimmet 1989).

Diabetes, especially NIDDM tends to be familial, and exceptionally high prevalence rates (up to 35% of all adults) have been documented in populations who have changed from a traditional to a modern lifestyle, e.g. certain groups of Indigenous Americans, Pacific islanders, Australian Aborigines and migrant Asian Indians (King and Zimmet 1988; National Diabetes Data Group 1979; Dowse et al. 1990).

The disease is also of growing public health concern in most of Arabian countries including Kuwait (Taha et al. 1983), Bahrain (Al-Mahroos 1986), and Saudi Arabia (Fatani et al. 1987). Prevalence of diabetes among hospital in-patients in Bahrain (Bahrain Health Information Center 1993) between 1990 and 1993, in those aged 14 year and 65 year and above, have shown increase in the trend from 5.1 per cent in year 1990 to 7.6 per cent in 1993 respectively (Table 2.11).

The prevalence of diabetes mellitus in Kuwait has not been reported in a formal survey. Prevalence rate of 6.4% for diagnosed diabetes among Kuwaitis and 9.1% among non-Kuwaitis was reported in 1982 (Prakash and Shubber 1982).

Table 2.11 Admission rates/100 of diabetes mellitus among patients admitted to medical wards in Salmaniya Center between 1990 and 1993.

	Male and female aged 14-65+ yr		
Year	**Total No**	**No of diabetics**	**(%)**
1990	5376	277	5.1
1991	5822	319	5.5
1992	5671	348	6.1
1993	5942	455	7.6

Source: Bahrain Health Information Centre (BHIC 1993)

A study was conducted among 1,385 male and 128 female Saudis in the Al-Kharj region to investigate the prevalence of diabetes (Basshus et al. 1982). Access to females was limited. Diabetes prevalence in Saudi Arab was found to be lower in males 2.5 per cent than females 4.7 per cent (Bell et al. 1984). In 510 males over 35 years of age, the prevalence was 6.5 per cent.

In another study in Jeddah (western region in Saudi Arabia) on 1018 subjects, diabetes mellitus was identified in 30 per cent of the patients (Fatani et al. 1983). Different provinces of Saudi Arabia have been surveyed, fasting hyperglycemia was encountered in 15% of Al-Khuber area, 11% in Al-Hafouf, 2% in Najran and 9% in Jaizan (Kassimi and Khan 1981). This study also showed a higher prevalence in males compared to females and in individuals over 40 years. The majority of the diabetes in Saudis is reported to be NIDDM, which is also ketosis-resistant (Fatani et al. 1983; Kingaton and Skoog 1986; Kingston 1983). In one study on 221 patients with hyperglycemia, 217 (about 98%) were found to have NIDDM (Kingston et al.1982). As in other populations, diabetes in Arabs is associated with being overweight, and is more common in middle age. Most patients are obese at first diagnosis (Amine et al. 1988; Al-Awadi and Amine 1989; Fatani et al. 1983; Kassimi and Khan 1981; Musaigor and Abdulaziz 1986; Musaigor 1990).

2.3.2 Prevalence of Diabetes among Arab Population

There are only two community surveys of diabetes in general population were conducted in two Arabian Peninsula States: Oman (Asfour 1993) and Saudi Arabia (Al-Nuaim et al. 1995) which used universal glucose tolerance testing and diagnostic criteria recommended by the World Health Organization (WHO 1985 b).

The Ministry of Health in Bahrain (Bahrain Health Information Center 1992) in 1992 provides limited information on out-patient diabetic attendance, but from the in-patient statistics there were 339 diabetic admissions aged 15 years old and above about 6.1% of total admissions to medical department of main general hospital in the country, with 12 deaths. The disease was the second commonest cause of admission to medical ward (Fig 2.1).

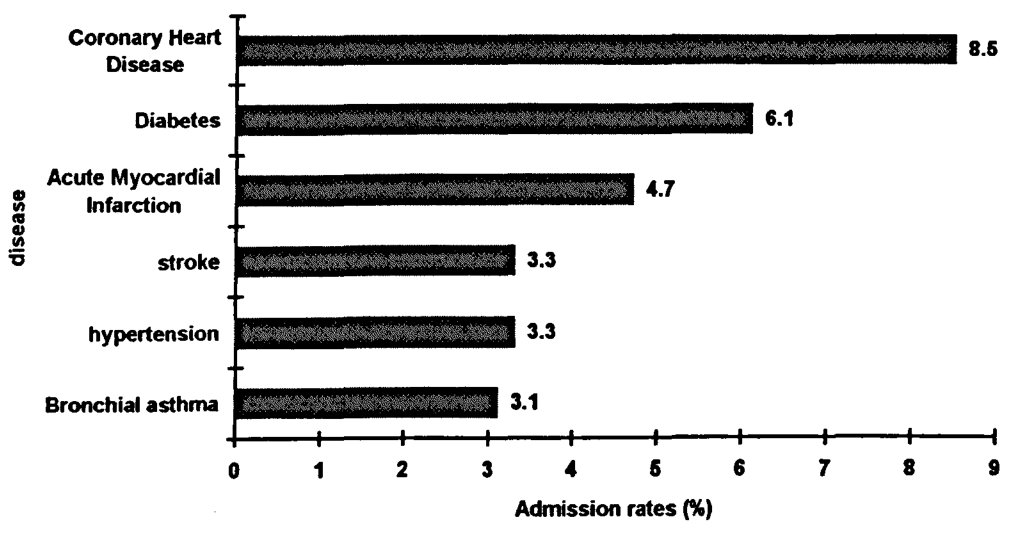


Figure 2.1 Admission rates of most common diseases to medical ward of main hospital in Bahrain for adults aged 15-74 years old during 1992

A community survey of diabetes prevalence in the Arabian Peninsula was carried out in Oman (Asfour 1993; King and Rewers 1993) where age-standardized prevalence in men and women aged 30-64 years was found to be 14%, and in Saudi Arabia (Al-Nuaim et al. 1995) was 28% and 40% (Table 2.12) which is similar to that in high prevalence populations of South Asian origin (King and Rewers 1993).

In addition, another survey showing the prevalence rates of NIDDM investigated by a fasting capillary blood test, among urban and rural Saudi populations aged between 20 and 60 years old, have been reported as 4.3% (Fatani et al. 1987), and obese diabetic adults hospitalized with NIDDM were 42% (Famuyiwa et al. 1992).

Table 2.12 Prevalence of diabetes mellitus among Arabs in Arabian Gulf States

Year	Country	Population criteria	Diagnostic criteria	Sex	Age(yr)	Prevalence (%) Male	Prevalence (%) Female
1991[a]	Oman	General pop Omani	WHO 1985 criteria	M&F	30-64	14%	14%
1982[b]	Saudi A	Al-Kharj general population	50g GTT	Male	> 35	6.5%	NA
1995[c]	Saudi A	Cross-sectional survey	WHO 1985 criteria	Male	41-50	28%	NA
				& Female	51-60	NA	40%

a (Asfour 1993) b (Basshus et al. 1982) c (Al-Nuaim et al. 1995)

Diabetes mellitus can be found in almost all populations throughout the world, but the incidence and prevalence of IDDM and NIDDM and the relative distribution of these two types of diabetes show major differences between countries and between different ethnic groups within individual countries (Table 2.13).

Table 2.13 Prevalence of diabetes in Arab and other populations aged 30-64*

Country	Prevalence (%) Men	Prevalence (%) Women
Tanzania[a]	3%	1%
Chinese[a]	16%	10%
India		
(Rural)[a]	4%	2%
(Urban)[a]	12%	11%
Oman		
(Arab)[a]	14%	14%
Italy[a]	11%	10%
USA		
(Black)[a]	9%	12%
(White)[a]	5%	7%

[a] (King and Rewer 1993)

**Prevalence of diabetes diagnosed according to WHO 1985 criteria*

The prevalence of NIDDM is estimated from population-based studies using the 1985 WHO Study Group's standard classification of and criteria for NIDDM. There are major differences in the age-adjusted prevalence of NIDDM between the populations shown. It is obvious that lifestyle changes have been followed by dramatic increases in the incidence and prevalence of NIDDM (Zimmet P 1992). Diabetes mellitus has been found consistently to be associated with CHD both in European populations, and in relatively low prevalence countries like China and Tanzania (King and Rewers 1993).

2.3.3 Precipitation Factors

2.3.3.1 Obesity

Surveys on prevalence rate of obesity (BMI >30 kg/m^2) in the general population of the Arabian Peninsula states (Al-Awadi and Amine 1987; Al-Awadi 1985; Binhemd et al. 1991; Prakash and Shubber 1982), show high rates among Saudi and Kuwaiti populations in comparison with some western populations in the UK (Bose K 1995; Kopelman PG et al. 1994) (Table 2.14). These observed statistics exhibit higher percentages than USA (Harris 1987) and UK (OPCS 1993), which showed about 16% and 14% of men and women are obese with criterion of BMI >30 Kg/m^2.

The obesity among Arab women has shown significant correlation between the waist/hip ratio and plasma glucose concentration at 120 minutes (Emara et al. 1993). The swift transition in lifestyle and living standards is relevant to the high problem of obesity in Bahrain and the Arabian Peninsula States.

Table 2.14 Prevalence of overweight in Arab[a] women compared with UK[b]

Country	Obesity* (%)
Oman	17 %
UK	24 %
Bahrain	40 %
Saudi Arabia	65 %
Kuwait	66 %

*[a] (King and Rewer 1993) * Obesity defined by BMI >30 Kg/m^2*
[b] (Bose K 1995; Kopelman PG et al. 1994)

2.3.3.2 Dietary change in Arab population and socioeconomic status

Several factors have been found to determine the dietary habits of the people in the Arab world. Food consumption pattern has dramatically changed in some Arab countries as a result of sudden increase in income from oil revenue. It is believed that food welfare policy has adversely affected the food habits in the Gulf states by encouraging the intake of fat, sugar, rice, wheat flour and meat (Musaiger 1993).

The common conception from the restricted literature accessible is that it is an emerging problem in Arabian Gulf States, particularly in urban societies. An increasing prevalence of the disorder may be related to the changes in social life-style and dietary pattern as a result of the rapid economic growth. People are eating meals rich in carbohydrates and fat, consequently leading to obesity (Table 2.15).

Table 2.15 Possible risk factors for diabetes mellitus among Arabs in the Gulf region

Obesity (central obesity)
High caloric diet intake
Lack of physical activity
Age - adulthood (maturity onset diabetes)
Gender (Females are more prone than males)
Insulin resistance
Genetic factors
Socio-cultural factors
Stress

education and women's employment all have a noticeable influence on food consumption patterns in this region. The migration movement, particularly which was carried out during the 1970s has a great impact on the food practices in many Arab countries.

Mass media, especially televised food advertisements, play an important role in modifying dietary habits (Musaiger AO 1990, Perrin D, Mojonnier L 1976, Musaiger AO 1993). Comprehensive studies on social, cultural and economic factors associated with food consumption patterns in the Arab region are highly recommended.

2.3.3.3 Complications of Diabetes

Diabetes mellitus especially NIDDM, is associated with severe disturbances of the metabolism of lipids and lipoproteins (Simpson et al. 1979; Kostner and Karadi 1988). It has been shown that NIDDM patients are more prone to atherosclerotic vascular disease, particularly coronary heart disease, compared with non-diabetic individuals (Fuller et al. 1983; Stamler et al. 1987).

The prevalence of coronary heart disease among Arab diabetic patients is not delineated, however, genetic and environmental factors seem to play a role in modulating the levels of these plasma lipids. A study on Saudi Arabs confirmed lipid, lipoprotein and apolipoprotein abnormalities in diabetic patients and showed significant lipid lipoprotein and apolipoprotein abnormalities in male and female patients (Al-Hazmi and Warsy 1994).

Nearly half (48%) of the newly diagnosed diabetics had complications, mainly nephropathy and neuropathy. The neurological complications of diabetic patients in Saudi Arabia have been reported (Zimmet et al. 1977; Kingston and Skoog 1986; Fonseca et al. 1985). Diabetic foot lesions were found recently to be present in 10.5% of diabetic patients seen in Riyadh Saudi Arabia (Sulimani et al. 1991).

2.3.4 Conclusion

The problem of diabetes mellitus in the Arab population of the Arabian Gulf States is large and appears to be growing. The present review clearly indicates that obesity is common amongst patients with diabetes in Arabian Peninsula. Recent changes in diet and lifestyle, associated with the accumulation of national wealth, may be considered as important factors associated with obesity. This emphasizes the vital role of dietary treatment in encouraging weight loss in these patients. In addition, obesity in this group is extraordinarily high, particularly among women.

This review has emphasized the prevalence rates of diabetes among Arab population in some countries of the Arabian Peninsula. Although reliable prevalence data are only available for Oman and Saudi Arabia, it appears that diabetes is now common throughout the Arabian Peninsula region, which has consequences for the increase of CHD morbidity and mortality. Socio-cultural susceptibility coupled with obesity probably plays an important role in the etiology of the disease. Heredity appears to play a major role in the pathogenesis of both IDDM and NIDDM. Complications are relatively common, especially CHD, neuropathy and retinopathy among the population of Arabian Peninsula. The most important question is whether the problem of diabetes can be prevented.

Diabetes mellitus has become a major public health problem requiring cross-sectional surveys into its prevalence in general population in Bahrain and other states in the Gulf, based on WHO criteria. Accessible demographic descriptive data on the scope of the problem require more knowledge of the risk factors for diabetes and obesity and their interrelationships in Arabs, so that appropriate intervention and prevention programs can be established.

2.4 SUMMARY

Coronary heart disease appears to be common in the Arabian Peninsula States, accounting for a high proportion of hospital admissions. There are no cause-specific mortality data reported to the WHO from these countries, except from Bahrain and Kuwait. These data show high rates of mortality from CHD in Bahrain and Kuwait and are similar to those in the USA. The trends of mortality from CHD shows a minimal decrease in Kuwait, but an increase in Bahrain.

The accuracy of death certification is uncertain. Most deaths attributed to CHD occur outside hospital, and assigning a cause of death is difficult without postmortem data. Only in Kuwait there has been validation study of the cause of death on certificates against hospital medical records. In Bahrain the proportion of death certificates with underlying cause in the category "symptoms, signs, and ill-defined conditions" declined markedly between 1986 and 1993. A review of published case-series and case-control studies of CHD shows that non-insulin dependent diabetes mellitus is one of the most important risk factors for myocardial infarction among the population of the Arabian Peninsula. Smoking, hypertension and obesity are common among hospital patients with CHD and survey data show high prevalence of obesity in the general population.

The survey of smoking among the general population in Bahrain has shown low prevalence rates of men and women, and it is the only survey in the Arabian Peninsula States. There are no population surveys of plasma cholesterol levels, but average serum cholesterol in hospital patients with CHD is not high in comparison with some other populations at high risk of CHD. Where reliable mortality data are not available, cross-sectional studies are the most useful way to assess rates of CHD in the region.

Such studies can measure prevalence of major Q waves on an electrocardiogram (ECG), diabetes mellitus and other risk factors for CHD. Several measures which would help to improve the accuracy of mortality data depend on obtaining autopsies for sudden deaths outside hospital, setting up a system for follow-up inquiry in cases where death certificates have been filled incorrectly, and adherence to the international coding systems.

Diabetes in Bahrain and other Arabian Peninsula countries is a health problem with considerable medical, social, and economic magnitude. Health services utilization data on primary and secondary care for diabetes in Bahrain show increased use of out-patients services and in-hospital patients. Coronary heart disease is the main cause of death, and this is most probably a sequence of diabetes complications on the cardiovascular system, although diabetes may not appear on the death certificate when death results from a complication of diabetes.

The impact of specific complications of diabetes on morbidity and mortality in Bahrain is not known. The relative frequency and impact of insulin-dependent and non-insulin-dependent diabetes in Bahrain are not available. In Oman, the community-based prevalence survey conducted in 1990 indicated high diabetic rates; 14% among men and women aged 35 to 64 years are believed to have diabetes. In Saudi Arabia, a cross-sectional study has shown prevalence rates of diabetes 28% for men aged 41-50 year old and 40% for women aged 51-60 years old.

The prevalence of diabetes is very high among patients diagnosed with ischaemic heart disease in Kuwait and Saudi Arabia. It is concluded that obesity is very common in the Arabian Peninsula and is probably the most important reversible risk factor for diabetes and CHD

Chapter 3
VALIDITY AND RELIABILITY OF DEATH CERTIFICATES DIAGNOSIS

3.1 INTRODUCTION

Cause-specific national mortality statistics are valuable in many aspects. They are primarily used to monitor health characteristics of general populations. Consequently, they contribute to health planning through setting priorities for disease prevention (Colburn and Baker 1974), and cost-effectiveness of health projects.

Despite the range and importance of the roles that cause-specific mortality statistics achieve, the researchers and plan investigators who employ these statistics often pay incomplete care to their measurement and ideal illustration (Manton and Stallard 1984).

Cardiovascular diseases* (CVD) account for about one quarter of all deaths in the world, which is the highest proportion of all causes of deaths. They are sometimes referred as "Killer number one". In developed countries, one-half of all deaths are caused by CVD (WHO 1983).

Although in developing countries, the proportion of CVD as a cause of death is estimated to be only about 16%, the absolute number of deaths caused by CVD is greater in these developing parts of the world than in industrialized countries, since 78% of all deaths in the world occur in the developing countries and only 22% in the developed countries (WHO 1983).

The trends in CVD mortality vary between countries in the world, as is widely known in men aged 40-69 years old between early 1970s and early 1980s (Uemura and Pisa 1985). Total death rate, have risen from 185.3 per 100,000 population in 1981 to 230.8 per 100,000 population in 1986 (Al-Mahroos 1992).

Cardiovascular Diseases without stroke

In countries that have experienced increase in CHD mortality, death rates from all diseases of the circulatory system have also increased (Stern 1979; National Center for Health Statistics 1975). It is, therefore, unlikely that the trend is attributable to any great extent to changes in diagnostic practice.

However, it is possible that a small part of the changes in these countries is due to differences in death certification and coding (National Center for Health Statistics 1975). Death certificates are important sources of data for surveillance and research. They are used to estimate mortality rates, trends and to determine outcomes in longitudinal studies.

The quality of medical diagnosis reported on death certificates is of fundamental importance in interpreting cause-of-death statistics (Glasser 1981). Although the vital data have been rarely available in some developing countries, many health workers and epidemiologists have commented on inaccuracies which limit their use in describing trends in disease incidence and differential incidence between population subgroups (Gwyne 1974; Pohlen 1978).

As registration practice has improved and completeness of ascertainment of deaths brought to a high level, a corresponding improvement in the quality of cause of death certification appears to have lagged (Carter 1985).

Various studies have been conducted on the measurement of the nature and quality of the medical diagnostic information listed on them. Similar information can indicate the degree of diagnostic sensitivity and specificity for major classes of diseases and can identify the direction of bias for specific diagnosis. Moreover, studies have been conducted on those deaths due to cerebrovascular diseases (Kuller et al.1979; Florey 1967) and CVD (Moriyama et al. 1971; Beadenkopf 1963).

Recent reports of declining trends in mortality rates from cerebrovascular diseases are reliant on the accuracy of certification of underlying cause of death. Inaccuracies may arise because death certificates are often completed without reference to all information in medical records, furthermore because of changes in coding conventions and diagnostic fashion (Garland et al. 1989). A study assessed the accuracy of the official Tasmanian mortality data for ischaemic heart disease (IHD) in 1987 and 1988, for males aged 25 to 74 years (Sexton et al. 1992). The findings showed that a death officially coded to ICD-9 rubrics 410-414 (IHD) had 94% sensitivity and a positive predictive value of 90% for fatal definite acute myocardial infarction or possible coronary death as defined by the WHO (Sexton et al. 1992; James et al. 1955). The methodology differs from one study to another. Some were based on comparison of clinical records with death certificates (Sexton et al. 1992), others were based on comparison of death certificates with the autopsy results (Kircher and Anderson 1987).

Numerous reports have documented both gross and minor discrepancies between the medical section of the death record and other sources of clinical and pathological information pertaining to the patient (Kircher and Anderson 1987; Alderson and Meade 1967). A study of validity of mortality rates for ischaemic heart disease, as estimated from death certificates, shows highly significant differences between countries (Nuttens et al. 1990). In the MONICA project, the results obtained from the conventional death certificate code were compared to the data collected in a complementary inquiry conducted for all deaths possibly due to ischaemic heart disease.

Three hundred and thirty patients, aged from 25 to 64 years, belonging to the urban community of Lille in France, and who died between October 1 and December 31, 1984, were included in this study. The sensitivity of the death certificate for the diagnosis of IHD was 77.9 percent and its specificity was 95.9 percent.
A study of the reliability of death certificate diagnosis in Kuwait revealed that there is need to improve the quality of death certificate diagnosis (Moussa et al. 1990). Data from five governmental hospitals in Kuwait were used to validate routine death certificates on patients dying in hospital. The authors studied 470 deaths with the following underlying or associated causes: hypertension, IHD, cerebrovascular disease and diabetes mellitus.

Direct causes of death were not included in the analysis, only definite or most probable causes of death were included. The records were independently reviewed by one cardiologist using the WHO criteria (WHO 1977). The (test bias) was used to test the reviewer's bias and reliability of his judgment. The adjunction process was effected by having one senior cardiologist re-review a random subsample of 140 records. The two reviewers showed good agreement. The authors also measured the difference between initial certifiers and the reviewer due to possible reviewer bias, rather than measuring the diagnostic accuracy of initial certifiers in reference to the reviewer. They showed poor agreement between original and revised certificates. The original certificates underestimated cerebrovascular disease as an underlying cause of death by 69%, diabetes 60%, IHD 33% and hypertension 32%. The process of compiling mortality statistics in Bahrain is crucial to national health care. For a quality control exercise, therefore, it was thought appropriate to investigate the quality of routinely collected mortality data and critically examine the entire process of mortality reporting from the time of the patient's death to the time that event becomes an item in national mortality statistics.

The justification for such an exercise becomes more crucial in view of certain disturbing mortality trends in Bahrain. One such example is coronary heart disease. Mortality from CHD has risen in Bahrain since late 1970s. The increase observed in routine mortality data was of the order of 40% over a decade and occurred in adult age groups and both sexes.

Examination of the validity of death certification is required to assess how much of the increase in CHD mortality in Bahrain is due to coding differences and how much is real. There are many important diagnostic problems when dealing with death certificates, even in countries that encourage autopsies. In Bahrain, the problem is even more severe since autopsies are discouraged unless there is a crime involved. For medico-legal reasons, the doctor who sees the patient at death is required to fill in the death certificate.

To assess how much of the increase in coronary heart disease mortality in Bahrain is due to coding differences and how much is real, an attempt was made to quantify the validity and reliability of death certification and coding for this cause.

3.2 DEATH CERTIFICATE SURVEILLANCE IN BAHRAIN

The completed certificate is sent to the Death Registry Office in the Directorate of Public Health, with a copy to the Department of Vital and Health Statistics to update the mortality data base. Another copy is filed in the clinical record of the deceased. To facilitate swift delivery of the deceased body, the death certificate is customarily completed within two hours after death. Certifiers may encounter problems in assigning an underlying cause of death in cases of multiple causes. A source of difficulties is that, when the death takes place at home, the relatives report to their local health center where usually the certifiers are not medically qualified. One indicator of problems in the mortality data in Bahrain is that 10% of deaths are recorded as "ill-defined" causes [International Classification of Disease (ICD) 780-798] by the Bahrain Health Information Center. This problem is attributable to the absence of cause of death information in many cases where for example the police medical officers issue the death certificate or in-hospital deaths. The trend of ill-defined cause of death in Bahrain has shown a decline in the rate since 1974 up to 1992.

Bahrain has a coroner's system and all deaths due to unnatural, violent, accidental, sudden and unknown causes must be reported to the coroner. Most Non-Bahraini (expatriates) cases are usually subjected to post-mortem examination after which a pathologist will sign the certificate for cause of death. Thus, certifying unnatural causes of death is permitted only if the coroner has been involved. Other categories of personnel are allowed to certify natural causes only.

3.3 Aims and Objectives of Death Certificates Study

3.3.1 Aims

i) To examine whether the observed high mortality from CHD in Bahrain is accurate or the result of some artifact.

ii) To assess the real magnitude of mortality from CHD and to identify how to improve the quality of mortality data by reducing the large number of deaths certified as being from "ill-defined" causes (ICD 780-798) in Bahrain.

3.3.2 Objectives

The purpose of this study was to assess agreement on cause of death reporting ischaemic heart disease by comparing death certificates and in-hospital medical charts and reports from medical registry. To examine the accuracy of death certification specifically:

1. To validate death certificate diagnosis against clinical medical records, estimating the sensitivity and specificity of death certificate diagnoses.

2. To validate routine ICD-coding of death certificate diagnosis against re-coded death certificates, estimating the sensitivity, specificity and test bias of the coding system.

3.4 MATERIALS AND METHODS

The design of this study was a retrospective cohort study using medical records supplemented by the Ministry of Health and review of government death records. The settings were in the Directorate of Public Health and Main public hospital in Bahrain.

Permission for the study were obtained from the Public Health Directorate and Chief of Staff in SMC of the Ministry of Health. The information from death certificates issued in the hospitals was recorded on a specially designed form **(Appendix 2)**. All death certificates in Bahrain in the year 1993 were reviewed to identify the cases in which death was indicated as due to CHD as underlying cause. Out of the total 371 deaths thus identified, one third had been certified in hospital, while the rest were certified outside hospital by police department medical doctors.

From those who died in Salmaniya Medical Center (SMC), a sample of 52 death certificates diagnosed as CHD and 57 death certificate diagnosed as non-CHD deaths aged 30-69 years old was drawn by simple random procedure. Two groups were extracted: deaths attributed to CHD, and deaths attributed to other causes. The available data then were examined to decide whether there was clinical or laboratory evidence to support CHD diagnosis. The certainty of the diagnosis was graded as CHD related or non-CHD related based on WHO criteria (WHO 1977) for acute myocardial infarction or any type of CHD (ICD-410-414), and according to the quality of the data supporting the diagnosis.

The final diagnosis was coded and comparison of the original and the revised death certificates was made. All 151 coded death certificates with diagnosis CHD of decedents aged 30-69 years old from all hospitals in Bahrain and 308 coded with other (non-CHD) by the Public Health Directorate Coder were re-coded by the reviewer to estimate the sensitivity and specificity of coding system of death certificates.

The re-coding followed the standard instructions given in the international form of medical certificate of causes of death (WHO 1980) by seeking the "disease or condition directly leading or underlying or contributing to death".

3.4.1 Types of death certificates

The proposed death certificate has a different layout from the current form. The front page is the actual death certificate and is in both official language Arabic on the right and English on the left (**Appendix 1**). The death certificates were grouped into three groups:

i) Deaths certified by a hospital medical practitioner.

ii) Deaths certified by police medical officers outside hospitals.

iii) Deaths certified by physicians from outside Bahrain.

3.4.2 Definition of underlying cause of death

The most effective public health objective in the prevention of death is to neutralize the precipitating cause as early as possible. For this purpose, the underlying cause has been defined as the disease or injury which initiates the chain of events leading directly to death, or the circumstances of the accident which produced the fatal injury.

3.4.3 Diagnostic criteria to label cause of death by reviewer

The following criteria were used to assign an underlying cause of death. The sequence of circumstances leading to death were recorded on the form simultaneously with any causes contributing to death and elements of the chain of events leading to death. Usually the section I-b and I-c in part one specific for disease to occur was assigned as the underlying cause. The WHO definition for the underlying cause of death (WHO 1977), "the disease or injury that initiated the train of morbid events leading to death", was adopted. The hospital deaths information from records department in the SMC records were reviewed.

The review of hospital clinical records assigned a diagnosis of CHD to any one having the criteria of the New York Heart Association for the diagnosis of diseases of the heart and great vessels (WHO 1977) or the WHO criteria for coronary heart disease diagnosis

(WHO 1975) were used to ascertain causes of death. Only deaths with a definite diagnosis on the death certificate were included.

The direct cause of death as defined by WHO, "the disease, injury, or complication leading to death", was also used. The author of this thesis also recorded, in order of significance, all the other diseases of conditions which were believed to have influenced the course of the morbid process unfavorably and thus contributed to the fatal outcome but were not related to the disease or condition directly causing death (associated cause).

Some criteria for "definite" ascertainment are positive, non-doubtful ECG changes, mortality from cardiogenic shock preceding massive Myocardial Infarction (MI) with classical clinical ECG findings and enzyme rise. Some instances of "most probable" establishment are massive pulmonary embolus 10 days after abdominal surgery diagnosed only by clinical picture, e.g. ECG, x-ray without autopsy and lung scan.

The second category of instances of "most probable" establishment was patients with former MI and positive risk factors (e.g.smoking, obesity, diabetes, hypertension and hyperlipidaemia) who were acknowledged to have typical symptoms and signs of acute MI. This study was based on the latest 9th revision of the WHO International Classification of Diseases (ICD) (WHO 1977).

3.5 RESULTS

The total number of deaths occurring in the all regions of Bahrain in 1993 were 1714, of which 371 were certified to CHD as underlying cause of death in that year. Most deaths due to CHD were certified by police medical officers, particularly when the death occurred out-of- hospital. Seventy five per cent of the total deaths occurred in hospital, 22% occurred outside hospitals, and the rest 3% outside Bahrain (Table 3.1).

Table 3.1 Reported deaths by sex, nationality and place of death in Bahrain 1993

	Death rates %									
	Bahraini				Non-Bahraini				Total	
Place of death	No	(%)	No	(%)	No	(%)	No	(%)	No	(%)
Hospitals	561	(33)	488	(28)	164	(10)	73	(4)	1286	(75)
Public Security*	150	(9)	140	(8)	84	(4)	8	(1)	380	(22)
Abroad	316	(2)	17	(1)	-- --	-- --	-- --	-- --	84	(3)
Total	740	(43)	645	(38)	248	(14)	81	(5)	1714	(100)

Source: Public Health Directorate, Ministry of Health, Bahrain

** Deaths occurs out-of-hospital (in the community)*

The total number of deaths were certified CHD as underlying cause of death were 371 deaths including in and out of hospital deaths. There were 220 CHD deaths occurred outside hospitals, whereas 151 occurred in hospitals, mainly at Salmaniya Medical Center.

Table 3.2 Characteristics of hospital deaths with CHD or Other in the death certificates

	Certificates* listing CHD		Certificates listing other	
Characteristic	No	(%)	No	(%)
Sex				
Male	27	(52%)	31	(29%)
Female	25	(48%)	26	(49%)
Nationality				
Bahraini	46	(89%)	48	(84%)
Non-Bahraini	6	(11%)	9	(16%)
Age-group				
30-39yr	2	(4%)	4	(7%)
40-49yr	4	(8%)	8	(14%)
50-59yr	15	(29%)	15	(26%)
60-69yr	31	(61%)	30	(52%)
LHS**				
<10 days	46	(88%)	27	(47%)
>10 days	6	(12%)	30	(53%)
Certificate certifier				
Intern	7	(13%)	14	(25%)
Resident	10	(19%)	16	(28%)
Senior resident	35	(68%)	27	(47%)

** Condition specified as underlying cause of death or contributory cause of death.*
*** LHS Length of Hospital Stay*

The sample of hospital cases consisted of 51 patients who were certified CHD as underlying cause of death (ICD-9 codes 410-414) (WHO 1980), and 57 patients were certified non-CHD as underlying cause of death at Salmaniya hospital have been reviewed. The number and percentage of males were more than female. Bahraini citizens made up most of the samples. Most CHD decedents (61%) were aged 60-69 years. The age distribution of those dying from causes of "CHD" or "Other" (Table 3.2).

The physicians (mostly senior residents) certified "CHD" and "Other" decedents were about 68% and 47% respectively. The length of hospital stay for CHD cases was found to be <10 days, while the other cases showed more than 10 days. The level of agreement between underlying cause of death due to CHD and any other diagnosis in hospital medical record for the 109 matched record is displayed in Table 3.3. The differences between hospital physician's diagnosis and reviewer's diagnosis validated by sensitivity 76%, specificity 72% and test bias 1.2.

Table 3.3 Comparison between diagnosis in the hospital charts* by physicians and reviewer's diagnosis of decedents aged 30-69y in Bahrain 1993.

		Reviewer's diagnosis	
		CHD	Other
Hospital diagnosis	CHD	34	18
	other	11	46

Sensitivity=a/a+c =34/45 x 100= 75% *Specificity=d/d+b=46/64= 72%*
Test bias= 1.2
** Salmaniya hospital decedents charts*

The quality of death certificates coded by Public Health Directorate (PHD) Coder was tested with reviewer's codes. The level of agreement between underlying cause of death due to CHD and any other diagnosis in death certificates for the 459 matched certificates presented in Table 3.4. There was narrow difference between reviewer's codes and (PHD) Coder, which showed very good percentages of specificity 89% and sensitivity 85% (Table 3.4).

Table 3.4 Comparison between coding by Public Health Directorate (PHD) Coder and recode of the Reviewer of death certificates* of decedents aged 30-69y in Bahrain 1993.

		Reviewer's diagnosis	
		CHD	Other
PHD diagnosis	CHD	116	35
	Other	21	287

Sensitivity= a/a+c =116/137 x 100= 85% *Specificity= d/d+b=287/322= 89%* *Test bias= 1.1*
** Death certificates listing underlying cause or contributory cause of death CHD and other.*

The results of analysis for comparison between coding by Public Health Directorate (PHD) Coder and recode of the Reviewer of death certificates is represented in (Table 3.5). The sensitivity was 87%, specificity was 89%, test bias was 1.1 and confirmation rate was 51%.

Table 3.5 Comparison between coding by Public Health Directorate (PHD) Coder and recode of the Reviewer of death certificates of decedents*

Coding by PHD Coder	Reviewer's coding: CHD No	CHD (%)	Other No	Other (%)	Total No	Total (%)
CHD	116	77	35	23	151	100
Other	21	7	287	93	308	100
Total	137	30	322	70	459	100

Sensitivity= 85% Specificity= 89% Confirmatory rate= 51% Test bias= 1.1

*** Death certificates listing underlying cause or contributory cause of death CHD and other***

Table 3.6 illustrates differences in percentages of sensitivity and specificity as a comparison between coding review and hospital record review. The level of agreement between underlying cause of death due to CHD and any other diagnosis in hospital medical record has shown lower percentages than coding review and higher bias rate.

Table 3.6 Sensitivity and specificity of CHD diagnosis and coding on death certificates as compared to reviewer, coder and information from hospital charts of decedents

	Coding review (%)	Hospital review (%)
Sensitivity	85	76
Specificity	89	72
Test bias	1.1	1.2

3.6 DISCUSSION

Exploration of the validity of death certificate information for classifying underlying causes of death has historically focused on "natural" or disease-related causes of death. An important question for public health interest in Bahrain is whether the high rates of CHD mortality in Bahrain is due to an actual increase in the incidence of coronary heart disease or due to overestimation by certifying physicians or miscoding by coding clerks.

To answer this question, it is necessity among other things, to examine the accuracy of certification and coding and to determine what measures are necessary to rectify any problem. The place of death may influence the accuracy of the recorded cause of death. Epidemiologic studies of coronary heart disease are heavily dependent on national mortality rates.

The diagnostic error for coronary heart disease is substantial but unquantifiable and is conservatively at least ± 30% (Stehbens 1990). Stehbens has agreed that combined with error, superimposed on innumerable errors and omissions in the compilation of mortality rates which precludes the use of cause-specific mortality data for scientific purposes.

In this study, 76 per cent of total deaths occurred in hospitals, 15 per cent at home, and 10 per cent from outside Bahrain most of which were certified in hospitals. The hospital death certificates are likely to be more accurate than police medical death certificates by reason of availability of in-hospital charts and any past medical history of the decedents, which might help physicians to assign an accurate underlying cause of death.

On the other hand, most (about 75%) of death certificates with a diagnosis of coronary heart disease occur out-of-hospitals and are certified by the police department in Bahrain. The biased diagnoses of CHD might be a factor in the high CHD rates in Bahrain. Postmortem is not carried out unless there is criminal suspicion associated with death, because traditionally, the relatives of deceased usually refuse the postmortem investigation. Since postmortem investigation has been established in the developed countries, the quality of mortality statistics has improved (Schottenfeld D et al. 1982).

Bahrain is following the International Form of Medical Certificate of Cause of Death from WHO, but there is a defect in the design of printed death certificates in Bahrain

(Appendix 1). The Part I-a, I-b and I-c is misaligned and mixed-up with the heading for part II, so that it is easy for the certifier to write a contributory cause of death in part I-c, where it will be coded underlying cause.

Validity of death certificates has been studied extensively (Engel et al. 1980; Corwin et al. 1980; Gillum et al. 1976) by various methods. The results of these studies are similar to the present study, showing inaccurate death certification in 10-30 percent of cases. To put it in positive terms, the level of correspondence between the official death certificates and those based upon the WHO diagnostic criteria was a little over 80%. This was true for all groups studied and nationalities, and for both sexes.

With regard to comparison between diagnosis of CHD in the hospital charts and reviewer's diagnosis, the sensitivity is more than predictive value of a positive results (confirmation rate), and the CHD false positive is more than CHD false negative, this may suggest that physicians tend to make certification diagnosis overestimated. On the other hand in Kuwait, the CHD diagnosis on the death certificates was found underestimated (Moussa et al. 1990).

The problems of death certification in hospital may be a consequence of inadequate training of physicians. The medical information on the death certificates is often incomplete, which increases the rates of ill-defined cause of death. The percent of ill-defined causes in Bahrain has fallen from 22% in 1974 to 7% in 1992 (Fig 1.3).

The physicians who certified most of hospital certificates were senior residents in this survey, while in some studies mostly their certifications were filled by junior residents (Anon 1982). Certifiers are not always familiar with the indexing of ICD-9 or the guidelines and instructions (WHO 1975) for filling out death certificates and do not realize how the order of entry of the terms which they record ultimately determines the selection of the underlying cause of death by the coders.

A gradual increase in death rate from cardiovascular disease was revealed in the Bahrain vital statistics (Bahrain Health Information Center 1991). It is difficult to say whether this trend is due to actual increase in the incidence of CHD or to overestimated diagnosis from hospital physicians or police medical officers, who are certifying two thirds of the total number of CHD mortality data.

The validation of coding CHD related deaths from death certificates by coding technician in the Public Health Directorate, and recode of the underlying cause of death by reviewer, we found that the false positive number was higher than the false negative, which mean that is an overestimated ICD-code diagnosis of CHD-related (410-414).

The agreement rate between death certificate and complementary inquiry was not modified by age, sex, socio-professional category, family situation, place of death and doctor who signed the certificate. This observation might mean that CHD mortality rates are overestimated in Bahrain.

The explanation of this is due to lack in training of coding clerks in medical terminology and WHO criteria of coding and classification of diseases and might be because of incomplete medical information on the death certificates. In Australia, a similar reliability and validity study of coding system has been carried out (Dobson 1983).

If physicians and coders understand how their reporting affect the classification of the underlying cause of death, they are likely to be more accurate in completing the death certificate. The vital statistics department can, and must, play a role in monitoring and encouraging accurate certification.

Ensuring that autopsy diagnosis are reflected on death certificates would be a step in the right direction. The quality of cardiovascular death certificate data will continue to be an important issue for epidemiologists and health policy makers, not simply to acknowledge but also to address, when using the mortality data in studies for control and prevention of cardiovascular diseases.

3.7 CONCLUSION AND RECOMMENDATIONS

3.7.1 Conclusion

There are several implications of the findings in the present study to investigate the accuracy of death certification of CHD mortality among decedents between 30-69 years of age in Bahrain. The ICD coding rules are followed reliably, and any tendency conclude in CHD mortality from official records are likely to be at least 75 per cent valid and reliable only inhospital deaths.

Therefore cardiovascular disease would be overestimated as a leading cause of death in Bahrain and a particularly unreliable community diagnosis. Present diagnostic and coding procedures are inadequate to distinguish trends in subclassifications of CHD (for example, in acute myocardial infarction).

Considerable confusion affects the certifying physicians in relation to the completion of the cause of death section of the death certificate. Attempts are needed to consigning to the physicians a standardized instruction in filling out the medical portion of the certificate.

Hospital deaths:

-moderate accuracy of certification.

-misclassification probably does not markedly alter them.

Out- of- hospital deaths:

-Validity unknown.

-cannot validate against autopsies.

-Could investigate criteria used by public doctors when interviewing families of decedents.

3.7.2 Recommendations

The Public Health Directorate should implement a medically qualified epidemiologist to supervise coders and to review the coded death certificate. The need for accurate certification of death for disease surveillance, research and planning is stressed. There is a need for reoriented thinking rather than just urging more education. The flaws in the theoretical framework of cause of death and the routine nature of death certification are unavoidable, but require consideration. Certifiers need practical feedback mechanisms, integral to continuing quality assurance at all levels and fostering an understanding of the construction of mortality data. There is a demand to improve the quality of death certificates diagnosed by police medical officers, by retrieving the admission in-hospital information or to stress on verbal autopsy from the next of kin and finally to encourage the postmortem diagnosis. Further prospective study is recommended about verbal autopsy to assess the validity of out-of-hospital CHD diagnosis on the death certificates, amenable to improve the quality of health statistical information in the Ministry of Health. Continued development should be a core public health medicine role in Bahrain. The accuracy of death certificates might be improved if coroners consulted clinicians more closely and if more senior hospital staff completed hospital death certificates.

3.8 SUMMARY

Agreement between death certificates and clinical records from the main general hospital in Bahrain was studied for a sample of 109 deaths occurring in 1993 for the following underlying or contributory causes: Coronary Heart Disease (CHD) and Others (non-CHD). The level of consistency between the stated cause of death on the death certificate and the diagnosis based on the hospital records with comparison of the reviewer's diagnosis was 76 per cent [test bias ratio was 1.2]. The agreement between technician coding of the death certificates mentioned CHD and others (non-CHD) cause of death for 308 deaths aged 30-69 years and certified by hospital physicians was 85 per cent [test bias ratio 1.1].

It was concluded that the total number of in-patient deaths attributed to the general category of CHD is reasonably accurate. The review of death certificates revealed numerous errors in completing death certificates. The majority of CHD diagnosis on the death certificates are certified by police doctors (two third) from community (out-of-hospital), and the rest from hospital doctors. The accuracy of these diagnosis is unknown.

It is recommended that improvement in the overall quality of mortality statistics in Bahrain is needed by hospital physician instructions and training, as well as for the coders and police physicians. Further investigation of the certification of out-of-hospital deaths could assess the criteria based on deaths attributed to CHD one.

Chapter 4

OBJECTIVES

4.1 INTRODUCTION

The prospect of this cross-sectional study is to present a true picture of the main non-communicable diseases in the Bahraini population and to make a comparison with other Arabian Peninsula populations as well as the other developed countries. Thus, this cross-sectional study uniquely might propose that the diabetes and coronary heart disease turn out more burdensome on women, or might be affect younger aged population, but this would be the reverse of the truth. This prevalence survey covered large number of Bahraini natives in order to find an adequate number of cases of CHD, since most individual of CHD diseases affect only a small fraction of the general population especially younger women

4.2 RATIONALE

The decision to study the prevalence of diabetes mellitus and CHD among Bahraini native population was motivated by widespread reported new cases of diabetes in the primary health care clinics, and mortality statistics showing death from CHD is the highest among the adults and elderly.

The fact is that no community-based studies have been conducted on the prevalence of diabetes, CHD and risk factors determination. The existing case series and case control studies in Bahrain and few cross-sectional studies in Arabian peninsula have shows that CHD and diabetes are common as non-communicable diseases.

The Ministry of Health in Bahrain has planned a prevention programme to decrease the incidence and control the known cases and that is one of the reasons to conduct a cross-sectional survey to measure the size of diabetes and CHD in Bahraini population.

4.3 AIMS

This study aimed to determine the prevalence of diabetes and CHD in Bahraini natives and associations with risk factors. The specific hypothesis to be tested is that diabetes and other metabolic complications of obesity would account for the high CHD rates. Furthermore, to prevent proliferation of these and other obesity-related diseases, and to plan adequate primary health care programs amenable to the control and prevention of obesity and related complications such as diabetes and CHD.

4.4 OBJECTIVES

The objectives of this study are:

(1) To estimate prevalence rates of diabetes and impaired glucose tolerance (IGT) in Bahraini natives, using standardized WHO diagnostic criteria, and to assess the association of diabetes with the following selected possible risk factors: age, obesity, family history of diabetes, and amount of Bahraini ancestry.

(2) To determine the age- and sex-specific prevalence of diabetes and to examine associations between related anthropometric and metabolic abnormalities in the Bahraini community.

(3) Finally, to estimate the prevalence of coronary heart disease in the Bahraini native population defined by ECG abnormalities according to the criteria for Minnesota Codes, and to investigate their associated factors, especially with non-insulin dependent diabetes, hypertension, hypercholesterolemia and physical activity.

4.5 SUMMARY

The nature of the opportunity - a planned cross-sectional study. Accordingly, the project addressed two sets of questions: the prevalence of diabetes mellitus, major Q wave on ECGs and determination of distribution of risk factors associated with these two diseases among Bahraini native population.

Chapter 5

METHODS

5.1 INTRODUCTION

The purpose of a cross-sectional study is to present a picture of disease in a population at a particular point in time. Generally, a single examination is implied, although sometimes there may be two examinations given initially to all subjects which may be followed by a more detailed examination of those suspected of possible abnormality. Information from a cross-sectional study is of two types, either relating to disease status, or describing other characteristics. Population surveys of cardiovascular disease may vary in their purposes almost as much as clinical investigations, whereas rational planning depends on forming a clear idea of the particular objective.

Fortunately, the mortality and recovery rates for a particular disease are often similar in different populations, in which case it is legitimate to use the respective prevalence rates as a comparative index of disease, but the assumption that is implied in making such a comparison may sometimes be incorrect. A good example of this situation is provided by contrasting the prevalence of IDDM in rural under developing countries, where there is no good control of diabetes. Certain surveys indicate that the age-specific prevalence rates for angina in middle and late life may be valid for men but not for women, and that the rates for S-T and T changes in the ECG may be actually higher in women, therefore it has to be biased. This unexpected finding could be perhaps related to the observation that CHD is less often associated with infarction in women survivors and can be identified in a prevalence study. Thus, a cross-sectional study alone might suggest that the disease bears more heavily on women, but this would be the reverse of the truth. Prevalence surveys must usually cover large numbers of persons in order to find an adequate number of cases, since most individual chronic diseases affect only a small fraction of the general population. Finally, the development of CHD may depend not simply on an individual's habits at a particular time, but also on a change in habits. The disease seems to be commoner in populations that have experienced a rise in the standard of living over such factors as change in social status, diet, or physical activity over a period of time.

5.2 DESCRIPTION OF POPULATION

5.2.1 Target population

The target population consisted of all Bahraini native men aged 40-59 years old and women aged 50-69 years old in all regions of the State of Bahrain. The non-Bahraini expatriates residents in Bahrain were excluded from this survey.

5.2.2 Study population and sample size

The sample of this study was obtained from Bahrain Central Statistical Organization , from the latest census in Bahrain which has been established during 1991. Bahriani natives, aged 40-59 years old men and 50-69 years old women were the target population which constituted the study population.

The calculation of sample size is based on the precision required for the prevalence estimate. The exact 95% confidence limits for various rates and sizes of random samples, based on the effects of sampling variability; the error is inversely proportional to the square root of sample size, so that doubling the sample size reduces the limits by about 30%. The appropriate formula (Rose G, Blackburn H, Cillum RF, Prineas RJ. 1982) for the calculation is as follows:

$$SE = \sqrt{\frac{pq}{n}}$$

where S.E.= standard error

p = proportion affected

q = (1 - P)

n = number in sample

$$SE = \sqrt{\frac{0.03X0.97}{1000}} = 0.005$$

To derive the required sample size, we set the expected prevalence of Q wave on the ECG at 0.03, based on published data from comparable populations, so the standard error after calculation will be 0.5%.P = 0.03

5.2.3 Sample Frame

The sampling frame has been set to a round value of 1/20, using this sampling fraction. The first individual was selected randomly, and then every 19th individual in the census list selected. The census list was sorted by region, block number, sex and age group. All urban and rural areas of Bahrain were represented in eleven regions.

The random sample was 2,000 Bahraini native men aged 40-59 years and 2,000 Bahraini native women aged 50-69 years old in the year 1995. A stratified systematic simple random selection of subjects, ensured that the age and sex distribution of the sample were reflected. A probability sample obtained in accordance with recommendations for sample surveys of health in developing countries (Bahrain Central Statistical Organization 1991).

The sample were representatively stratified for sex, age, geographical area. The target population of the survey was between age 40-59 males and 50-69 females, approximately 38366 people (11%) of total Bahraini population and about 7% of total whole Bahrain population respectively.

5.2.4 Techniques for drawing the sample

If n= the required sample size, and N= the number of persons in the enumerated population, then the selection of every (n/N)th person on the list will provide an effectively random sample of the right size, provided that the starting point is randomly selected.

5.2.5 Inclusion and exclusion criteria

All standard regions of Bahrain were represented in this survey. The subjects selected only Bahraini native men and women, and the target populations were both men aged 40-59 years old and women aged 50-69 years old (Table 5.1). All known and unknown individuals with diabetes were included in the sample.

All non-Bahraini residents were excluded from this survey and any subject aged less than 40 years in men and 50 years in women. Subjects aged more than 59 years in men and 69 years in women were excluded as well. Also, subjects with serious disability or life-years in women were excluded as well. Also, subjects with serious disability or life-threatening illness, mental handicap, recent psychiatric illness, terminal malignancy or other advanced disease.

Table 5.1 Bahraini population men aged 40-59 y and women 50-69 y by regions and sex

	Total Bahraini population				Total survey population			
	Male		Female		Male		Female	
Region	No	(%)	No	(%)	No	(%)	No	(%)
Hidd	494	(1.2)	404	(1.1)	32	(1.5)	30	(1.4)
Muharraq	3921	(10.2)	3223	(8.4)	203	(9.5)	169	(7.9)
Manama	3603	(9.4)	3388	(8.8)	166	(7.8)	213	(10.0)
Jidhafs	2205	(5.7)	1917	(5.0)	140	(6.6)	101	(4.7)
Northern region	1368	(3.6)	1042	(2.7)	67	(3.1)	61	(2.7)
Sitra	1290	(3.4)	1093	(2.8)	74	(3.4)	56	(2.6)
Central region	1766	(4.6)	901	(2.3)	75	(3.5)	36	(1.7)
Isa Town	3005	(7.8)	1255	(3.3)	182	(8.5)	81	(3.8)
Riffa	2528	(6.6)	1313	(3.4)	165	(7.7)	70	(3.2)
Western region	946	(2.3)	705	(1.8)	63	(2.9)	50	(2.3)
Hamad Town	1568	(4.1)	431	(1.1)	78	(3.7)	16	(1.0)
Total	22694	(59.1)	15672	(40.9)	1245	(58.5)	883	(41.5)

Source: Bahrain Central Statistical Organisation (BCSO 1991).

The percentage distribution of the subjects in all regions of Bahrain are presented in Table 5.2. Both men and women showed similar percentages distribution between original sample of the survey and responded subjects sample.

Table 5.2 Original and survey sample population by region and sex in 1991 Census.

	Original sample population				Total survey population			
			Female		Male		Female	
Region	No	(%)	No	(%)	No	(%)	No	(%)
Hidd	50	(1.2)	45	(1.1)	32	(1.5)	30	(1.4)
Muharraq	414	(10.2)	342	(8.4)	203	(9.5)	169	(7.9)
Manama	357	(8.8)	383	(9.4)	166	(7.8)	213	(10.0)
Jidhafs	242	(5.9)	194	(4.9)	140	(6.6)	101	(4.7)
Northern	138	(3.4)	117	(2.9)	67	(3.1)	61	(2.7)
Sitra	141	(3.5)	111	(2.7)	74	(3.4)	56	(2.6)
Central	183	(4.5)	99	(2.4)	75	(3.5)	36	(1.7)
Isa Town	332	(8.2)	119	(2.9)	182	(8.5)	81	(3.8)
Riffa	280	(6.9)	127	(3.1)	165	(7.7)	70	(3.2)
Western	99	(2.4)	75	(1.8)	63	(2.9)	50	(2.3)
Hamad Town	166	(4.1)	46	(1.1)	78	(3.7)	16	(1.0)
Total	2402	(59.2)	1658	(40.8)	1245	(58.5)	883	(41.5)

Source: Bahrain Central Statistical Organization (BCSO 1991).

5.2.6 Letter of invitation

Broad guidelines, including an example letter, were given to each center. These included the following: the letter should be brief (usually less than one page) and include details, in lay language, of

(i) the purpose of the study,

(ii) what participation in the study would entail,

(iii) why the subject had been chosen for participation,

(iv) confirmation that any examination performed would be free of charge, and

(v) reassurance that the data obtained will be fully confidential.

Each center, however, was ultimately responsible for the design of its own letter, and for arranging a convenient appointment system. A follow up letter was sent to those who failed to attend after the first letter. A record book which recorded details of all those who were invited and when they attended for interview was kept in each center. The record book was forwarded to the coordinating center at end of the survey.

5.3 SURVEY PROCEDURE

5.3.1 Participation survey centers

Eleven centers for the Ministry of Health in Bahrain participated in the Bahrain Heart Health and Diabetes Survey (BHHDS); one health center in the capital was used as a headquarter for coordinating and surveillance of data collection.

Participation centers were recruited on the basis of access to a population based sample, and facilities to perform this community survey. In addition, each center was provided with required sufficient financial and administrative resources to complete data collection.

5.3.2 Survey publicity

Publicity concerning the survey appeared in the local newspapers and on the radio. The publicity was arranged by the Ministry of Information, and the radio publicity was conducted in Arabic language. At the time of the survey, written and verbal information was given to each household concerning the reasons for the survey and what it might entail for each individual.

There was a specific "motivator" for the survey community nurse who had the primary responsibility for liaison and for issuing invitations and re-invitations. As well as initial contact at the time of the survey, each community region was contacted several days before the arrival of the survey team in that area. Additionally, all individuals were given an invitation letter (with instructions for fasting) within 2-3 days of their appointment.

The newspaper advertisements, radio and television announcements and posters were arranged through the Health Education Department in the Ministry of Health. Subjects who required an official letter for their employer requesting the latter's cooperation in allowing the person time off from work to attend the survey were given.

The extent to which non-responders were sought depended on the overall response rate, but normally involved at least one re-invitation while the survey team remained in the area. Demographic characteristics of non-responders were determined at the household census and compared with those of responders. A sub-sample of non-responders contacted during the survey to complete a brief questionnaire to identify their reason for non-attendance (e.g. too ill, dead, not interested, away from Bahrain, etc).

Most of subjects questioned about non-response were not interested 47/120 (39%), too ill were 7/120 (5%), wrong address were 16/120 (13%), busy were 30/120 (25%), traveled abroad were 19/120 (16%) and finally 3/120 (2.5%) were in the jail for unknown reason. An appropriate survey site was selected for each region in Bahrain and all health centers in Bahrain were recruited. All subjects were asked to fast and to present to the survey clinic in each health center in Bahrain between 7.30 and 10.30 in the morning. Participants were asked to bring their invitation letter and any medical documents about diseases treatment and their medication.

5.3.3 Pilot study

A pilot study was carried out to determine the prevalence of disease in the Bahraini community and to ascertain the best methods applicable for a large study. Three sites were chosen for the study, Muhharaq area, Manama and Isa Town. The subjects were volunteers aged between 40 years and 69 years who visited the appropriate health centers.

Over the 2 month study period, a total of 184 subjects were examined. The prevalence of diabetes was 22% by the World Health Organization (WHO) criteria. The prevalence of known cases of diabetes was 7% in men and 11% in women respectively. Of the 184 subjects examined, 58% had positive history of chest pain and the prevalence of known heart disease was 4.7%. The prevalence of diabetes mellitus was 17.9% in men and 25% in women.

5.3.4 Training programs

Staff were trained by the principal investigator before starting the survey. They were trained how to do the interview with the subjects, to fill in the questionnaires, anthropometric measurements, blood pressure and ECG recording.

The laboratory staff were also trained by the leader of the survey prior to beginning of the project. They were trained to fill laboratory sheets in the questionnaire and to ensure about the subject case if he/was a known case of diabetes or unknown. They instructed that if the subject is known diabetic no glucose load to be given. They were trained about the blood samples separation in the centrifuger before sending the samples to the main laboratory of the Ministry of health

5.3.5 Supervision

This survey was supervised both by the author of this thesis and an expert community nurse. Periodic observation of the work of each interviewer was followed by both supervisors and re-interview of a proportion of subjects.

5.4 DATA MANAGEMENT

5.4.1 Data collection

All data were collected on standardized questionnaire and forms and were transferred to computer files and edited for errors, before computer analysis. The data collected were timely performance of range and logic checked by computer. The distribution variables among interviewers were compared for missing and biased data collected.

5.4.1.1 General health information

The questionnaires were completed by the staff community nurses of Ministry of Health with each participant. All questionnaires were written in English, but translated and written by the principal investigator into the Arabic language spoken by the participants.

Subjects were asked about history of health status, any medical illness at present or past, use of any medication, history of chest pain-Rose Questionnaire (Rose and Blackburn 1982), physical activity, type of food eaten in last seven days (7 days recall diet questionnaire **Appendix** 3). Physical activity was divided into two categories; occupational physical activity (sitting, walking, standing, carrying heavy objects) and any sports exercise (walking, cycling, jogging, football playing etc.).

5.4.1.2 Smoking and social information

Socio-econmic information was obtained about occupation, family income (for non employed women, they were been asked about husbands occupation) and past family socio-demographic data when subject was at the age of 12 years old. A family history of diabetes or hypertension was recorded when any first degree relative had these disorders. Subjects taking any type of alcohol were grouped together as alcohol drinkers.

Subjects were asked if they smoked, at the time of the survey or in the past. If they were current of the past smokers, the number of cigarettes smoked per day and duration of smoking was recorded.

5.4.1.3 Medical history information

The questionnaire, which had previously been tested in a pilot study of 100 subjects volunteers with similar characteristics , consisted of questions requesting general information about each person and information concerning the presence of noninfectious diseases diagnosed by physicians.

Regarding cardiovascular diseases, any present history of myocardial infarction, angina, hypertension, and ischaemic heart disease. For diabetes, if had been diagnosed as diabetes IGT and gestational diabetes for women. Women were asked in detail about parity, history of contraception used, any gynecological diseases and menopausal history.

5.4.2 Clinical Physical Assessment

5.4.2.1 Blood pressure (BP) measurement

Blood pressure was recorded by one staff nurse in each health center, trained specially for the survey. Blood pressure measurements were recorded in a quiet room after the subject was told to rest for 5 minutes. Standard mercury sphygmomanometers were used with a single long cuff which ensures a full encircling of the arm in all subjects.

Outer garments were removed to properly expose the right arm. If the latter is missing or deformed, then the left was used, and this noted adjacent to the blood pressure records. The right arm were rested comfortably on the table, elbow level with the heart, and upper arm at an angle of about 40^0 to the trunk. Large adult-size cuff were used as standard. The nurse were trained in the following steps: the cuff was applied firmly with the middle portion of the bladder positioned over the brachial artery. The lower edge of the cuff was 2-3 cm above the cubital fossa, to allow space for the bell of the stethoscope. The observer established the pulse obliteration pressure by palpating the radial pulse with the index finger of the left hand while inflating the cuff with the other. The cuff inflated to about 30 mmHg above this level. The stethoscope bell was lightly placed over the position of the brachial artery. The cuff pressure was released at a steady rate of about 2 mm Hg per heart beat. Systolic pressure is the level where the first sounds identifiable as pulses are heard. Diastolic pressure was taken at the level where sounds cease (5th phase).

The cuff was then be deflated completely and the measurement recorded. A further measurement was then be taken by following the same sequence. If the observer is unable to hear or forgets a phase recording, the was deflated and the measure repeated. In cases where there is no apparent phase 5, the phase 4 measurement (first muffling of sound) was recorded, with such reading noted on the record sheet. If the two readings are different by greater than around 20%, then a third measure should be recorded adjacent to the others.

5.4.2.2 Anthropometric Measurements

(i) Body mass index (BMI)

Weight and height were recorded with the subjects wearing very light clothing and without shoes. Accurate balance scales were used, height was recorded to the nearest centimeter and weight was to the nearest 0.1 kilogram. Height was measured at the start centimeter, rounding up if midway, using a measuring rod. Subject was stand up-right with back against the stand, heels together and eyes directed forward so that the top of the tragus of the ear is horizontal with the inferior orbital margin, and the measuring plate lowered on to the scalp to give the correct level.

(ii) Waist-hip measurements

The waist and hip measurements were recorded by the same person who recorded the height and weight in the same room. The subjects were asked to stand relaxed in a screened area. One layer of light clothing over underwear is acceptable. The observer knelt or sat at an appropriate height in front of the subject, who breathed quietly and normally. A dress-maker's measuring tape was used, taking care that it is applied horizontally. The waist was defined as the smallest girth between the costal margin and illac crest, and the hip as the circumference at the level of the greater trochanters.

Waist girth was measured at the midpoint between the iliac crest and the lower margin of the ribs. An approximate indicator of this level was ascertained by asking the subject to bend sideways. Hip girth was recorded as the maximum circumference around the buttocks posteriorly and indicated anteriorly by the symphysis pubis. Measurements were made to the nearest 0.5 centimeter and were repeated following both initial recordings. If there was variation greater than 2 cm between duplicate readings then a third was taken and recorded alongside the second one.

5.4.3 Blood specimens collection, handling and processing

All the tested persons were asked to fast overnight (minimum 10 hours), and the period of fasting was ascertained by questioning the study subjects prior to registration. After registration, 10cc of fasting venous blood specimens were collected from all subjects using florid tubes for fasting blood glucose and EDTA tubes for lipids assay.

Plasma was separated by centrifuge immediately, labeled, kept in ice boxes soon and transferred within 6 hours to the main laboratory of the Ministry of Health, for assay glucose and different lipid parameters. Fasting and 2-h plasma glucose values were determined immediately. Plasma glucose was estimated in the laboratory by glucose oxidase method (GOD-PAP Kit, Boehringer). Known cases of diabetes were instructed not to take 75g glucose syrup for 2hs-GTT.

5.4.3.1 Glucose determination

Blood samples were taken after an overnight fast of 12-16 hours on the second visit to the clinic. Venous blood were taken for estimating plasma glucose, plasma cholesterol, and plasma triglyceride concentrations. Then 75 g glucose dissolved in 300 ml Cola drink and water were drunk in two to five minutes and the venous blood glucose concentration were re-estimated two hours later. A guaranty was given by the manufacturers of the Cola drink that it does nôt contain any source of fructose, but only glucose.

Temporary laboratory spaces were established at each survey site with bench space, and a centrifuge. This facility was in close proximity to the area of blood collection. One person was responsible for the measurement of the plasma glucose, and plasma lipids.

Glucose values and subject numbers were recorded clearly in separate columns in the Glucose Results Book and transcribed to survey forms as soon as possible at the end of the day's work. The glucose analyzer technician and the assistants ensured the glucose specimens were collected from the venesection station and centrifuged as quickly as possible (within 30 minutes). Plasma was pipetted into microcentrifuge tubes and presented to the technician, 10 ml (fasting) and 5 ml (2-hour) plain specimens were left at room temperature and allowed to clot prior to serum separation.

5.4.3.2 Blood lipid determination

Total plasma cholesterol and triglycerides were measured using the Cobas Mira S Clinical Analyzer (F Hoffman La Roche & Co., Basel, Switzerland) and Roche diagnostics Unimate 7 cholestrol kits. Sufficient blood was taken for a sample to be used for glucose and lipids, and also to store a frozen plasma and cells samples for future fasting plasma insulin and determining the genetic outlook among Bahraini native population.

5.4.4 Electrocardiogram

Standard supine 12 lead electrocardiograms (ECG) were recorded with a paper speed of 25 mm/s in the sample population. All electrocardiographic equipment fulfilled the recommendations of the American Heart Association's technical specifications. Electrocardiographic recordings were carried out by staff nurses of the Ministry of Health, who were specially trained for subject preparation, electrode placement, and other aspects.

The staff nurses were trained with the following: resting 12-lead ECGs were performed on subjects. They should preferably be in a quiet area with a screened couch. Careful preparation of the skin-electrode contact is necessary, involving skin cleansing and shaving, application of jelly, and use of clean electrodes with cable contacts.

Clip-on limb leads are convenient and time-saving. Chest leads should be positioned in the standard fashion and the subject's name and survey number were recorded on his/her tracing. The box on the subject's record sheet should be ticked to indicate that the test has been performed. Following completion of the ECG, excess jelly should be wiped from the skin and the recording maintained at this station in order of survey number. All electrocardiograms were read and checked to ensure its quality before shipping them to London for coding. Abnormalities were checked by the principal investigator and reviewed by the cardiologists for further medical assessment and follow-up with the subject.

5.5 STATISTICAL POWER OF THIS STUDY

5.5.1 Data entry and data management

All data which were generated through the interview, physical examination and laboratory measurement were entered into computer program formulated by one person expert in data entry. The software package used for this data entry was D-Base IV. The program ascertained which type of questionnaire was being entered, and then compared demographic information about the subject from the Bahrain Statistical Organization to that given on the questionnaire.

This was used to ensure that data was entered for the right subject. Answers to questions were then recorded if the subject was eligible, and also information about eligibility and response. Most questionnaires were entered once, by same contracted person. Then all entered data into the computer was cleaned and checked weekly by the author of this thesis to ensure errors and missing data. A random sample of 100 was re-entered towards the end of the Survey period, which showed an error rate of less than 1%. Information from this program was also used to create lists for sending reminder questionnaires to non responders.

5.5.2 Data coding and statistical analysis

5.5.2.1 Statistical analysis

Information was divided and analyzed separately by section:

i. Description of the subjects in the study

ii. Prevalence rates of diabetes, obesity, hypertension, and coronary heart disease.

iii. Established and less well established risk factors

Data was analyzed using the STATA FOR WINDOWS (Stata Corp Mass.USA) statistical package. Current prevalence of disease and risk factors e.g. diabetes (known and/or newly diagnosed), IGT, cigarette smoking, obesity, hypertension, and ECG ischaemia, by age, sex and ethnicity were calculated. Age standardization prevalence rates of diabetes were compared with other surveys using same criterion. Mean/median values and distributions of continuously distributed variables were described. Simple statistics (e.g X^2 and odds ratios) were used to identify differences between groups, and ttest was also applied to identify differences between two means of continuous variables such as body mass index, waist- to- hip ratio, Cholesterol etc. Geometric mean was calculated using log-transformed values to reduce skewness produced by some variables such as triglycerides.

Data were first explored in univariate analysis. Each association was first studied in bivariate analysis. Similarly, relation of outcomes to potential confounders was first assessed in bivariate analysis. Multivariate logistic regression was used in attempts to elaborate important independent risk factors. Association between continuous variables was studied by linear regression. Association between continuos dependent variables and independent categorical variables was estimated of variance and analysis of covariance.

Adjusted means with their standard errors were produced by linear regression. Significance of trends in means by factored independent variables with three or more levels was estimated by fitting the independent variable as a continuos variable in a least linear regression model. Most results presented in this thesis are adjusted for age (10 years age groups), and sex when both sexes are combined and to ethnic origin by area of residence and at least one of grandparents country of birth (Sunni Arab, Shi'ite Arab, Mixed, and Iranian). Data were adjusted for variables which significantly predicted the outcome, these variables most often included: age, sex, area of residence, BMI, smoking, high blood pressure and high cholesterol.

5.5.2.2 Restriction of analysis

Data were analyzed separately for men and women, and pooled results for both genders were performed only exceptionally when sex-specific results are similar, and after making sure that interaction term between sex exposure of interest is not significant.

5.5.2.3 ECG data coding and analysis

ECGs were coded in duplicate according to the Minnesota classification, (Blackburn, et al. 1982) by observers trained against packs from Minnesota with no information about the participant other than identity number available to the observers.

The following categories of positive screening findings were defined:

A) Angina and possible Infarction based on diagnosis of cardiologists in the hospitals and standard questionnaire. (Data were missing in 47 men aged 40-59, and 31 women aged 50-69 years).

B) Positive ECG signs were regarded as occurring in subjects with any one or more of the following items of the Minnesota Code:

Q/ QS waves (codes 1.1-3) and S-T depression (codes 4.1-4), T-wave inversion or flattening (5.1-3), or left bundle branch block LBBB (codes 7.1). ECG recorded were missing in 39 (1.8%) men aged 40-59 yr, and 21(1.0%) women aged 50-69 yr and unable to code were 37(1.7%) men and 33(1.5%) women, coded positive ECG were 181(8.5) men and 274(12.9%) in women and finally ECG coded normal were 985(46.3%) men and 558(26.3%) in women (Table 5.3).

In accordance with another report (Reid et al. 1976) from the Whitehall study analyses were: "probable CHD" (major Q and QS items: codes 1.1 and 1.2), and "positive CHD on ECG " (minor Q and QS items, S-T/T items or left bundle branch block LBBB: codes 1.3, 4.1-4, 5.1-3 and 7.1). In accordance with another report (Blackburn et a. 1982)

from the Whitehall study analyses were performed after combining the "probable CHD" and "positive CHD on ECG" categories to obtain as "possible CHD on ECG" category.

Table 5.3 The classification of electrocardiograms were recorded and coded.

	Men		Women		Total	
ECG	**No**	**(%)**	**No**	**(%)**	**No**	**(%)**
Missing	39	1.8	21	1.0	60	2.8
Undoable	37	1.7	33	1.5	70	3.2
Coded positive	181	8.1	274	12.9	455	21.0
Coded normal	985	46.3	558	26.3	1543	73.0
Total	1242	58.4	886	41.6	2128	100

The variable labeled qwave "Major Q/QS 1.1-3 wave on ECG", and indicator variable were defined (0="no Q wave, 1=code 1-1, 2 =code 1-2, 3=code 1-3). The major Q wave diagnosis defined (0=Negative Q wave and 1= Positive Q wave). We generated a variable history of diagnosed CHD (angina or infarction) and positive on ECG were defined as (0=No history of CHD and 1=Yes history of CHD).

Probable CHD diagnosed by physicians, variable created for positive major Q wave and positive diagnosis by physician and defined as (0=normal on ECG, and 1=Probable CHD diagnosed by physicians). ST-J depression variable was defined(0=no ST wave, 1=code 4-1, 2=code 4-2, 3=code 4-3, and 4= code 4-4). T wave inversion variable was defined (0=no T wave, 1=code 5-1, 2=code 5-2, 3=code 5-3). Left bundle branch block LBBB defined as(0=No LBBB, 1=code 7-1, 2=code 7-2, 3=code 7-3, 4=code 7-4" 5 "code 7-5".

Frequency of positive CHD by category of ECG signs was defined as(0=normal ECG, 1=minor Q, ST depression, T wave or LBBB, 2=major Q). Possible CHD diagnosed on ECG was defined as (0 =possible CHD, 1=normal ECG).

5.5.2.4 Diabetes data coding and analysis

The diabetic category includes men and women treated for diabetes and those with 2-hour glucose ≥11.1 mmol/l. Impaired glucose tolerance was defined as 2-hours glucose 7.8-11.0 mmol/l. (WHO 1985). Test of significance for prevalence rates in each exposure category were directly standardized to the combined age distribution of the groups being compared. Abnormalities were then grouped according to the WHO criteria.

Fasting plasma glucose (mmol/l) indicator variable was defined as (1<7.8 mmol, 2=7.8 mmol or more). Glucose tolerance test category was defined as (1=normal, 2=impaired 3= diabetic). Diabetes new or known, indicator variable was defined as(0=not diabetic and 1= diabetic). A new variable was created to have four categories for glucose tolerance category and defined as (1=normal, 2= IGT, 3=new diabetic, and 4=known diabetic).

5.5.2.5 Anthropometric measurements data, coding and analysis

Quetelet's body mass index (BMI) was calculated for each subject, using the equation [weight (Kg)/ height(m)^2]. Abnormalities were then grouped according to the following classification: Body mass index category (kg/m2), indicator variable was defined as(1 <20 Kg/m2, 2=20-24.9 Kg/m2, 3=25-29.9 Kg/m2, 4=30-39.9 Kg/m2, 5=40 kg/m2 or more). Obesity diagnosis indicator variable was defined as (0=Ideal weight when BMI<30 and 1=Overweight when BMI>30). Waist-hip ratio category indicator variable was defined as (1<0.85, 2=0.85-0.89, 3= 0.90-0.94, 4=0.95-0.99, 5=1.00-1.04, and 6 >1.04). Waist-height ratio category indicator variable was defined as (1 <0.45 2=0.45-0.50 3=0.50-0.55 4=0.55-0.60 5=0.60-0.65 6 >0.65).

5.5.2.6 Physical activity data coding and analysis

Walking and cycling information were then grouped according to the criteria:

For walking assessment, we created Km walked on weekday indicator variable was defined as [walkkm=5 x walkwk(walking/day in average week) + walkwe(walking in week end)]. For cycling and cycling/week indicator variable was defined as [cyclewk=5 x cyclwk(cycling/day in average week) + cyclewe(cycling in weekend)].

For assessment of amount of calories expenditure from walking and cycling we generate new variable calxkm=(30 walkkm + 21 cyclekm)/7 and this variable labeled as “calxkm” "Kcal/day in walking/cycling", then we categorized calxkm to three groups: 1) calgr= calxkm<30, 2) calgr= calxkm>=30 & calxkm<70 and calgr= calxkm>=70.

5.5.2.7 Smoking data coding and analysis

To ensure that the association between smoking and CHD was not biased by men who had stopped smoking when heart disease was diagnosed, ex-smokers were classified together with current smokers, according to the number of cigarettes per day usually smoked in the past.

5.5.2.8 Plasma lipids data, coding and analysis

Abnormalities were then grouped according to the following criteria

Fasting plasma cholesterol category (mmol/l), indicator variable was defined as (1 <5.2 mmol/l, 2=5.2-6.2 mmol/l, and 3 >6.2 mmol/l). Plasma triglycerids category, indicator variable was defined as (1 <2.8 mmol/l, 2=2.8-3.1 mmol/l, and 3 >3.1 mmol/l). High density lipoproteins (mmol/l), indicator variable was defined as (1 <1.7 mmol/l, 2=1.7-2.5 mmol/l, and 3 >2.5 mmol/l). Low density lipoproteins (mmol/l), indicator variable was defined as (1 <1.8 mmol/l, 2=1.8-2.4 mmol/l, and 3 >2.4 mmol/l).

5.5.2.9 Blood pressure measurements data coding and analysis

Abnormalities were then grouped according to the following criteria

Systolic blood pressure (mmHg), indicator variable was defined as (1= <160 mmHg, and 2=160 mmHg or more). Diastolic BP category (mmHg), indicator variable was defined as (1 <95 mmHg, 2=95 mmHg or more). We created two variables for calculating the median of systolic and diastolic blood pressure. .

For systolic blood pressure, we generated bpsysto=(systo1n+systo2n)/2. The bpsysto recoded (bpsysto 0=missing), and the variable bpsysto labeled as "Systolic blood pressure (mmHg)". Systolic blood pressure category (mmHg), indicator variable was defined as (1 if bpsysto <160 mmHg and 2 if bpsysto>=160)

For diastolic blood pressure, we generated bpdisto=(disto1n+disto2n)/2. The bpdisto recoded (bpdisto 0=missing), and the variable bpdisto labeled as "Diastolic blood pressure (mmHg)". Diastolic blood pressure category (mmHg), indicator variable was defined as (1 if bpdisto <95 mmHg and 2 if bpsysto>=95)

Four types of blood pressure were defined according to blood measurements by present survey nurses, history of high blood pressure diagnosed before, and history of treatment of blood pressure. For blood pressure diagnoses we generated blood pressure group=4 "Treated hypertensive" if told high BP before and on regular treatment for high BP. Blood pressure group=3 "Untreated definite hypertensive" if told high BP before but no regular treatment for high BP and systolic BP>=160 or diastolic BP>=95. Blood pressure group=2 "Borderline hypertensive" if not been told high BP before and systolic BP >=140 or diastolic BP>=90. Blood pressure group=1 "Normotensive" if not been told high BP before and systolic BP <140 or diastolic BP <90 mmHg.

To define normal and high blood pressure, we generated new variable labeled “hibp” "Hypertensive or normal". Normal blood pressure category (mmHg), indicator variable was defined as hibp=0 "Normal BP" and high blood pressure category (mmHg), indicator variable was defined as hibp=1 "Hypertensive".

To define adequately treated high blood pressure, we generated new variable labeled “bpadq” "Adequately treated Hypertensive" Adequate treated blood pressure category (mmHg), indicator variable was defined as hibp=0 “Treated hypertensive, systolic BP <=160 and diastolic BP<=95” . Not adequate treated blood pressure category (mmHg), indicator variable was defined as hibp=1 “Treated hypertensive, systolic BP >160 and diastolic BP >95 mmHg” . To define median blood pressure, we generated new variable labeled “bpsysr=500” if treated hypertensive=1 and variable labeled “bpdisr=500” if treated hypertensive=1. Median treated systolic blood pressure category (mmHg), indicator variable was defined as "Systolic BP with treated high" and median treated diastolic blood pressure category (mmHg), indicator variable was defined as "Diastolic BP with treated high".

5.5.2.10 Social class data coding and analysis

“Level of education” grouped into those with university degrees, school diplomas, illiterate. Test of significance for prevalence rates are based on the P values statistics with stratification by 10-year age group. Associations of diabetes and CHD with various measures of risk factors such as smoking, obesity, and plasma lipids, were investigated using multiple logistic regression (MLR) analysis, with diabetes and CHD outcome as the dependent variables. Tests of significance were derived from logistic regression models and the degree of effect of risk factors was summarized by the odds ratio (OR), 95% confidence interval (95% C.I.) and test for linear trend.

When comparing mean values of risk factors between age groups and social classes, standard of covariance was used for continuous variables, while the percentages were compared using logistic regression. All analysis were adjusted for age.

5.5.2.11 Parity and menopause coding and analysis

Parity indicator variable was defined as(0=no children and 1= with children). A new variable was created to have four categories for parity category and defined as (0=0 child, 1= 1-4 child, 2=5-7 child, and 3=8 children or more). Menstrual cycle (Periods) indicator variable was defined as(0=premenopause and 1=postmenopause).

5.6 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance and quality control activities were performed in all the different phase of this study to maximize the reliability and validity of the data collected. The examining community nurses recorded the information into the questionnaires and in the clinical forms. The coordinator of this survey received those forms at end of the weekday. After checking for competence, the coordinator filed and stored them in coordinating center. The supervisor and coordinator of this survey reviewed all the questionnaires and clinical forms.

The quality control of the forms and questionnaires, carried out routinely throughout the period of field work, was greatly facilitated by the design of this data collection. Cross-checking of information was frequently made by supervisor and coordinator of this survey. If inconsistencies were detected and could not be resolved by the field workers at the survey center, then they were requested to repeat checking the form or questionnaire with the subject to correct or complete it with some additional piece of information.

Besides the initial training programme, the field work team had regular meetings with the supervisor and coordinator of the survey during the whole period of data collection in order to share experiences and discuss difficulties encountered in the work. All the equipment used in this survey has been cross-checked to ensure quality of performance and any maintenance needed was provided to ensure high quality results of the measurements. Quality control of laboratory analyses was performed according to the established programmes, based on international scientific standards, of each laboratory involved in this survey. Before submission to the keyboard data entry, the questionnaires and forms were reviewed for completeness, consistency and other errors. After entry, computer programmes were run to verify the consistency of responses within each questionnaire or form and between them.

5.7 DEFINITIONS

5.7.1 Diabetes mellitus

Diabetes and impaired glucose tolerance were defined according to the 1985 World Health Organization Criteria (WHO 1985b) for epidemiological studies, and were as follows:

1) NIDDM: FPG ≥140 mg/dl (7.8 mmol/l) or 2-hr plasma glucose >200 mg/dl (11.1 mmol/l), or history of physician-diagnosed diabetes;

2) and IGT: FPG <140 mg/dl (7.8 mmol/l) and 2-hr plasma glucose 140-199 mg/dl (7.8-11.1 mmol/l).

3) A history of physician-diagnosed diabetes, with or without current use of hypoglycaemic agents, will be differentiated newly diagnosed and previously known NIDDM.

4) Non-diabetic (normal): All those who do not meet the above criteria for either NIDDM or IGT will be classified as having normal glucose tolerance.

5.7.2 Hypertension

Hypertension was defined by (World Health Organization 1978) criteria, that is systolic blood pressure ≥160 mm Hg or diastolic pressure ≥95 mm Hg, or both.

5.7.3 Obesity

Obesity was defined by body mass index calculation as weight/height^2 (Kg/m^2). Overweight were defined as a body mass index ≥25 in men and women and obesity as a body mass index of ≥30 in both men and women.

5.7.4 Consanguinity

Consanguinity was defined by a blood relationship between mother and father and classified to three groups, double first cousin, first cousins, and other relationship.

5.7.5 Socioeconomic status

The following classification of socioeconomic status by occupation, which has been used by the Census Bureau (Bahrain Central Statistical Organization 1991) in 1991:

1. **Administrative & Managerial Workers** (Undersecretary, assistant undersecretary, and administration directors).

2. **Professional, Technical Related workers** (Chemists, physicians, geologists, astronomers, pathologists, Botanists, Engineers, pilots, ship captains, pharmacologists, lawyers, legal judge and professional economics).

3. **Technicians and Technical Related workers** (Physiotherapy technicians, nurses, dental technicians, X-ray technicians, pharmacology technicians, school teachers, accountant technicians, executive secretary and bank teller).

4. **Clerical & Related Workers** (Birth registrar, death registrar, legal Clarks, office clerics, typist, employment services clarck sand collectors).

5. **Sales Workers** (Sales and purchasing mediation occupations, brokers and auctioneers, insurance, shipping and clearance mediation occupation and food supply salesmen)

6. **Service Workers** (Hairdressers, bakers, cooks, waiters, stewards, laundry and pressing workers, washing machine operator, domestic services, porters, messengers and guards).

7. **Agriculture, Animal Husbandry, Forestry Workers, Fishermen & Hunters** (Field crops farmers, gardeners, livestock farmers, horse stablemen, milkers, dairy products makers, poultry farmers and sea fishermen).

8. **Production, Related Workers, Transport Eqpt. Operators & Laborers** (Industrial operations, leather industries, textile workers, tailoring and dress workers, printing press workers, bricks workers, stone workers, petroleum refining workers, plastic and rubber industries workers, food industries workers, and butchers).

9. **Transport & Communications Workers** (Drivers).

10. **Not working, house wife or not stated.**

5.8 ETHICAL CONSIDERATION

The study was well accepted by families and all regions of Bahraini native associations of the study area. Fieldworkers informed the families in all the island about procedures and all objectives, and they invited the selected subjects to participate.

Confidentiality of information was guaranteed to families, only the research team would access the forms and only numbers were used in the data file to identify subjects.

All people with newly detected cases of diabetes or any changes on the ECGs were informed about their results of clinical examination, and were referred for treatment by their family physician or by specialist in diabetes or cardiology in the hospital in Bahrain. The treatment is free of charge in Bahrain for everyone.

Chapter 6

RESULTS

SUMMARY

This chapter has described and presented different important results of the main objectives mentioned prior to this part of this thesis. Different measures of diabetes problem and CHD among Bahraini native population were presented in detail, and explained how, these two non-communicable diseases experience of different sex, and age-groups could be compared by odds ratios and 95% confidence interval.

Other section of this chapter covered measures of risk factors associated with prevalence rates of diabetes, such as obesity, physical activity, high plasma cholesterol and family history of NIDDM.

In addition, attempted measures of risk factors associated with prevalence rates of CHD, such as diabetes, smoking habit, obesity, physical activity, and high plasma cholesterol. Such measures can help in assessing the efficiency with which scarce health care resources are used, although they must be interpreted with care. With, conduction of this cross-sectional community survey, there is a growing availability of epidemiological data on morbidity from cardiovascular disease and diabetes and on the utilization of health care resources.

The survey was conducted in Bahrain between June 1995 and February 1996. Altogether, 2128 subjects born from 1926 to 1945 in women and from 1936 to 1955 in men. This random sample covered 6% of all Bahraini native residents in the age-group of 40-69 yr.

The entirely prevalence rates of diabetes were 30%: 26% in men, and 36% in women. In a logistic regression analysis adjusting for age, diabetes was associated with body mass index (BMI) in both sexes, and waist-hip ratio (WHR) and with physical activity in men only. Plasma cholesterol was 0.4 mmol/L higher in those with diabetes than in non-diabetic individuals, even after adjusting for obesity.

The prevalence of diabetes was 33% in Sunnis and 26% in Shi'ites ($P<0.001$), this difference was unexplained by physical activity. Prevalence rates of CHD by major Q waves (Minnesota codes 1-1 or 1-2) on ECG was 3.5% in men and 1.7 in women aged 50-59 years old. Major Q waves were strongly associated with smoking and diabetes but not with plasma cholesterol levels.

Prevalence of NIDDM in Bahraini natives is among the highest in the world. Obesity and physical inactivity do not fully account for the high rates in Bahrainis compared with Europeans, or for the Sunni-Shi'ite difference.

The association of NIDDM with raised cholesterol is an unusual finding which suggests that disturbance of lipid metabolism may underlie the susceptibility to NIDDM in this population. Prevalence of CHD appears to be comparable with UK and strongly associated with NIDDM. Control of obesity would help to reduce risk of both NIDDM and CHD in Bahrain.

6.1 PARTICIPATION RATE

Invitation letters were sent to 4060 individuals to participation in the Diabetes and Heart Health Survey. One thousand nine hundred and thirty two subjects did not participate. Of those who were invited, 917 were unwilling to participate, 592 did not reply to the invitation letters, 129 died, 89 moved outside of Bahrain during the survey, and 41 became seriously ill and disabled before conducting the survey.

Nine hundred and seventeen subjects refused to participate in the survey, giving an overall participation rate of 70%. Formation of the final study population of 2128 subjects is shown in (Figure 6.1). The 2128 men and women who participated represented almost all regions of Bahrain except a few remote islands with small populations.

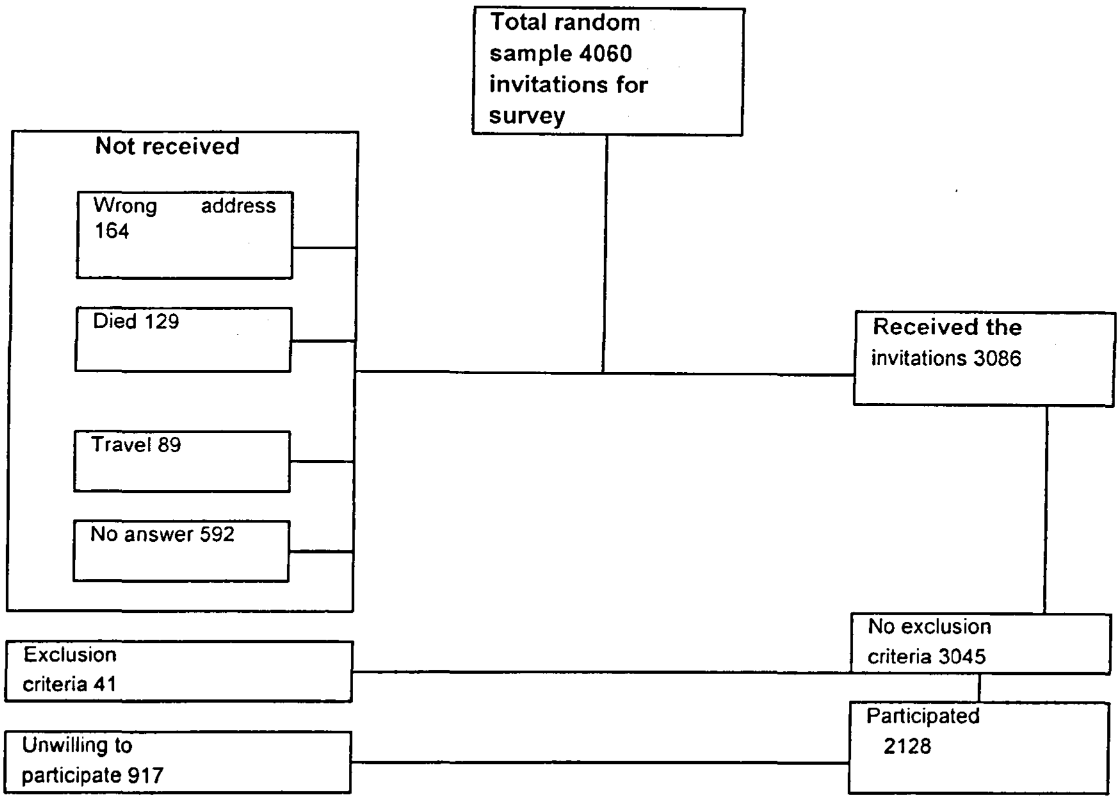


Figure 6.1 participation rates in Diabetes and Heart Health Survey

6.2 ETHNIC ORIGIN AND SOCIOECONOMIC STATUS

Three variables related to ethnic origin were recorded: religious denomination, district of residence, and country of birth of each grandparent. A question on religious denomination was not included in the original questionnaire as it was felt that this item would cause difficulties in the current political situation.

After fieldwork had been completed, the research nurse classified participants as Sunni or Shi'ite Arabs on the basis of name analysis supplemented by telephone inquiry in cases of doubt. Districts of residence were grouped into three categories: predominantly Sunni, predominantly Shi'ite Arabs, and mixed.

Country of birth of grandparents was grouped into three categories: all four grandparents born in Saudi Arabia or Bahrain, at least one grandparent born in Iran, and other. Data on country of birth of all four grandparents was available for 2000 participants. Of these, 1622 reported that all four grandparents had been born in the Arabian Peninsula and 306 reported that at least one grandparent had been born in Iran (Table 6.1).

Table 6 .1 Cross-tabulation for religious-ethnic area of residence by race* in Bahrain

	Grandparents country of birth					
	Arabian Peninsula*		Iran♦		Total	
Religion area residence	**No**	**(%)**	**No**	**(%)**	**No**	**(%)**
Sunni	176	(11%)	68	(22%)	244	(13%)
Shi'ite	648	(40%)	30	(10%)	678	(35%)
Mixed	798	(49%)	208	(68%)	1006	(52%)
Total	1622	(100%)	306	(100%)	1928	(100%)

** All 4 grandparents country of birth in Arabian Peninsula*
♦ At least one grandparent were born in Iran

Cross-tabulations of the three variables are shown in Tables 6.1 and 6.2. The proportion of participants who had at least one grandparent born in Iran was 33% in residents of Sunni districts, 4% in residents of Shi'ite Arab districts, and 23% in residents of mixed districts. As there was uncertainty about the accuracy with which religious denomination had been assigned by name analysis and telephone inquiry, this variable was not used further.

Instead participants were assigned to four groups based on district of residence and country of birth of grandparents:-

1. *Sunni Arab - resident in Sunni district, all grandparents born in Bahrain or Saudi.*
2. *Shi'ite Arab - residence in Shi'ite Arab district, all grandparents born in Bahrain or Saudi.*
3. *Iranian - at least one grandparent born in Iran.*
4. *Mixed/unclassified - none of the above.*

Table 6.2 Cross-tabulation for religion-ethnic area of residence by Islamic denomination in Bahrain

		Islamic denomination			
		Sunni		Shi'ite	
Religion area of residence	N	No	(%)	No	(%)
Sunni regions	297	269	(28%)	28	(2%)
Shi'ite regions	723	78	(8%)	645	(55%)
Mixed regions	1108	601	(63%)	507	(43%)

The ethnic composition of the participants, by this classification was: 11% (n=176) Sunni Arabs, 40% (n=648) Shi'ite Arabs, 22% (n=68) Iranians, and 52% (n=1006) Mixed/unclassified. Illiteracy rates were highest among older women 81% aged 60-69 yr and 67% for women aged 50-59 years. The lowest illiteracy rates were among younger men 5%. Educational status was highest among younger men. Fewer than 3% of participants were never married, but a high proportion of women aged 60-69 were widowed (Table 6.3).

Table 6.3 Characteristics of the study Bahraini population by sex and age-groups

	Men		Women	
	40-49 yr	50-59 yr	50-59 yr	60-69 yr
Number surveyed	699	522	487	390
Islamic religion group				
Sunni	333 (48%)	231 (44%)	203 (42%)	165 (42%)
Shi'ite	366 (52%)	291 (56%)	284 (58%)	225 (58%)
Ethnic area resident				
Sunni	117 (17%)	76 (14%)	54 (11%)	46 (12%)
Shi'ite	227 (32%)	191 (37%)	163 (34%)	137 (35%)
Mixed	358 (51%)	255 (49%)	270 (55%)	207 (53%)
Ethnic origin by grandparents/area of residence				
Sunni Arab	69 (11%)	46 (9%)	32 (8%)	27 (8%)
Shi'ite Arab	206 (32%)	171 (36%)	143 (33%)	123 (34%)
Mixed	271 (43%)	185 (39%)	171 (40%)	157 (44%)
Iranian	92 (14%)	75 (16%)	83 (19%)	52 (14%)
Marital status				
Married	632 (94%)	474 (94%)	362 (77%)	208 (55%)
Never married	23 (3%)	12 (2%)	5 (1%)	6 (2%)
Widowed	4 (1%)	9 (2%)	96 (20%)	153 (40%)
Divorced	12 (2%)	8 (2%)	6 (1%)	11 (3%)
Education				
Illiterate	37 (5%)	145 (29%)	316 (67%)	305 (81%)
School diploma	469 (70%)	288 (57%)	105 (32%)	68 (18%)
University degree	***165 (25%)***	***70 (14%)***	***6 (1%)***	***5 (1%)***
Consanguinity				
Yes	235 (36%)	174 (36%)	169 (37%)	133 (37%)
No	422 (64%)	309 (64%)	284 (63%)	227 (63%)

6.3 HOUSEHOLD INCOME

Table 6.4 shows the socioeconomic data in Bahraini native men aged 40-59 yr and women aged 50-69 years 81% of men aged 50-59 years were employed, compared with only 9% of women.

Table 6.4 Characteristics values of socioeconomic data by age-group and sex in Bahrain

	Men		Women	
	40-49 years	50-59 years	50-59 years	60-69 years
Number surveyed	699	522	487	390
Employed				
Yes	625 (93%)	406 (81%)	42 (9%)	14 (4%)
No	46 (7%)	97 (19%)	426 (91%)	363 (96%)
Monthly income*				
< BD 250 ($660)	138 (21%)	169 (35%)	NA	NA
BD 250-500($600-1320)	240 (37%)	155 (32%)	NA	NA
BD 500-750($1320-2000)	154 (23%)	91 (18%)	NA	NA
BD >750($2000)	122 (19%)	72 (15%)	NA	NA

** House hold income for women respondents is omitted because most women answered don't know for the family income NA = Not Applicable*

Few Bahraini women in this generation have worked outside the home. Household income for women respondents is omitted because most women answered did not know for the family income, whereas most men (92 %) responded to this item. The median household income was between BD 250 and BD 500 ($ 660-1320). Mean family income was highest in residents of Sunni areas, lowest in residents of Shi'ite areas and intermediate in residents of mixed areas.

6.4 PHYSICAL ACTIVITY

The distance walked per average week day were presented in Table 6.5. The majority of people in Bahrain walk less than one kilometer on average week days. The men were more active than women. Only 6% of women aged 50-59 years old were active by walking at least one km/day.

Table 6 .5 Number and (%) of Bahraini men and women walking distance/km on average week days

	Men		Women	
	40-49 yr	50-59 yr	50-59 yr	60-69 yr
No of km walking	**No (%)**	**No (%)**	**No (%)**	**No (%)**
< 1 km	423 (63%)	340 (68%)	437 (93%)	362 (95%)
1-3 km	150 (22%)	103 (20%)	26 (6%)	14 (4%)
4 or more	98 (15%)	59 (12%)	5 (1%)	2 (1%)
Total	671 (100)	502 (100)	468 (100)	378 (100)

The majority of people in Bahrain do not cycle; only 6% of men aged 40-49 years old were cycling and 9% of those aged 50-59 years old. Only 7 women reported were cycling (Table 6.6).

Table 6 .6 Number and (%) of Bahraini men cycling distance/km on average week days

	Age-group	
	40-49 yr	50-59 yr
Cycling	No (%)	No (%)
Yes	42 (6%)	43 (9%)
No	629 (94%)	460 (91%)
Total	671 (100)	503 (100)

6.5 OBESITY

The mean WHR was higher in men than in women 0.96 (SD 0.07) Versus 0.94 (SD 0.08). In comparison with European populations, mean waist-hip ratio of women was much higher, and the sex difference in waist-hip ratio was much less. The mean BMI was higher in women than men within the age-group 50-59 years (Table 6.7).

Table 6.7 Characteristics of anthropometric measurements among general Bahraini population

	Men		Women	
	40-49 years	50-59 years	50-59 years	60-69 years
Number surveyed	699	522	487	390
Clinical examination data				
Mean (SD) height(cm)	168.0 ± 7.1	165.3 ± 7.1	154.3 ± 5.7	153.2 ± 5.8
Mean(SD) weight(Kg)	78.2 ± 14.5	72.8 ± 13.5	67.8 ± 14.7	63.8 ± 15.1
Mean (SD) waist (cm)	95.2 ± 12.1	94.6 ± 11.8	96.6 ± 13.1	94.5 ± 13.4
Mean (SD) hips (cm)	98.9 ± 11.4	98.0 ± 11.0	102.6±12.9	99.1 ± 12.6
Mean (SD) BMI	27.6 ± 4.8	26.6 ± 4.5	28.4 ± 5.6	27.1 ± 5.7
Mean (SD) WHR	0.96 ± 0.08	0.97 ± 0.07	0.94 ± 0.08	0.95 ± 0.09
Mean (SD) WHTR	0.56 ± 0.07	0.57 ± 0.07	0.62 ± 0.08	0.61 ± 0.08

The age-specific distribution of BMI in Bahraini population is presented in Table 6.8, and (Fig 6.). The prevalence of obesity (defined as BMI ≥30 kg/m^2) was higher in women (37%) than men (22%).

Table 6.8 Age-and sex specific prevalence of obesity in Bahraini natives by BMI category

Age-group	N	<20 Kg/m2 N (%)	20.24.9 Kg/m2 N (%)	25-29.9 Kg/m2 N (%)	30-39.9 Kg/m2 N (%)	≥ 40 Kg/m2 N (%)
Men						
40-49 years	668	19 (3)	190 (28)	272 (41)	175 (26)	12 (2)
50-59 years	500	33 (7)	164 (33)	194 (39)	105 (21)	4 (1)
Women						
50-59 years	468	20 (4)	122 (26)	155 (33)	154 (33)	17 (4)
60-69 years	377	32 (8)	114 (30)	121 (32)	98 (26)	12 (3)

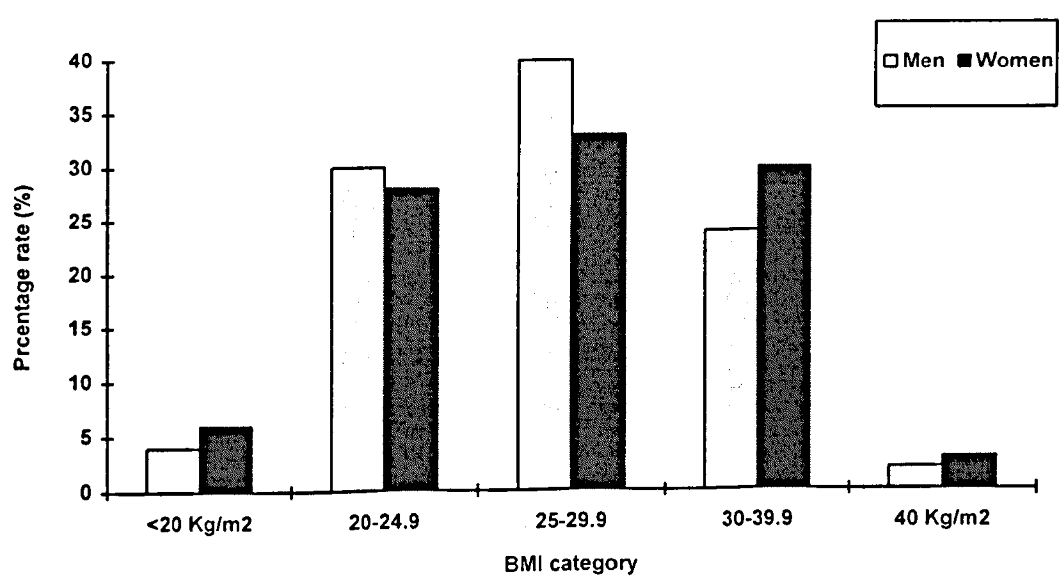


Figure 6.2 Distribution of Body Mass Index Kg/m2 in Bahraini population by BMI-group and sex

The prevalence of obesity among Sunni men was 38% Versus 23% among Shi'ite Arabs and 25% for Iranian descent Bahraini population. In Sunni women prevalence was 58% Versus 28% among Shi'ite Arabs women and 33% among Iranian women (Table 6.9).

Table 6.9 Distribution BMI (kg/m²) by sex and ethnic groups

	Sunni Arab	Shi'ite Arab	Mixed	Iranian
Men				
Body mass index				
<30 Kg/m2	73 (62%)	293 (77%)	355 (76%)	126 (75%)
≥30 Kg/m2	44 (38%)	86 (23%)	112 (24%)	41 (25%)
Women				
Body mass index				
<30 Kg/m2	25 (42%)	192 (72%)	225 (69%)	92 (67%)
≥30 Kg/m2	34 (58%)	76 (28%)	102 (31%)	45 (33%)

6.5.1 Relation of physical activity to obesity

The number and percentage rates of hours viewing television were highest among Sunni Arab men and women, and the lowest rates were for Shi'ite Arabs men and women. The Sunni Arab men and women had more number of hours watching television per week than Shi'ite Arabs men and women in Bahrain, but Iranian descent Bahraini population men and women even had more than both Sunnis and Shi'ite Arabs (Table 6.10). Significant inverse relationship was found between number hours viewing television per week by ethnic groups and the prevalence of diabetes was assessed by using univariate logistic regression.

Table 6.10 Distribution No of hours viewing television and smoking by sex and ethnic groups

	Sunni Arab	Shi'ite Arab	Mixed	Iranian
Men				
No of hours viewing TV				
< 1hour	16 (14%)	156 (44%)	135 (30%)	28 (17%)
1-3 hours	36 (31%)	147 (41%)	174 (39%)	61 (37%)
4-8 hours	30 (26%)	38 (11%)	97 (22%)	35 (21%)
9-15 hours	17 (15%)	9 (3%)	27 (6%)	27 (16%)
16 hours or more	16 (14%)	5 (1%)	16 (3%)	14 (9%)
Women				
No of hours viewing TV				
< 1hour	11 (20%)	139 (60%)	105 (37%)	33 (26%)
1-3 hours	13 (24%)	62 (27%)	94 (33%)	45 (36%)
4-8 hours	14 (26%)	22 (10%)	59 (20%)	27 (21%)
9-15 hours	5 (9%)	6 (3%)	15 (5%)	14 (11%)
16 hours or more	11 (21%)	1 (0.5%)	14 (5%)	7 (6%)

The distance walked or cycled was not related to obesity. Table 6.11 compares participants by categories of hours viewing television per week, less than one hour/week, 1-3 hours, 4-8 hours, 9-15 hours and 16 hours or more. Within each sex, the mean total cholesterol showed significant differences between the five groups watching television.

Men who view television per week, less than one hour/week had mean LDL-cholesterol 3.4 Versus 3.6 in those men who view television, 9-15 hours and 16 hours or more. In addition, the means weight and BMI were significantly different between the five groups viewing TV per week in men only.

Table 6.11 Mean (SD) values of risk factors for population viewing TV in Bahrain by sex

	Number hours viewing TV					P
	< 1	1-3	4-8	9-15	16 or more	value
Men						
Number surveyed	(N=346)	(N=438)	(N=210)	(n=91)	(n=59)	
Age (years)	50 ± 5.8	49 ± 5.7	49 ± 5.6	50 ± 5.7	49 ± 5.8	0.619
Clinical examination data						
Height (cm)	166.7 ± 7.2	166.9 ± 6.9	167.6 ± 6.6	166.1 ± 8.4	166.4 ± 8.3	0.470
Weight (kg)	74.4 ± 12.9	76.4 ± 15.1	77.1 ± 14.2	75.8 ± 12.3	79.6 ± 14.7	0.05
Waist (cm)	94.2 ± 10.8	95.4 ± 12.1	95.8 ± 13.1	94.5 ± 10.5	97.0 ± 12.0	0.319
Hips (cm)	97.9 ± 9.5	99.2 ± 11.6	98.7 ± 12.1	97.3 ± 13.3	100.9 ± 12.7	0.191
BMI (kg/m^2)	26.7 ± 4.2	27.3 ± 4.9	27.4 ± 4.8	27.5 ± 4.1	28.8 ± 5.2	<0.02
Cholesterol	5.0 ± 1.02	5.2 ± 1.08	5.2 ± 0.99	5.4 ± 1.10	5.3 ±1.03	<0.01
HDL (mmol/l)	0.96 ± 0.25	0.97 ± 0.27	0.94 ± 0.27	1.00± 0.26	0.94 ± 0.26	0.527
LDL (mmol/l)	3.36 ± 0.89	3.50 ± 1.01	3.47 ± 0.94	3.71 ± 0.95	3.56 ± 0.98	<0.02
Triglyceride	1.18 (1.14, 1.12)	1.16 (1.14, 1.19)	1.19 (1.14, 1.22)	1.20 (1.14, 1.27)	1.21 (1.14, 1.28)	0.341
Women						
Number surveyed	(N=297)	(N=232)	(N=135)	(N=84)	(N=39)	
Mean (SD) age	59 ± 5.4	59 ± 5.5	59 ± 4.9	59 ± 5.2	60 ± 5.3	0.518
Clinical examination data						
Height (cm)	153.3 ± 5.5	154.1 ± 6.2	154.0 ± 5.2	154.0 ± 5.4	153.8 ± 6.0	0.599
Weight (kg)	65.1 ± 14.3	66.7 ± 14.8	68.3 ± 16.4	67.0 ± 13.8	70.7 ± 16.1	0.096
Waist (cm)	95.3 ± 13.4	95.8 ± 12.7	97.0 ± 13.4	95.1 ± 12.0	99.6 ± 15.4	0.281
Hips (cm)	100.1 ± 12.0	101.9 ± 12.7	102.9 ± 14.1	100.9 ± 14.3	103.6 ± 13.7	0.177
BMI (kg/m^2)	27.6 ± 5.5	28.0 ± 5.8	28.7 ± 6.1	28.2 ± 5.3	29.8 ± 6.1	0.125
Cholesterol	5.5 ±1.1	5.5 ± 1.08	5.8 ± 1.8	5.6 ± 1.0	5.8 ± 0.93	<0.03
HDL (mmol/l)	1.09 ± 0.30	1.12 ± 0.28	1.16 ± 0.33	1.16 ± 0.21	1.19 ± 0.34	0.100
LDL (mmol/l)	3.72 ± 0.98	3.75 ± 0.95	3.85 ± 0.98	3.75 ± 0.88	3.91 ± 0.88	0.617
Geometric mean Triglyceride•	1.12 (1.09,1.14)	1.12 (1.09, 1.15)	1.15 (1.11, 1.20)	1.13 (1.06, 1.21)	1.16 (1.09, 1.24)	0.148

P values are based on least-squares regression for each dependent variable, with age as continuous variable.
Triglyceride•[Geometric mean(95% Confidence interval)]

When those who reported watching television for more than 16 h/week were compared with those who reported watching less than this, average waist girth was 3.0 cm greater (95% CI 0.4 to 5.6) and average body mass index was 1.1 (95% CI 0.04 - 2.1) kg/m^2 greater. Table 6.12 shows results of regression analysis with BMI, waist or WHTR as dependent variable adjusting for age, sex and hours TV as a continuous variable (1 to 5).

Table 6.12 Least-squares regression with waist, BMI and WHTR as dependent variable in men and women and age-adjusted regression coefficient for hours TV

	Coef.	Std. Err.	T	P>|t|	(95% Conf. Interval)
Body mass index					
No hours viewing TV	.22	.11	1.987	0.04	(0.002, 0.44)
Waist					
No hours viewing TV	0.65	0.27	2.384	0.01	(0.11, 1.19)
Waist-height ratio					
No hours viewing TV	0.003	0.001	2.070	0.03	(0.001, 0.006)

(hours TV 1=< 1 h, 2= 1-3 h, 3= 4-8 h, 4= 9-15 h and 5= 16 h or more is continuous variable)

In a further analysis, ethnic origin was added to the model as a categorical variable with Sunni Arab as baseline category. The effects of ethnic origin and TV watching on BMI remained independently significant (Table 6.13).

Table 6.13 Least-squares regression with BMI as dependent variable in men and women and age-adjusted regression coefficient for risk factors ethnic and number hours viewing TV

	Coef.	Std. Err.	P>|t|	(95% Conf. Interval)
Age	-0.12	0.02	<0.001	-0.16, -0.08
Sex	2.03	0.32	<0.001	1.40, 2.66
Hours viewing TV	0.25	0.11	<0.02	0.03, 0.48
Shi'ite Arabs	-2.23	0.45	<0.001	-3.12, -1.33
Mixed	-1.95	0.43	<0.001	-2.80, -1.09
Iranian	-2.12	0.48	<0.001	-5.08, -1.16

(Ethnic origin as categorical variable with 4 levels, Sunni Arab as baseline category)

6.5.2 Relation of education to obesity

Table 6.14 compares participants by education status: illiterate, read and write only, primary school, secondary school, BSc, Master degree and doctorate degree. Within each sex, the mean BMI was increasing with higher education level.

Table 6.14 Distribution mean ± (SD) BMI (kg/m^2) by education level and gender

	Mean± SD BMI (kg/m2)	
Education level	**Men**	**Women**
Illiterate	25.7 ± 4.8	27.3 ± 5.5
Read and write	26.5 ± 4.6	28.5 ± 5.8
Primary school	27.2 ± 5.1	30.1 ± 6.2
Secondary school	27.7 ± 4.6	29.2 ± 4.3
BSc	27.6 ± 3.6	30.2 ± 8.0
Master degree	28.7 ± 4.5	NA
Doctorate	27.6 ± 3.6	NA

Table 6.15 shows results of regression with BMI as dependent variable adjusting for age, income and education as a continuos variables and activity at work in men. Ethnic origin variable added to the model as a categorical variable with Sunni Arabs as a baseline category. The effects of ethnic origin and activity at work on BMI remained significant. Education and income were no longer significant.

Table 6.15 Least-squares regression with BMI as dependent variable in men and age-adjusted, income, education regression coefficient for risk factors activity at work and ethnic origin

	Coef.	Std. Err.	P>|t|	(95% Conf. Interval)
Age	-0.07	0.02	<0.009	-0.12, -0.02
income	0.33	0.18	<0.061	-0.01, 0.68
Education	-0.02	0.13	<0.889	-0.27, 0.24
Activity at work	0.26	0.08	<0.001	0.42, 0.10
Shi'ite Arabs	-2.03	0.52	<0.001	-3.06, -0.99
Mixed	-1.69	0.51	<0.001	-2.69, 0.68
Iranian	-2.12	0.58	<0.001	-3.26, 0.97

(Ethnic origin as categorical variable with 4 levels, Sunni Arab as baseline category)

In women, activity at work could not be included in the model because few women worked outside the home. The effects of ethnic origin and education on BMI remained independently significant.

6.5.3 Effect of parity on obesity and related risk factors

The mean number of pregnancies among women in the survey was 7.4. Only 31 women were nulliparous. Table 6.16 compares mean levels of each risk factors by parity group.

Average weight, waist and hip girth were lower in nulliparous women than in parous women. Mean plasma cholesterol and triglyceride showed an increasing trend with increasing parity, but this was not statistically significant.

Table 6.16 Mean (SD) values of risk factors for Parity in Bahraini women aged 50-69 years

	0 children	1-4 child	5-7 children	8 or more	P value
Number surveyed	(N=31)	(N=375)	(N=300)	(N=122)	
Mean (SD) age (year	58 ± 5.2	60 ± 5.3	59 ± 5.0	60 ± 5.6	
Clinical examination data					
Mean (SD) height (cm)	155.2 ± 5.5	153.6 ± 5.7	153.6 ± 5.8	153.9 ± 5.3	0.297
Mean (SD) weight (Kg)	60.2 ± 11.1	66.1 ± 14.2	66.6 ± 15.4	65.0 ± 16.4	0.04
Mean (SD) waist (cm)	90.7 ± 13.0	96.4 ± 13.4	96.1 ± 13.4	93.7 ± 12.5	0.04
Mean (SD) hips (cm)	96.5 ± 8.8	101.1 ± 13.3	101.7 ± 13.0	99.7 ± 11.9	0.04
Mean (SD) BMI (Kg/m^2)	25.4 ± 4.6	27.9 ± 5.5	28.1 ± 5.9	27.3 ± 6.1	0.007
Mean (SD) WHR	0.93 ± 0.09	0.95 ± 0.09	0.94 ± 0.08	0.94 ± 0.07	0.727
Mean (SD) WHTR	0.58 ± 0.08	0.62 ± 0.08	0.62 ± 0.09	0.61 ± 0.08	0.01
Mean (SD) T-Cholesterol(mmol/l)	5.5 ± 0.92	5.6 ± 1.26	5.6 ± 1.15	5.8 ± 1.24	0.194
Mean (SD) HDL-Choles(mmol/l)	1.12 ± 0.24	1.10 ± 0.28	1.14 ± 0.32	1.12 ± 0.31	0.840
Mean (SD) LDL-Choles(mmol/l)	3.68 ± 0.87	3.69 ± 0.86	3.75 ± 1.02	3.94 ± 1.07	0.169
Geometric mean (95% C.I) Triglyceride (mmol/l)	1.07 (1.01, 1.14)	1.13 (1.11, 1.16)	1.12 (1.09, 1.15)	1.13 (1.09, 1.18)	0.835

P values are based on least-squares regression for each dependent variable, with age as continuous variable.

In a regression analysis with parity as a categorical variable, BMI was 3 kg/m^2 higher in parous than in nulliparous women. Using least-squares regression, a significant association of BMI with parity was formed. There was no trend of increasing BMI between 1-4 children and 8 or more (Table 6.17).

Table 6.17 Least-squares regression of BMI on parity as a categorical variable

	Coef.	P value	95% Confidence Interval
	BMI (Kg/m2		
No children	0.0	(Reference)	
1-4 child	3.15	0.003	1.06, 5.23
5-7 child	3.29	0.002	1.18, 5.39
8 or more	2.55	0.02	0.30, 4.80

6.5.4 *Effect of menopause on obesity and related risk factors*

Table 6.18 compares mean levels of risk factors in premenopausal and postmenopausal women., with p-values based on regression after adjusting for age. 86% (706/825) of women in the survey reported that they were post-menopausal in response to the question "Are you still having your periods?". In comparison with premenopausal women, postmenopausal women were shorter and had higher average plasma total cholesterol (5.6 mmol/l versus 5.3 mmol/l) and plasma triglyceride.

Table 6.18 Mean values of risk factors in those with pre- and postmenopausal women

	Menopause		
	Pre-menopausal	Post-menopausal	P value*
Number surveyed	(N=119)	(n=706)	
Mean (SD) age (year	55 ± 3.6	60 ± 5.3	<0.001
Clinical examination data			
Mean (SD) height (cm)	155.2 ± 5.9	153.4 ± 5.5	<0.025
Mean (SD) weight (Kg)	69.9 ± 15.1	65.2 ± 14.9	0.086
Mean (SD) waist (cm)	96.1 ± 14.0	95.6 ± 13.2	0.669
Mean (SD) hips (cm)	102.8 ± 12.8	100.7 ± 12.9	0.871
Mean (SD) BMI (Kg/m^2)	28.9 ± 5.8	27.6 ± 5.7	0.276
Mean (SD) WHR	0.93 ± 0.08	0.95 ± 0.09	0.293
Mean (SD) WHTR	0.61 ± 0.09	0.62 ± 0.08	<0.02
Mean (SD) Total Cholesterol(mmol/l)	5.3 ±1.1	5.6 ± 1.2	<0.01
Mean (SD) HDL-Cholesterol(mmol/l)	1.12 ± 0.31	1.09 ± 0.27	0.307
Mean (SD) LDL-Cholesterol(mmol/l)	3.77 ± 0.96	3.65 ± 0.95	0.207
Mean**(95% C.I) Triglyceride(mmol/l)	1.07 (1.03, 1.10)	1.14 (1.12, 1.16)	<0.01

** P value based on univariate age-adjusted regression with menopausal status as binary variable*
*** Geometric mean (95% Confidence Interval)*

6.5.5 *Self-rating of obesity*

Table 6.19 and Table 6.20 shows a cross tabulation of weight classified by body mass index to participant's own rating of the desirability of their weight. Despite the high average body mass index in both men and women participants, most did not rate themselves as overweight. Even among those with a body mass index greater than 30 kg/m^2 , 53% of men and 62% of women rated themselves as "about the right weight" or "underweight".

Table 6.19 Cross-tabulation of men participants rating of the desirability of their weight with a classification based on body mass index

	Body mass index category			
	<20 Kg/m^2	20-24.9	25-29.9	>30 Kg/m^2
	No (%)	No (%)	No (%)	No (%)
Underweight	11 (21)	47 (13)	21 (4)	3 (1)
Right weight	40 (77)	299 (83)	361 (76)	156 (52)
Little over weight	1 (2)	16 (4)	84 (18)	107 (36)
Very over weight	0 (0)	0 (0)	9 (2)	33 (11)

For further analyses , the four self-rated categories were combined into two: "overweight" or "very overweight" , versus "underweight" or "about the right weight" (Table 6.20). When associations with this dichotomous variable were examined in a logistic regression analysis adjusting for age, sex and body mass index, family income (odds ratios from the lowest to the highest categories of family income were 1, 1.6, 2.5, and 3.4) and grandparental origin in Iran (odds ratio 2.5, 95% CI 1.5 to 4.1) were independent predictors of self-rating as overweight. Exclusion of participants with diabetes did not change these associations.

Table 6.20 Cross-tabulation of women participants rating of the desirability of their weight with a classification based on body mass index

	Body mass index category			
	<20 Kg/m^2	20-24.9	25-29.9	>30 Kg/m^2
	No (%)	No (%)	No (%)	No (%)
Underweight	13 (25)	46 (19)	24 (9)	20 (7)
Right weight	33 (63)	180 (76)	217 (78)	155 (55)
Little over weight	4 (8)	10 (4)	34 (12)	74 (27)
Very over weight	2 (4)	0 (0)	2 (1)	31 (11)

6.6 HYPERTENSION

Table 6.21 shows the median systolic and diastolic blood pressure in Bahraini men and women by age-group. In the age group 50-59 years median blood pressure were the same in men and women.

Table 6.21 Median blood pressure among Bahraini natives general population

	Men		Women	
	40-49 years	50-59 years	50-59 years	60-69 years
Number surveyed	699	522	487	390
Clinical examination data				
Median• systolic BP	125	130	130	140
Median• diastolic BP	80	80	80	81.5

•For median BP:Treatment-adjusted medians of systolic and diastolic blood pressure with treated high

6.6.1 Prevalence of hypertension

The crude prevalence rates of hypertension (defined as systolic >160 mmHg or diastolic >95 mmHg) was 30%. The age-specific prevalence rates of hypertension in Bahraini population are presented in Table 6.22. Prevalence rates increased with age in both men and women. In the age group 50-59 years the prevalence of hypertension was similar in men (29%) and women (32%). 30% (636/2120) were hypertensive; of these 636, questionnaire data on medical history was available for 568. Of these 568, 351 (62%) recalled a previous diagnosis of hypertension by a doctor.

Of these 351, 298 (85%) were on treatment. Of the 297 who were on treatment and for whom diastolic and systolic blood pressure were available, 41% (123/297) were adequately treated (defined by systolic BP <140 mmHg and diastolic BP <90 mmHg). Of 297 hypertensive on treatment, only 56% (167/297) had systolic BP <150 mmHg and diastolic BP <95 mmHg. Thus 38% of hypertensive participants were undiagnosed, and 59% of treated hypertensive individuals were inadequately controlled.

Table 6.22 Age-and sex specific prevalence of hypertension in Bahraini natives by gender

Age-group	N	Normal BP		Hypertensive		
		Normal BP N (%)	Borderline BP N (%)	Untreated BP N (%)	Treated BP N (%)	Total Prevalence N (%)
Men						
40-49 years	698	453 (65)	100 (14)	100 (14)	45 (7)	145 (21)
50-59 years	520	263 (51)	102 (20)	90 (17)	65 (12)	155 (29)
Total	1218	716 (59)	202 (16)	190 (16)	110 (9)	300 (25)
Women						
50-59 years	484	238 (49)	88 (18)	70 (15)	88 (18)	158 (32)
60-69 years	388	155 (40)	66 (17)	74 (19)	93 (24)	167 (43)
Total	872	393 (45)	154 (18)	144 (16)	181 (21)	325 (37)
All	2090	1109 (53)	356 (17)	334 (16)	291 (14)	625 (30)

**Hypertension defined by WHO World Health Organization diagnostic criteria:*
Normotensive: Systolic BP <160 mmHg & diastolic BP <90 mmHg
Undiagnosed: No history of high BP and Systolic BP ≥160 mmHg & diastolic BP ≥90 mmHg
Hypertensive
Untreated: History of high BP and Systolic BP ≥160 mmHg & diastolic BP ≥90 mmHg and not receiving regular medication
Treated: History of high BP and Systolic BP ≥160 mmHg & diastolic BP ≥90 mmHg and receiving regular medication

In both men and women, average waist, WHR, WHTR and BMI were higher in hypertensive than normotensive participants (Fig 6.3). By least-squares regression, with body mass index and waist- to hip ratio as dependent variables with age as a continuous variable, there were strong associations with hypertension in both men and women.

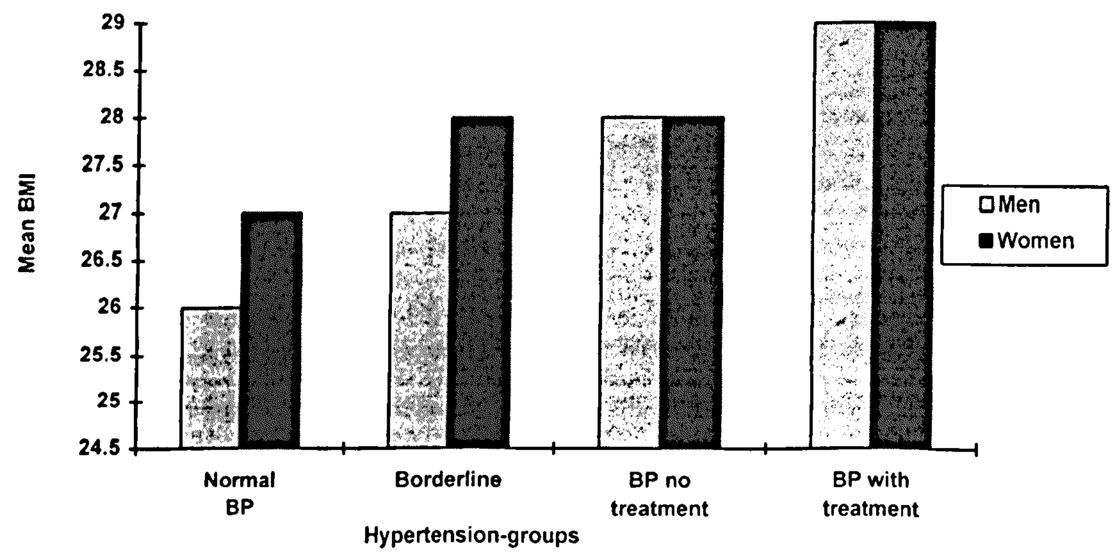


Figure 6.3 Mean BM by status of blood pressure in Bahraini natives

6.6.2 Comparison of subjects with and without hypertension

Table 6.23 compares participants with normotensive, borderline, untreated and treated hypertensive. Within each sex, mean weight, waist girth, hip girth, body mass index, and waist-to-height ratio were greater in hypertensive participants, whether treated or untreated, than in normotensive participants.

Table 6.23 Mean (SD) values of risk factors for hypertension in Bahrain by sex

	Normal BP	Borderline BP	Untreated BP	Treated BP	P value*
Men					
Number surveyed	(N=726)	(N=207)	(n=193)	(n=116)	
Age (years)	49 ± 5.6	51 ± 5.8	50 ± 5.7	52 ± 5.3	<0.001
Clinical examination data					
Mean (SD) height (cm)	167.1 ± 7.0	166.3 ± 7.8	166.4 ± 6.9	166.4 ± 6.9	0.695
Mean (SD) weight (Kg)	74.4 ± 13.5	75.6 ± 15.1	78.4 ± 15.9	81.6 ± 13.6	<0.001
Mean (SD) waist (cm)	93.3 ± 11.3	94.8 ± 12.3	98.5 ± 12.6	101.3 ± 10.9	<0.001
Mean (SD) hips (cm)	97.2 ± 10.9	9.5 ± 12.2	103.0 ± 11.0	113.0 ± 12.1	<0.001
Mean (SD) BMI (Kg/m^2)	26.6 ± 4.4	27.2 ± 4.8	28.3 ± 5.4	29.3 ± 4.6	<0.001
Mean (SD) WHR	096 ± 0.08	0.96 ± 0.08	0.97 ± 0.07	0.99 ± 0.11	<0.01
Mean (SD) WHTR	0.55 ± 0.06	0.57 ± 0.07	0.59 ± 0.07	0.60 ± 0.06	<0.001
Mean T-cholesterol(mmol/l)	5.1 ± 1.03	5.3 ± 1.07	5.3 ± 1.07	5.6 ±1.24	<0.001
Mean HDL-cholesterol (mmol/l)	0.96 ± 0.26	1.0 ± 0.28	0.97 ± 0.28	0.95 ± 0.29	0.335
Mean LDL-cholesterol (mmol/l)	3.39 ± 0.92	3.48 ± 0.95	3.55 ± 0.94	3.75 ± 1.14	<0.007
Geometric mean (95% C.I) Triglyceride (mmol/l)	1.16 (1.14, 1.18)	1.17 (1.13, 1.21)	1.18 (1.14, 1.23)	1.29 (1.24, 1.35)	<0.001
Women					
Number surveyed	(N=395)	(N=156)	(N=145)	(N=182)	
Mean (SD) age (year	59 ± 5.2	60 ± 5.3	60 ± 5.0	61 ± 5.6	<0.005
Clinical examination data					
Mean (SD) height (cm)	153.7 ± 5.7	153.9 ± 5.7	153.8 ± 5.6	154.0 ± 6.0	0.727
Mean (SD) weight (Kg)	64.8 ± 14.3	65.8 ± 13.7	67.1 ± 18.7	68.4 ± 14.0	<0.005
Mean (SD) waist (cm)	94.4 ± 13.1	95.3 ± 12.2	96.5 ± 15.2	98.3 ± 12.5	<0.003
Mean (SD) hips (cm)	10.0 ± 12.8	11.1 ± 11.3	101.0 ± 14.9	103.3 ± 12.4	<0.006
Mean (SD) BMI (Kg/m^2)	27.3 ± 5.5	27.7 ± 5.4	28.2 ± 7.0	28.8 ± 5.5	<0.007
Mean (SD) WHR	0.93 ± 0.02	0.94 ± 0.08	0.94 ± 0.08	0.95 ± 0.09	0.532
Mean (SD) WHTR	0.61 ± 0.07	0.62 ± 0.09	0.63 ± 0.08	0.60 ± 0.04	<0.007
Mean T-cholesterol(mmol/l)	5.5 ±1.3	5.5 ± 0.99	5.8 ± 1.24	5.7 ± 11	0.094
Mean HDL-cholesterol (mmol/l)	1.11 ± 0.28	1.14 ± 0.32	1.15 ± 0.34	1.08 ± 0.30	0.147
Mean LDL-cholesterol (mmol/l)	3.69 ± 0.95	3.67 ± 0.91	3.94 ± 1.12	3.84 ± 0.95	<0.03
Geometric mean (95% C.I) Triglyceride (mmol/l)	1.10 (1.08, 1.12)	1.12 (1.08, 1.16)	1.11 (1.07, 1.16)	1.21 (1.17, 1.25)	<0.001

P values are based on least-squares regression for each dependent variable, with age as continuous variable
Triglyceride•[Geometric mean(95% Confidence interval)]

As for diabetes, the association of hypertension with waist-hip ratio was statistically significant in men but not in women. Mean plasma cholesterol was higher in hypertensive participants - treated or untreated - than in normotensive participants but in women the differences in plasma total cholesterol were not statistically significant. Differences in mean LDL-cholesterol accounted for most of the differences in mean total cholesterol between groups. There were no significant differences in mean HDL-cholesterol between hypertensive and normotensive participants. Treated hypertensive but not untreated hypertensive were associated with higher triglycerides.

6.6.3 Risk Factors Associated with Hypertension

Table 6.24 shows the results of logistic regression analyses for men with hypertension as dependent variable, examining associations with risk factors one at a time in a model with age as the only other independent variable. Body mass index, WHR and waist-height ratio and family income were strongly associated with hypertension. After adjustment for BMI the associations with waist, WHTR and income were no longer significant.

Table 6.24 Logistic regression of risk factors for Hypertension in Bahraini natives men

	Age-Adjusted			Age + BMI-Adjusted		
Risk factor	OR	P	95% CI	OR	P	95% CI
BMI	1.10	<0.001	1.07, 1.13			
Diabetes★	1.76	<0.001	1.31, 2.37	1.7	0.001	1.24, 2.31
WHR	9.40	0.005	1.95, 45.2	2.6	0.263	0.48, 14.1
WHTR	1772.7	<0.001	23.4, 135.9	4.6	0.246	0.35, 59.9
Cholesterol (mmol/l)	1.2	0.001	1.09, 1.40	1.2	0.007	1.053, 1.37
Triglycerides (mmol/l)	1.1	0.03	1.01, 1.20	1.08	0.100	0.98, 1.18
HDL-cholesterol (mmol/l)	0.82	0.435	0.49, 1.34	0.91	0.740	0.53, 1.56
LDL-cholesterol (mmol/l)	1.23	0.003	1.07, 1.42	1.21	0.01	1.04, 1.41
Km walked/week⁺	0.98	0.092	0.96, 1.00	0.98	0.053	0.96, 1.00
Km cycle/week*	1.00	0.640	0.98, 1.02	1.00	0.518	0.98, 1.02
Any sport (yes/ no)	1.00	0.976	0.72, 1.38	0.99	0.958	0.71, 1.38
Act strenuous activity(yes/no)	0.76	0.077	0.56, 1.02	0.71	0.03	0.53, 0.97
Calories expenditure/week♯	0.94	0.270	0.85, 1.04	0.94	0.224	0.82 1.03
Family hist. Of hypertension'	1.69	<0.001	1.26, 2.27	1.5	0.005	1.14, 2.09
Education♣	1.01	0.767	0.91, 1.12	0.99	0.429	0.82, 1.55
Income⁎	1.17	0.01	1.02, 1.34	1.01	0.708	0.79, 1.17
Hours of TV†	1.05	0.379	0.93, 1.20	1.01	0.708	0.89, 1.15

⁺ Number of kilometers walking on average weekend, and on average week day defined by 3 category:
a) <1 km b) 1-3 km c) 4 km or more.
** Number of kilometers cycling on average weekend, and on average weekday defined by 3 category:*
a) <2 km b) 2-6 km c) 7 km or more.
♯ Calories expenditure/km from walking and cycling
⁎ Income defined by groups of Bahrain currancy by 4 category:
a) <BD 250 b) 250-499 c) 500-750 d) more than BD 750.
' Family history ofhypertension (Yes/no)
♣ Education and defined by a)illiterate b) school c) university
† TV= Number of hours watching television/day, and defined by 5 categories:
a) <1 hours b) 1-3 hours c) 4-8 hours d) 9-15 hours e) 16 hours or more
★Diabetes as diagnosed(yes/no)

Associations with diabetes, plasma total cholesterol (or LDL), and family history of hypertension remained significant after adjustment for BMI. Cycling, coded either as a binary variable or as the average distance cycled per day, as physical activity variable to show a insignificant relationship with hypertension.

Table 6.25 shows the results of logistic regression analyses for women with hypertension as dependent variable, examining associations with risk factors one at a time in a model with age as the only other independent variable. Diabetes ,body mass index, WHR and waist-height ratio were strongly associated with hypertension. The family history of hypertension was strongly associated with hypertension.

Cycling, coded either as a binary variable or as the average distance cycled per day did not show a relationship with hypertension in women. Whereas, the variable for sport (any sport doing?) was inversely associated with hypertension OR=0.30 (P<0.02, 95% CI 0.10, 0.88) and the significant relationship persisted after adjusting for BMI.

Table 6.25 Logistic regression of risk factors for Hypertension in Bahraini natives women

	Age-Adjusted			Age + BMI-Adjusted		
Risk factor	OR	P	95% CI	OR	P	95% CI
BMI (Kg/m^2)	1.04	0.002	1.01, 1.06			
Diabetes★	1.9	<0.001	1.48, 2.68	1.8	<0.001	1.37, 2.54
WHR	23.1	0.180	0.59, 17.5	4.5	0.246	0.35, 59.9
WHTR	15.3	0.002	2.77, 84.7	6.6	0.167	0.45, 95.8
Cholesterol (mmol/l)	1.15	0.01	1.02,1 .29	1.1	0.04	1.00, 1.27
Triglycerides (mmol/l)	1.3	0.002	1.09, 1.45	1.2	0.01	1.04, 1.40
HDL-cholesterol (mmol/l)	0.86	0.547	0.54, 1.38	0.91	0.709	0.56, 1.46
LDL-cholesterol (mmol/l)	1.22	0.007	1.05, 1.41	1.20	0.01	1.04, 1.40
Km walked/week•	0.98	0.665	0.93, 1.04	0.99	0.740	0.94, 1.04
Km cycle/week*	0.87	0.356	0.66, 1.15	0.87	0.759	0.66, 1.15
Any sport (yes/ no)	0.30	0.02	0.10, 0.88	0.29	0.02	0.09, 0.85
Act strenuous work	0.23	0.058	0.05, 1.05	0.27	0.085	0.06, 1.19
Calories expenditure/km∤	0.89	0.492	0.64, 1.23	0.90	0.560	0.60, 1.62
Family hist. Of hypertension'	2.0	<0.001	1.46, 2.80	1.9	<0.001	1.40, 2.69
Education♣	0.91	0.226	0.78, 1.06	0.89	0.1487	0.76, 1.04
Hours of TV	0.99	0.995	0.87, 1.14	0.98	0.832	0.86, 1.12

• Number of kilometers walking on average weekend, and on average week day defined by 3 category:
a) <1 km b) 1-3 km c) 4 km or more.
** Number of kilometers cycling on average weekend, and on average weekday defined by 3 category:*
a) <2 km b) 2-6 km c) 7 km or more.
∤ Calories expenditure/km⁷ from walking and cycling
' Family history ofhypertension (Yes/no)
♣ Education and defined by a)illiterate b) school c) university
ᶠ TV= Number of hours watching television/day, and defined by 5 categories:
a) <1 hours b) 1-3 hours c) 4-8 hours d) 9-15 hours e) 16 hours or more
★Diabetes as diagnosed(yes/no)

6.7 DIABETES

6.7.1 Prevalence of diabetes and impaired glucose tolerance

The crude prevalence rates for diabetes and IGT were 30% and 18% respectively. The age-specific prevalence rates of diabetes and IGT are presented in Table 6.26. In the age group 50-59 years, the prevalence of diabetes in women was 35%, higher than in men (29%). Prevalence of IGT also was higher in women (19%) than in men (16%).

Table 6.26 Age-and sex specific prevalence of diabetes mellitus and IGT*

		Not diabetic		Diabetic		
		Normo-glcemic	IGT	New cases	old cases	Total Prevalence
Age-group	N	N (%)	N (%)	N (%)	N (%)	N (%)
Men						
40-49 years	668	404 (60)	111 (17)	71 (11)	82 (12)	153 (23)
50-59 years	506	276 (55)	80 (16)	46 (9)	104 (20)	150 (29)
Total	1174	680 (58)	191 (16)	117 (10)	186 (16)	303 (26)
Women						
50-59 years	458	207 (45)	89 (19)	49 (11)	113 (25)	162 (35)
60-69 years	370	148 (40)	83 (23)	45 (12)	94 (25)	139 (37)
Total	828	355 (43)	172 (21)	94 (11)	207 (25)	301 (36)
All	2002	1035 (52)	363 (18)	211 (11)	393 (20)	604 (30)

**Diabetes defined by WHO World Health Organization diagnostic criteria:*
New: Fasting plasma glucose FPG ≥7.8 mmol/l or 2-hr plasma glucose ≥11.1 mmol/l.
Previous: A history of physician-diagnosed diabetes, with or without current use of hypoglycemic agents.
Not diabetic- IGT: FPG 7.8 mmol/l and 2-hr plasma glucose ≥7.8-11.1 mmol/l.
Normo-glycaemic: FPG <6.1 mmol/l and 75 g OGTT <11.2 mmol/l.

Within each sex the prevalence of diabetes rose with age but the relationship was less steep than that shown in other populations (Fig. 6.4).

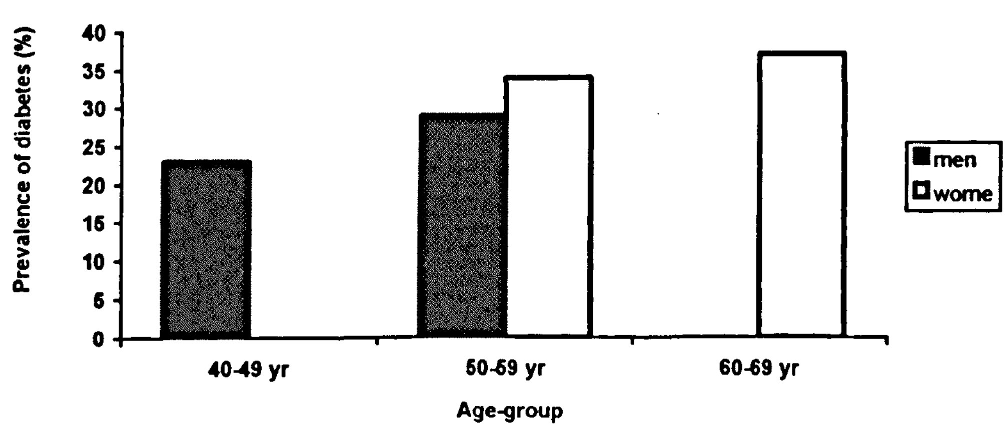


Figure 6.4 Prevalence of diabetes among Bahraini natives by sex and age-group

6.7.2 Comparison diabetes prevalence with other populations

Comparison has been made between prevalence of diabetes in this survey and prevalence in other populations after age-adjusting to the age distribution of the Bahraini men and women in this survey. (Table 6.27).

Table 6.27 Age-adjusted* prevalence of diabetes mellitus in Bahrain compared with selected study populations

Ethnic group	Prevalence (%)				
	Age-specific				Age-adjusted
Men	40-44 yr	45-49 yr	50-54 yr	55-59 yr	40-59 (Years)
Chinese					
(Da Qing)	0.9	1.1	1.7	3.5	1.9
Americans					
(Black)	10.3	13.1	6.6	10.9	10.3
(Mexican)	13.9	18.5	8.4	30.8	19.0
Indians					
(Mauritius)	13.2	24.3	26.4	23.5	21.6
Arab					
(Oman)	16.6	15.1	16.7	26.4	19.2
(Bahrain)	17.6	27.4	24.7	31.9	24.4
Pima/Papago					
(Native American)	55.9	62.1	51.5	59.0	57.4
	Age-specific				Age-adjusted
Women	50-54 yr	55-59 yr	60-64 yr	65-69 yr	50-69 yr
(Da Qing)	3.6	3.1	3.0	4.6	3.5
USA					
(Black)	6.6	30.0	16.9	22.2	20.1
(Mexican)	17.4	36.5	26.1	50.6	34.6
Indians					
(Mauritius)	14.9	18.8	35.3	34.7	25.3
Arab					
(Oman)	20.2	24.3	18.8	31.6	23.8
(Bahrain)	30.0	36.9	36.8	36.1	35.1
Pima/Papago					
(Native American)	55.1	73.3	70.0	63.3	66.2

****All these rates were Adjusted according to Bahraini native population of this survey.***

All prevalence rates of diabetes presented in Table 5.27 are based on surveys using oral glucose tolerance tests and WHO diagnostic criteria. The lowest prevalence rates (<4%) were seen in Chinese people, both men and women.

Moderate prevalence rates (5-10%) were seen in black American men. High prevalence rates (11-20%) were seen in Arab Omani men, American Mexican native men and black American women. Very high prevalence rates were seen in Arab Bahraini women and Arab Omanis women; 35% and 24% respectively.

The rates in Bahrain are higher than in other high-risk populations such as Omanis and Mauritius Indians, and are exceeded only by the prevalence rates of ~50% observed in Pima and Papago American natives of Arizona.

Diabetes prevalence in the Bahraini native population is similar to that in Aboriginal Australians studied by (Cameron WI et al. 1986). They reported prevalence rates of 25% in men and 24% in women in the age group 45-54 years. In the age group 55-64 years prevalence in Aboriginal men and women was 31%.

6.7.3 Relation of diabetes prevalence to ethnic origin

The age-specific prevalence of diabetes and IGT by ethnic origin (defined by combining district of residence and grandparents' country of birth as described earlier) are presented in Table 6.28. The highest rates of diabetes were in Sunni Arabs: prevalence (age-adjusted within sex) was 41% in Sunni Arab men and 66% in Sunni Arab women..

Table 6.28 Prevalence of diabetes mellitus* and IGT by ethnic origin in Bahrain

		Not diabetic		Diabetic			
Gender/ ethnic-group	N	Normo-glcemic N (%)	IGT N (%)	New cases N (%)	old cases N (%)	Total Prevalence N (%)	Age-adjusted†
Men							
Sunni	113	48 (42)	24 (17)	11 (10)	30 (27)	31 (37)	41.2%
Shi'ite Arabs	374	238 (64)	49 (13)	46 (12)	41 (11)	87 (23)	22.7%
Mixed	456	262 (57)	79 (17)	40 (9)	75 (16)	115 (25)	24.5%
Iranian	169	99 (59)	33 (20)	11 (6)	26 (15)	37 (21)	23.3%
Women							
Sunni	54	9 (17)	9 (17)	10 (18)	26 (48)	36 (66)	66.0%
Shi'ite Arabs	257	119 (46)	59 (23)	30 (12)	49 (19)	79 (31)	27.9%
Mixed	320	126 (39)	67 (21)	36 (11)	91 (29)	127 (40)	39.9%
Iranian	133	73 (55)	25 (19)	11 (8)	24 (18)	35 (26)	23.5%

**Diabetes defined by WHO World Health Organization diagnostic criteria*

† Age-adjusted by direct standardization to Bahraini population of this survey

The prevalence rates in Shi'ite Arabs and Iranians were much lower: 23% and 28% in Shi'ite Arab men and women respectively, and 21% and 26% in Iranian men and women respectively (Fig 6.5). Prevalence in the "Mixed/unclassified" group was intermediate between the high-risk Sunnis and the low-risk Shi'ite Arabs. There was no clear relationship of impaired glucose tolerance to ethnic origin.

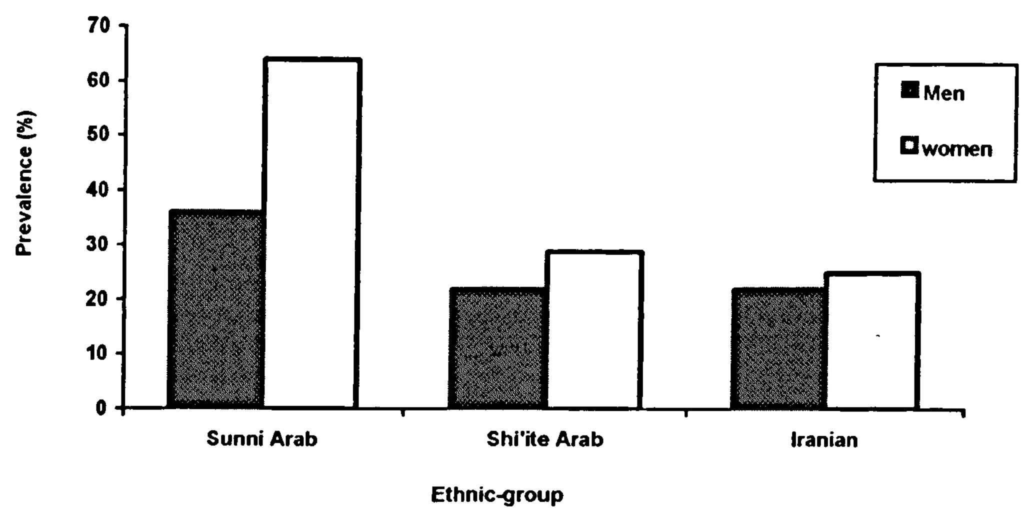


Figure 6 .5 Prevalence of diabetes among Bahraini natives by sex and ethnic-group

Ethnic differences in prevalence of diabetes were examined further in a logistic regression analysis adjusting for age, with ethnicity as a categorical variable. In comparison with Sunni Arabs as baseline category, odds ratios for diabetes were lowest in Iranians, slightly higher in Shi'ite Arabs, and intermediate in the Mixed/unclassified group (Table 6.29).

Table 6.29 Univariate age-adjusted logistic regression for ethnic risk association with Diabetes

	Men			Women		
Risk factor	OR	P	95% CI	OR	P	95% CI
Sunni	1.0	(Reference)		1.0	(Reference)	
Shi'ite Arabs	0.48	0.002	0.30, 0.76	0.22	<0.001	0.11, 0.40
Mixed	0.54	0.007	0.34, 0.84	0.35	0.001	0.19, 0.64
Iranian	0.47	0.006	0.27, 0.80	0.18	<0.001	0.09, 0.35

6.7.4 Prevalence of diabetes by region of residence

Prevalence of diabetes was compared between the eleven regions of Bahrain. The region of residence is of course closely related to ethnic origin. In both men and women, diabetes prevalence rates were higher in Sunni regions than in Shi'ite Arab regions of Bahrain. Riffa and Hidd regions, almost entirely inhabited by Sunnis, had the highest rates of diabetes especially in women, 58% and 53% receptively (Table 6.30).

The lowest rates were in the predominantly Shi'ite Arabs regions: Western region and Budyea. Of the mixed regions, the lowest rates of diabetes were in Hamad Town (this town is recently-built, and residents are younger than in other regions (Fig 6.6).

Table 6.30 Age-adjusted Prevalence rates† of diabetes by region and sex

	Men			Women		
Region	n/No	Crude rates	Age-Adjusted	n/No	Crude rates	Age-Adjusted
Sunni regions						
Hidd	11/32	(34%)	(35%)	15/28	(53%)	(50%)
Riffa	51/159	(32%)	(33%)	36/62	(58%)	(58%)
Shi'ite Arabs regions						
Budayea	20/66	(30%)	(30%)	12/57	(21%)	(21%)
Western region	12/60	(12%)	(19%)	12/50	(24%)	(24%)
Jidhaf's	28/134	(21%)	(21%)	25/93	(27%)	(26%)
Sitra	16/71	(22%)	(21%)	21/54	(39%)	(39%)
Mixed regions						
Hamad Town	12/76	(16%)	(12%)	3/14	(21%)	(22%)
Central region	17/72	(24%)	(23%)	8/32	(25%)	(26%)
Manama	35/159	(22%)	(22%)	69/204	(34%)	(33%)
Muharraq	62/198	(31%)	(31%)	65/163	(40%)	(40%)
Isa Town	39/168	(23%)	(22%)	28/77	(36%)	(41%)
Total	303/1195	(26%)	(25%)	294/834	(36%)	(35%)

† Age-adjusted according to the age distribution of Bahraini population in this survey

In all further analyses, these districts were grouped according to ethnic mix. The relationship of diabetes with district of residence (grouped by religious denomination) was examined separately in logistic regression analyses. After adjusting for age and sex, the odds ratio for diabetes was 0.45 (95% CI 0.34 - 0.61) in residents of Shi'ite Arabs districts compared with residents of Sunni districts, and 0.58 (95% CI 0.44 - 0.76) in residents of mixed districts compared with residents of Sunni districts.

Religious denomination assigned by analysis of names supplemented with telephone inquiry did not predict diabetes independently of district of residence. As noted earlier, there is uncertainty about the accuracy with which this variable classified participants as Sunni or Shi'ite Arabs .

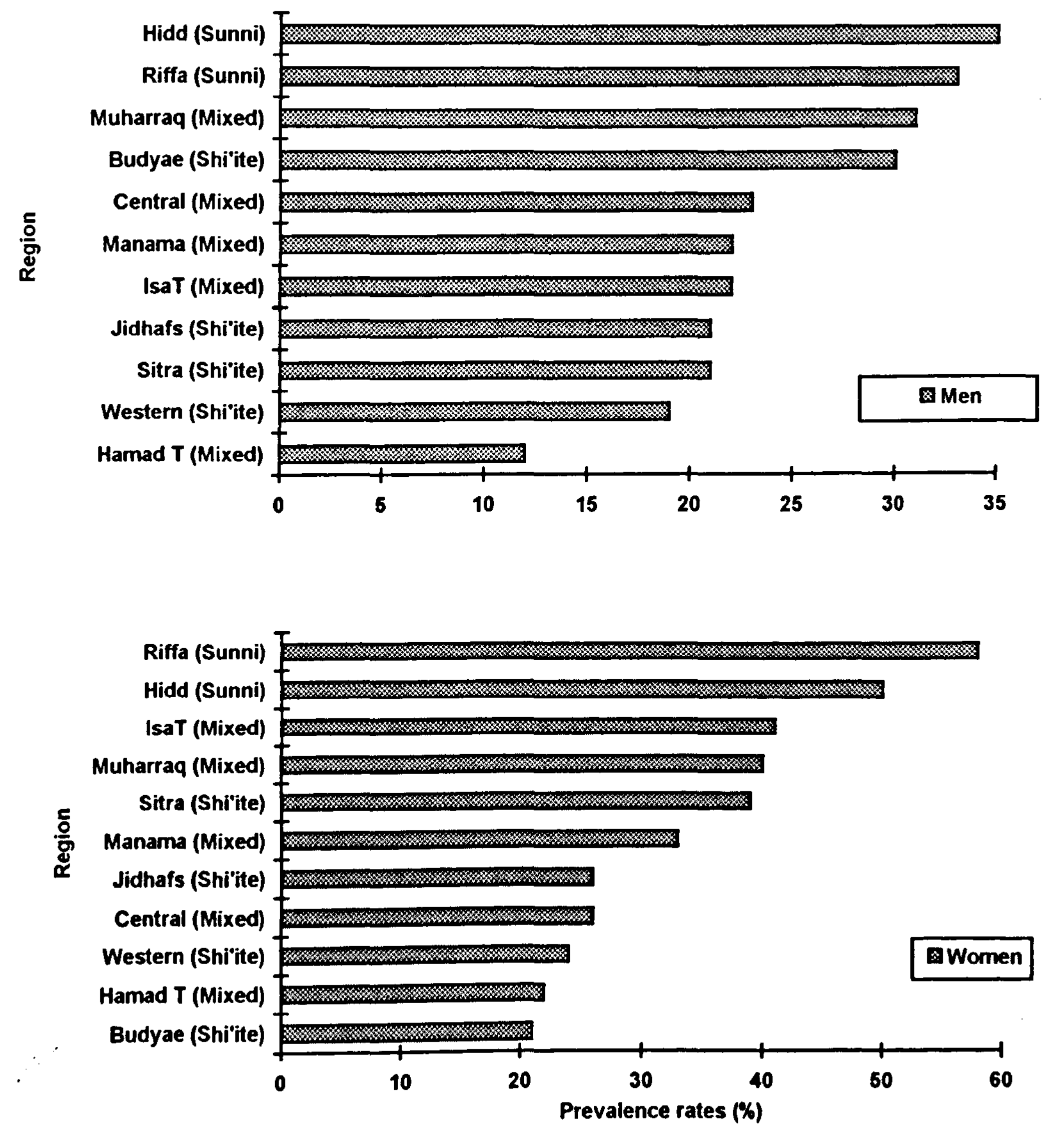


Figure 6.6 Age-adjusted Prevalence rates of diabetes in men and women by ethnic region-group

Table 6.31 compares risk factors for diabetes by ethnic group. In comparison with other ethnic groups, Sunni Arabs were shorter, heavier and had higher average body mass index. Mean waist/height ratio, however, was similar in the four ethnic categories.

Table 6.31 Comparison of risk factors for diabetes by ethnic origin

	Ethnic groups				
	Sunni	Shi'ite Arabs	Mixed	Iranian	P value
Men					
Number surveyed	(N=117)	(n=380)	(n=469)	(n=169)	
Mean (SD) age (year	49 ± 5.3	50 ± 5.6	49 ± 6.0	50 ± 5.9	0. 638
Clinical examination data					
Mean (SD) height (cm)	164.6 ± 7.6	165.8 ± 6.9	168.5 ± 6.9	168.3 ± 7.0	<0.001
Mean (SD) weight (Kg)	77.8 ± 13.8	73.5 ± 14.5	77.3 ± 14.4	76.7 ± 14.1	<0.001
Mean (SD) waist (cm)	93.8 ± 11.1	94.1 ± 12.0	96.3 ± 12.2	95.9 ± 12.1	0.01
Mean (SD) hips (cm)	96.8 ± 11.5	97.8 ± 9.8	100.1 ± 11.7	99.6 ± 11.9	0.004
Mean (SD) BMI (Kg/m^2)	29 ± 4.7	27 ± 4.7	27 ± 4.7	27 ± 4.6	<0.001
Mean (SD) WHR	0.97 ± 0.1	0.96 ± 0.07	0.96 ± 0.07	0.96 ± 0.08	0.607
Mean (SD) WHTR	0.57 ± 0.06	0.56 ± 0.07	0.57 ± 0.07	0.57 ± 0.07	0.500
Mean(SD) T-Cholesterol(mmol/l)	5.4 ±1. 1	5.0 ± 1.0	5.1 ± 1.0	5.2 ± 1.0	<0.001
Mean (SD) HDL-Choles(mmol/l)	0.97 ± 0.29	0.96 ± 0.27	0.97 ± 0.25	0.96 ± 0.25	0.919
Mean (SD) LDL-Choles (mmol/l)	3.76 ± 1.07	3.37 ± 0.93	3.45 ± 0.95	3.53 ± 0.91	0.001
Geometric mean (95% C.I) Triglyceride (mmol/l)	1.21 (1.16, 1.27)	1.15 (1.12, 1.18)	1.18 (1.15, 1.21)	1.19 (1.14, 1.23)	0.794
Women					
Number surveyed	(N=59)	(n=268)	(n=329)	(n=137)	
Mean (SD) age (year	59 ± 5.0	59 ± 5.2	59 ± 5.5	59 ± 5.4	0.213
Clinical examination data					
Mean (SD) height (cm)	152.4 ± 5.9	152.6 ± 5.5	154.8 ± 5.8	154.8 ± 5.8	<0.001
Mean (SD) weight (Kg)	69.6 ± 16.1	64.0 ± 14.7	65.8 ± 15.6	66.5 ± 15.2	0.002
Mean (SD) waist (cm)	95.8 ± 11.6	95.2 ± 13.4	95.7 ± 14.1	95.9 ± 13.4	0.753
Mean (SD) hips (cm)	101.2 ± 12.6	98.1 ± 11.6	102.4 ± 13.8	102.8 ± 13.3	<0.001
Mean (SD) BMI (Kg/m^2)	30 ± 5.3	27 ± 5.7	27 ± 5.7	28 ± 5.7	<0.001
Mean (SD) WHR	0.94 ± 0.07	0.97 ± 0.08	0.93 ± 0.09	0.93 ± 0.08	0.150
Mean (SD) WHTR	0.62 ± 0.07	0.62 ± 0.08	0.61 ± 0.08	0.61 ± 0.08	0.291
Mean (SD) Cholesterol(mmol/l)	5.9 ±1.2	5.5 ± 1.1	5.6 ± 1.3	5.5 ± 1.2	0.04
Mean (SD) HDL-Choles(mmol/l)	1.20 ± 0.32	1.10 ± 0.32	1.12 ± 0.29	1.13 ± 0.27	0.171
Mean (SD) LDL-Choles (mmol/l)	4.03 ± 1.23	3.37 ± 1.00	3.72 ± 0.93	3.80 ± 0.89	0.135
Geometric mean (95% C.I) Triglyceride (mmol/l)	1.18 (1.11, 1.25)	1.11 (1.08, 1.14)	1.13 (1.10, 1.16)	1.14 (1.09, 1.17)	0.952

**** P values are based on least-squares regression for each dependent variable, with age as continuous variable.***

In comparison with Sunni Arabs, mean plasma cholesterol was 0.42 (95% CI 0.27 - 0.57) mmol/l lower in residents of Shi'ite Arab after adjusting for age and sex. These differences were reduced only slightly by adjusting for obesity. Most of the difference in total cholesterol was accounted for by LDL-cholesterol. The mean HDL-cholesterol showed no significant difference between ethnic groups in men or women. Residents of

Sunni Arab men reported walking more but were less likely to cycle than residents of Shi'ite Arab men or Iranians (Table 6.32).

Table 6 .32 Number (%) of men cycling by ethnic groups

	Sunni	Shi'ite Arabs	Mixed	Iranian
	No (%)	No (%)	No (%)	No (%)
Yes	2 (2%)	37 (10%)	29 (6%)	14 (8%)
No	115 (98%)	343 (90%)	440 (94%)	155 (92%)

6.7.5 Comparison of diabetic and non-diabetic subjects

The characteristics of subjects with and without diabetes are compared in Tables 6.33 and 6.34 Diabetic men and women were older than non-diabetic participants. Median systolic BP was higher in diabetic men than in non-diabetic men (130 mmHg Versus 125 mmHg (P<<0.001)). Median systolic BP in diabetic women was 141 mmHg compared with 136 mmHg (P<<0.001) in non-diabetic women.

Table 6.33 Characteristics of variables in men aged 40-59 years with and without diabetes

	Not diabetic	Diabetic	P value
Number surveyed	(N=892)	(n=303)	
Mean (SD) age (year	49 ± 5.7	50 ± 5.6	<0.001
Questionnaire data			
No (%) Family history of diabetes	242(27%)	146(50%)	<0.001†
Clinical examination data			
Median BP (mmHg) Systolic	125	130	<0.001
Median BP (mmHg) diastolic	80	83	<0.002
Mean (SD) heart rate (beat/min)	115 ± 23.2	119 ± 25.2	<0.01*
Mean (SD) height (cm)	166.8 ± 7.2	166.8 ± 7.0	0.99*
Mean (SD) weight (Kg)	75.1 ± 14.4	77.9 ± 13.7	<0.004*
Mean (SD) waist (cm)	93.9 ± 11.7	98.1 ± 12.0	<0.001*
Mean (SD) hips (cm)	98.0 ± 11.0	100.0 ± 11.7	<0.008*
Mean (SD) BMI (Kg/m^2)	27 ± 4.7	28 ± 4.7	<0.001*
Mean (SD) WHR	0.95 ± 0.07	0.98 ± 0.09	<0.001*
Mean (SD) WHTR	0.56 ± 0.06	0.58 ± 0.07	<0.001*
Mean (SD) Total Cholesterol(mmol/l)	5.0 ± 0.9	5.4 ± 1.1	<0.001*
Mean (SD) HDL-Cholesterol(mmol/l)	0.95 ± 0.25	1.0 ± 0.30	<0.005*
Mean (SD) LDL-Cholesterol(mmol/l)	3.42 ± 0.94	3.60 ± 1.01	<0.001*
Geometric mean Triglyceride (mmol) (95% CI)	1.14 (1.12, 1.16)	1.27 (1.23, 1.31)	<0.001*

**** P value based on ttest for difference between two means***

† P value based on chi square and odds ratio for difference between two proportions

The mean BMI in diabetic men was 28 (SD 4.7 Versus 27 (SD 4.7 (P<<0.001) in non-diabetics men, and mean BMI in diabetic women was 29 (SD 5.8 Versus 27 (SD 5.5 (P<<0.001) in non-diabetic women. Abdominal obesity was associated with diabetes in both men and women.

The mean WHR in diabetic men was 0.98 (SD 0.09 Versus 0.95 (SD 0.07 (P<<0.001) in non-diabetic men. In women the differences in mean waist-hip ratio between diabetic and non-diabetic participants were not significant However waist-height ratio was higher in diabetic than in non-diabetic participants in both men and women.

The mean WHTR in diabetic men was 0.58 (SD 0.07 compared with 0.56 (SD 0.06 (P<0.001) in non-diabetic men (Table 6.33). The mean WHTR in diabetic women was 0.64 (SD 0.08 Versus 0.61 (SD 0.08 (P<0.001) in non-diabetic women (Table 6.34).

The mean plasma cholesterol in non-diabetic men was 5.0 (SD 0.9) Versus 5.4 (SD 1.1, (P<<0.001) in diabetic men (Table 6.31). Mean plasma cholesterol in diabetic women was 5.5 (SD 1.2 Versus 5.8 (SD 1.2 (P<<0.001) in non-diabetic women. The mean plasma triglyceride was higher in diabetic than in non-diabetic men and women.

Mean plasma triglyceride in diabetic men was 2.1 mmol (SD 1.2) Versus 1.6 mmol (SD 1.2) (P<<0.001) in non-diabetic men, and the mean plasma triglyceride in diabetic women was 1.8 mmol (SD 1.2) Versus 1.3 mmol (SD 0.7) in non-diabetic women.

An unexpected finding was that the mean HDL-cholesterol was higher in diabetic men than in non-diabetic men. In women the mean HDL-cholestero was not different in those with and without diabetes. This association of NIDDM with higher HDL-cholesterol levels in men was not accounted for by adjusting for age, BMI, waist girth and total cholesterol.

6.7.6 *Family history, consanguinity and diabetes*

32% (648 of 219) of participants reported a positive family history of diabetes (Has anyone in your family had diabetes?). In a logistic regression analysis, positive family history was associated with an odds ratio of 2.8 (95% CI 2.3 - 3.4) for diabetes, after adjusting for age and sex. In comparison with women who did not have a family history of diabetes, women with a family history of diabetes had higher average weight, body mass index and hip girth. (Table 6.34).

Table 6.34 Characteristics of variables in women aged 50-69 years with and without diabetes

	Not diabetic	Diabetic	P value
Number surveyed	(n=540)	(n=293	
Mean (SD) age (year	59 ± 5.3	60 ± 5.3	0.361
Questionnaire data			
No (%) Family history of diabetes	117(22%)	126 (44%)	<0.001†
Clinical examination data			
Median BP (mmHg) Systolic	136 ± 23	141 ± 23	<0.003*
Median BP (mmHg) diastolic	81 ± 11	83 ± 12	<0.005*
Mean (SD) heart rate (beat/min)	121 ± 27.9	124 ± 29.7	0.14*
Mean (SD) height (cm)	153.9 ± 6.0	153.5 ± 5.3	0.39*
Mean (SD) weight (Kg)	64.2 ± 14.3	69.5 ± 15.5	<0.001*
Mean (SD) waist (cm)	94.3 ± 11.9	98.8 ± 12.9	<0.001*
Mean (SD) hips (cm)	99.7 ± 12.4	103.9 ± 13.0	<0.001*
Mean (SD) BMI (Kg/m^2)	27 ± 5.5	29 ± 5.8	<0.001*
Mean (SD) WHR	0.94 ± 0.08	0.95 ± 0.08	0.150*
Mean (SD) WHTR	0.61 ± 0.08	0.64 ± 0.08	<0.001*
Mean (SD) Cholesterol(mmol/l)	5.5 ± 1.2*	5.8 ± 1.2	<0.001*
Mean (SD) HDL-Cholesterol(mmol/l)	1.12 ± 0.31	1.12 ± 0.29	0.975*
Mean (SD) LDL-Cholesterol(mmol/l)	3.68 ± 1.31	3.90 ± 1.02	<0.001*
Geometricmean(95% C.I) Triglyceride(mmol)	1.08 (1.06, 1.10)	1.22 (1.19, 1.25)	<0.001*

** P value based on ttest for difference between two means*
† P value based on chi square and odds ratio for difference between two proportions.

In comparison with men who did not have a family history of diabetes, men with a family history of diabetes had higher average weight and body mass index. These associations persisted when participants with diabetes (new or previously-diagnosed) were excluded.

Plasma triglyceride was higher in men with family history of diabetes than in men without positive family history, but this difference was no longer significant after excluding diabetic participants.

In both men and women, mean plasma cholesterol was 0.2 mmol/l higher in those with positive than in those with negative family history of diabetes (Table 3.35).

Table 6.35 Mean values of risk factors in those with and without a family history of diabetes

	Family history of diabetes		P
	No	Yes	value*
Men			
Number surveyed	(N=789)	(n=394)	
Mean (SD) age (year	50 ± 5.8	48 ± 5.4	<0.001
Clinical examination data			
Mean (SD) height (cm)	166.8 ± 7.4	167.1 ± 6.8	0.427
Mean (SD) weight (Kg)	75.1 ± 14.6	77.4 ± 13.3	<0.008
Mean (SD) waist (cm)	94.7 ± 12.2	95.7 ± 11.4	0.172
Mean (SD) hips (cm)	98.2 ± 11.1	99.1 ± 11.6	0.207
Mean (SD) BMI (Kg/m^2)	27 ± 4.8	28 ± 4.3	<0.01
Mean (SD) WHR	0.96 ± 0.07	0.96 ± 0.09	0.271
Mean (SD) WHTR	0.56 ± 0.07	0.57 ± 0.06	0.581
Mean (SD) Cholesterol(mmol/l)	5.1 ±1. 0	5.3 ± 1.1	<0.02
Mean (SD) HDL- Cholesterol(mmol/l)	0.97 ± 0.27	0.95 ± 0.26	0.367
Mean (SD) LDL- Cholesterol(mmol/l)	3.45 ± 0.93	3.49 ± 1.02	0.273
Geometric mean(95% CI) Triglyceride (mmol/l)	1.15 (1.13, 1.17)	1.13 (1.11, 1.15)	<0.001
Women			
Number surveyed	(N=582)	(n=254)	
Mean (SD) age (year	59 ± 5.3	59 ± 5.3	0.126
Clinical examination data			
Mean (SD) height (cm)	153.5 ± 5.7	154.5 ± 5.8	<0.02
Mean (SD) weight (Kg)	64.8 ± 15.2	69.2 ± 14.2	<0.001
Mean (SD) waist (cm)	95.2 ± 13.2	97.1 ± 13.4	0.05
Mean (SD) hips (cm)	100.0 ± 12.5	103.5 ± 13.4	<0.001
Mean (SD) BMI (Kg/m^2)	27 ± 5.8	29 ± 5.5	<0.001
Mean (SD) WHR	0.95 ± 0.08	0.94 ± 0.08	0.05
Mean (SD) WHTR	0.62 ± 0.08	0.62 ± 0.08	0.168
Mean (SD) Cholesterol(mmol/l)	5.5 ±1. 1	5.7 ± 1.4	<0.01
Mean (SD) HDL- Cholesterol(mmol/l)	1.12 ± 0.32	1.11 ± 0.26	0.548
Mean (SD) LDL- Cholesterol(mmol/l)	3.70 ± 0.98	3.86 ± 0.95	<0.03
Geometric mean(95% CI) Triglyceride (mmol/l)	1.22 (1.19, 1.25)	1.13 (1.10, 1.16)	0.864

***** P value based on univariate age-adjusted regression of risk factors and family history of diabetes***

In women this difference remained statistically significant after excluding diabetic participants.

15% (304/1982) of participants reported that their parents were single first cousins and 11% (211/1982) that their parents were double first cousins. Parental consanguinity was not associated with excess risk of diabetes; in a logistic regression analysis adjusting for age and sex, the odds ratio was 1.06 (95% CI 0.77 - 1.47) for those with parents who were double first cousins versus those with no parental consanguinity, and 1.05 (95% CI 0.79 to 1.39) for those whose parents were single first cousins versus those whose with no parental consanguinity).

*Table 6.36 Mean values of risk factors in those with and without a family history of diabetes**

	Family history of diabetes		P
	No	Yes	value**
Men			
Number surveyed	(N=623)	(n=242)	
Mean (SD) age (year	49 ± 5.8	48 ± 5.4	<0.001
Clinical examination data			
Mean (SD) height (cm)	166.8 ± 7.4	166.9 ± 6.8	0.893
Mean (SD) weight (Kg)	74.5 ± 14.7	77.0 ± 13.5	<0.02
Mean (SD) waist (cm)	93.6 ± 11.8	94.7 ± 11.6	0.241
Mean (SD) hips (cm)	97.6 ± 10.9	99.1 ± 11.2	0.073
Mean (SD) BMI (Kg/m^2)	26 .7± 4.8	27.6 ± 4.4	<0.01
Mean (SD) WHR	0.96 ± 0.07	0.95 ± 0.07	0.564
Mean (SD) WHTR	0.56 ± 0.06	0.56 ± 0.06	0.254
Mean (SD) Total-Cholesterol(mmol/l)	5.0 ± 0.06	5.2 ± 1.01	0.277
Mean (SD) HDL- Cholesterol(mmol/l)	0.96 ± 0.26	0.93 ± 0.23	0.126
Mean (SD) LDL- Cholesterol(mmol/l)	3.41 ± 0.91	3.45 ± 1.0	0.645
Geometric mean(95% CI) Triglyceride (mmol/l)	1.13 (1.11, 1.15)	1.08 (1.06, 1.10)	<0.02
Women			
Number surveyed	(N=405)	(n=117)	
Mean (SD) age (year	59 ± 5.4	58 ± 5.1	0.111
Clinical examination data			
Mean (SD) height (cm)	153.6 ± 6.0	155.1 ± 6.0	<0.01
Mean (SD) weight (Kg)	63.0 ± 14.3	68.3 ± 13.7	<0.001
Mean (SD) waist (cm)	93.7 ± 13.0	95.8 ± 13.5	0.114
Mean (SD) hips (cm)	98.9 ± 12.3	102.5 ± 12.8	<0.006
Mean (SD) BMI (Kg/m^2)	26.6 ± 5.4	28.4 ± 5.5	<0.002
Mean (SD) WHR	0.94 ± 0.08	0.93 ± 0.07	0.176
Mean (SD) WHTR	0.61 ± 0.08	0.61 ± 0.08	0.337
Mean (SD) Total Cholesterol(mmol/l)	5.4 ±1.03	5.7 ± 1.6	<0.03
Mean (SD) HDL- Cholesterol(mmol/l)	1.12 ± 0.32	1.10 ± 0.25	0.460
Mean (SD) LDL- Cholesterol(mmol/l)	3.64 ± 0.92	3.81 ± 0.90	0.068
Geometric mean(95% CI) Triglyceride (mmol/l)	1.18 (1.14, 1.22)	1.09 (1.04, 1.12)	0.867

*** P value based on univariate age-adjusted regression of risk factors and family history of diabetes*

**All known cases of diabetes and new cases diagnosed in this survey excluded from the comparison in this table*

6.7.7 *Prevalence of diabetes by tertiles of risk factors*

Prevalence of diabetes and IGT in Bahraini native by tertiles of body mass index, waist-to hip ratio, waist-height ratio, systolic and diastolic blood pressure, plasma cholesterol and triglycerides is shown in Table 6.37. All these variables were positively associated with diabetes, except for waist-hip ratio in women.

Table 6.37 Prevalence of diabetes and IGT in Bahraini native by tertiles of BMI, WHR and systolic, diastolic BP, plasma cholesterol and triglycerides

	Prevalence (%)							
	Men				Women			
Tertile with sex-group	1	2	3	P	1	2	3	P
Body mass index								
IGT	11.1	17.6	20.7		18.3	23.2	20.5	
New diabetics	6.8	8.4	14.5		5.6	8.9	17.3	
Known diabetics	14.7	16.1	18.4		18.3	31.3	27.4	
Total	32.6	42.1	53.6	<0.001	42.2	63.4	65.2	0.183
Waist-hip ratio								
IGT	13.3	18.1	17.1		17.7	20.6	24.2	
New diabetics	6.2	9.6	12.9		10.5	10.5	11.9	
Known diabetics	12.7	14.5	21.3		23.2	27.7	26.5	
Total	32.2	42.2	51.3	<0.001	51.4	58.8	62.6	0.336
Waist-height ratio								
IGT	13.8	16.9	20.6		14.6	20.8	22.8	
New diabetics	5.9	9.5	18.2		4.4	8.9	14.6	
Known diabetics	14.3	16.9	19.8		16.5	25.3	29.3	
Total	32.0	43.4	58.6	<0.001	35.5	55.0	66.7	<0.001
Systolic blood pressure								
IGT	14.5	16.9	16.9		18.7	17.7	23.7	
New diabetics	6.2	8.5	15.0		5.1	13.0	12.0	
Known diabetics	15.1	16.5	16.9		20.6	24.2	28.5	
Total	35.8	41.9	48.8	0.003	44.4	54.9	64.2	0.001
Diastolic blood pressure								
IGT	13.5	18.2	17.1		17.9	21.2	22.0	
New diabetics	5.2	10.3	13.0		9.7	9.4	13.5	
Known diabetics	16.1	15.5	16.9		23.3	23.7	28.3	
Total	34.8	44.0	47.0	0.001	50.9	54.3	63.8	0.058
Plasma triglycerides								
IGT	12.3	14.8	21.1		17.1	22.5	22.4	
New diabetics	4.9	10.5	13.9		8.5	8.9	17.4	
Known diabetics	12.6	15.8	19.0		15.8	24.8	36.9	
Total	29.8	41.1	54.0	<0.001	41.4	56.2	76.7	<0.001
Plasma cholesterol								
IGT	13.1	17.4	19.2		17.9	19.5	23.0	
New diabetics	7.6	9.7	13.7		7.3	12.6	12.6	
Known diabetics	14.0	12.8	22.5		15.6	24.1	31.7	
Total	34.7	39.9	55.4	<0.001	40.8	56.2	67.3	<0.001

6.7.8 Relation of diabetes with hypertension

The age-specific prevalence rates of diabetes and IGT in normotensive and hypertensive Bahrainis are presented in Table 6.38. Within each sex, prevalence of diabetes was higher in hypertensive than in normotensive participants: 36% Versus 23% in men, and 47% versus 31% in women.

Table 6.38 Prevalence of diabetes mellitus and IGT among hypertensive by sex*

		Not diabetic		Diabetic		
		Normo-glcemic	IGT	New cases	old cases	Total Prevalence
Sex/ BP status	N	N (%)	N (%)	N (%)	N (%)	N (%)
Men						
Normotensive	913	555 (61)	149 (16)	71 (8)	138 (15)	209 (23)
Hypertensive	279	133 (48)	45 (16)	48 (17)	53 (19)	101 (36)
Women						
Normotensive	535	271 (51)	98 (18)	54 (10)	112 (21)	166 (31)
Hypertensive	294	83 (28)	73 (25)	40 (14)	98 (33)	138 (47)

**Diabetes defined by WHO World Health Organization diagnostic criteria*

6.7.9 Association of obesity with diabetes

The age-specific prevalence rates for diabetes increased with BMI in each age-sex category (Table 6.39). The sex difference in diabetes prevalence was no longer statistically significant after adjusting for body mass index in a logistic regression analysis. Even in underweight individuals those with BMI < 20 kg /m2, the prevalence of diabetes was 18% in men and 16% in women.

Table 6.39 Age-and sex specific prevalence of diabetes in Bahraini natives by BMI category

	BMI Kg/m2 category				
Age-group	<20 Kg/m2	20.24.9 Kg/m2	25-29.9 Kg/m2	30-39.9 Kg/m2	40 Kg/m2
	N (%)	N (%)	N (%)	N (%)	N (%)
Men					
40-49 y	3/18 (17)	36/186 (19)	57/266 (21)	48/172 (28)	4/12 (33)
50-59 y	**6/33 (18)**	**38/162 (23)**	**61/188 (32)**	**36/105 (34)**	**2/4 (50)**
Women					
50-59 y	**2/19 (11)**	**34/117 (29)**	**57/151 (38)**	**54/147 (38)**	**7/17 (41)**
60-69 y	6/30 (20)	25/111 (23)	42/36 (36)	51/96 (53)	10/11 (91)

**Obesity defined as the following:BMI ≥30 kg/m²*

The slope of the relationship of WHR to diabetes was less steep in men than in women (Fig 6.7).

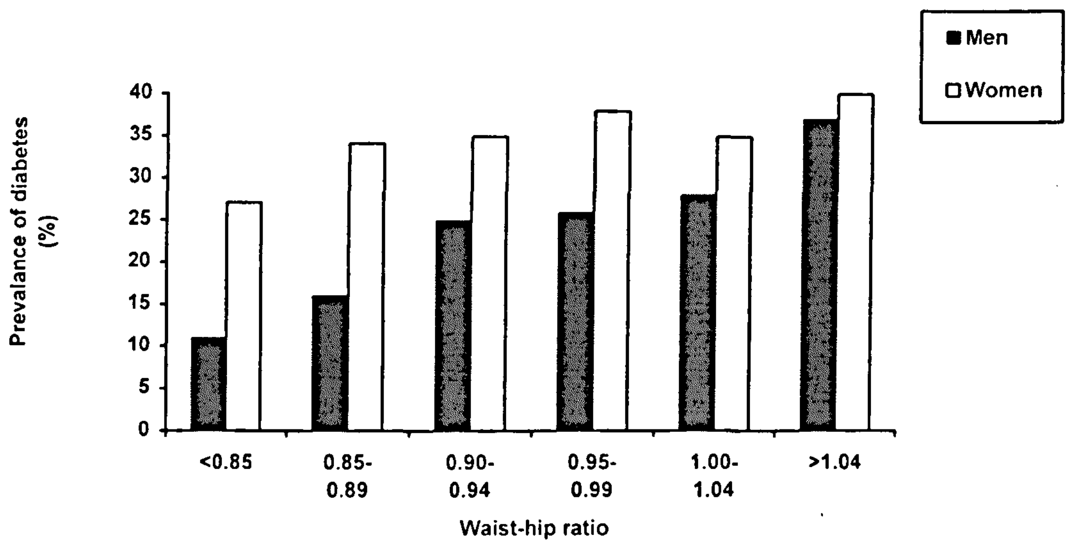


Figure 6.7 Prevalence of diabetes according to sex and body fat distribution (WHR) in Bahraini natives

The relationship of diabetes to body mass index and waist-hip ratio was examined in logistic regression analyses (Table 6.40). In men both body mass index and waist-hip ratio were strongly predictive of diabetes. In women, body mass index was a far stronger predictor of diabetes than waist-hip ratio.

Table 6.40 Logistic regression of obesity as a risk factors for Diabetes by gender

	Men			Women		
Risk factor	OR	P	95% CI	OR	P	95% CI
BMI groups						
<20 Kg/m^2	1.0	(Reference)		1.0	(Reference)	
20-24.9 Kg/m^2	1.4	0.349	0.66, 3.10	1.9	0.114	0.85, 4.37
25-29.9 Kg/m^2	1.8	0.114	0.86, 3.92	3.3	0.004	1.47, 7.30
30-39.9 Kg/m^2	2.4	0.027	1.10, 5.17	4.3	<0.001	1.92, 9.66
40 Kg/m^2	3.3	0.056	0.96, 11.9	8.8	<0.001	3.00, 26.1
Waist-hip ratio						
<0.85	1.0	(Reference)		1.0	(Reference)	
0.85-0.89	1.6	0.334	0.61, 4.18	1.4	0.251	0.79, 2.44
0.90-0.94	2.8	0.024	1.14, 6.85	1.5	0.149	0.86, 2.55
0.95-0.99	2.9	0.020	1.18, 6.95	1.7	0.060	0.97,2.82
1.00-1.04	3.1	0.015	1.24, 7.66	1.4	0.218	0.80, 2.58
>1.04	4.5	0.001	1.80, 11.6	1.8	0.051	0.99, 3.29

Table 6.41 shows standardized age-adjusted logistic regression coefficients of risk factors associated with diabetes mellitus. Standardizing the logistic regression coefficients by dividing each predictor variable by its standard deviation allows the strength of associations to be compared between predictor variables. In men WHTR was the strongest predictor of diabetes, whereas in women BMI and WHTR were equally strong predictors.

Table 6.41 Standardized logistic regression adjusted for age of risk factors for Diabetes*

	Men			Women		
Risk factor	OR	P	95% CI	OR	P	95% CI
Age	1.0	<0.001	1.02, 1.05	1.0	0.063	0.99, 1.05
Std BMI/kgm^2	1.3	<0.001	1.13, 1.51	1.5	<0.001	1.29, 1.70
Std WHR	1.3	<0.001	1.15, 1.52	1.1	0.176	0.95, 1.27
Std WHTR	1.5	<0.001	1.27, 1.72	1.5	<0.001	1.27, 1.70

** Standardized to SD of 1*

Weight loss after the onset of diabetes may weaken associations between glucose intolerance and obesity. In further analyses diabetes and IGT were combined as a single outcome variable: glucose intolerance. Associations with this combined variable are likely to be less affected by weight loss than associations with diabetes itself. Associations of waist-hip ratio with glucose intolerance were statistically significant in both sexes (Table 6.42).

Table 6.42 Logistic regression for obesity as a risk factors for Diabetes and IGT

	Men			Women		
Risk factor	OR	P	95% CI	OR	P	95% CI
BMI groups						
<20 Kg/m^2	1.0	(Reference)		1.0	(Reference)	
20-24.9 Kg/m^2	1.35	0.354	0.71, 2.59	1.71	0.105	0.89, 3.27
25-29.9 Kg/m^2	2.14	0.01	1.13, 4.05	3.3	<0.001	1.72, 6.30
30-39.9 Kg/m^2	3.02	0.001	1.57, 5.83	4.01	<0.001	2.08, 7.73
40 Kg/m^2	6.4	0.003	1.87, 21.8	9.87	<0.001	3.15, 30.8
Waist-hip ratio						
<0.85	1.0	(Reference)		1.0	(Reference)	
0.85-0.89	1.99	0.072	0.94, 4.22	1.28	0.339	0.76, 2.15
0.90-0.94	2.61	0.008	1.28, 5.29	1.62	0.056	0.98, 2.66
0.95-0.99	3.21	0.001	1.59, 6.47	1.87	0.1	1.15, 3.06
1.00-1.04	3.72	<0.001	1.80, 7.67	1.82	0.02	1.41, 4.50
>1.04	4.25	<0.001	1.99, 9.07	2.52	0.00	2.06,3.55
Waist-height ratio						
<0.45	1.0	(Reference)		1.0	(Reference)	
0.45-0.49.9	1.15	0.809	0.36, 3.70	1.24	0.727	0.36, 4.24
0.50-0.54.9	2.82	0.058	0.96, 8.25	0.68	0.517	0.22, 2.13
0.55-0.59.9	2.85	0.055	0.97, 8.33	1.35	0.575	0.47, 3.87
0.60-0.64.9	3.48	0.02	1.18, 10.25	2.60	0.069	0.92, 7.30
>0.65	5.03	0.004	1.68, 15.03	2.77	0.04	1.00, 7.65

6.7.10 Association of physical activity with diabetes

The association between physical activity and diabetes was measured by using univariate logistic regression (Table 6.43). No significant associations with distance walked or cycled were found.

Table 6.43 Logistic regression of physical activity as a risk for Diabetes and IGT by gender

	Men			Women		
Risk factor	**OR**	**P**	**95% CI**	**OR**	**P**	**95% CI**
Walking on average week days and weekend days						
≤ 3 kilometer	1.0	(Reference)		1.0	(Reference)	
4-12 kilometer	0.84	0.292	0.61, 1.15	0.77	0.384	0.43, 1.37
> 12 kilometer	1.02	0.833	0.71, 1.52	2.82	0.111	0.78, 10.1
Cycling on average week days and weekend days						
< 1 kilometer	1.0	(Reference)				
1-4 kilometer	0.76	0.490	0.36, 1.62	NA	NA	NA
> 4 kilometer	0.32	0.060	0.09, 1.08	NA	NA	NA
10 km	0.35	0.173	0.08, 1.56	NA	NA	NA
Calories expenditure/day (Walking/cycling equivalent to km/week walked)						
< 1 kilometer	1.0	(Reference)		1.0	(Reference)	
1-2 km energy.	1.02	0.872	0.75, 1.39	1.00	0.991	0.55, 1.81
3 km energy	0.79	0.256	0.53, 1.18	0.96	0.968	0.17, 5.32

The variable Calories expenditure/km was created for assessment of amount of calories expenditure from walking and cycling we generate new variable calxkm=(30 km walking + 21 km cycling)/7 and this variable labeled as "calxkm" "Kilocalories/day in walking/cycling".

In a logistic regression analysis adjusting for age and sex, there was an inverse relationship between hours TV watching and diabetes. This was no longer significant when ethnic origin was included in the model (Table 6.44).

Table 6 .44 Logistic regression with diabetes as dependent variable and age, sex, hours TV and ethnic origin

Ethnic origin	OR	P	95% Confidence Interval
Hours TV	1.04	0.434	0.94, 1.15
Shi'ite Arabs	0.38	<0.001	0.25, 0.55
Mixed	0.52	<0.001	0.36, 0.74
Iranian	0.34	<0.001	0.22, 0.52

6.7.11 Association of plasma lipids with diabetes

The association between plasma cholesterol and prevalence of glucose intolerance examined in logistic regression analyses (Table 6.45). An unexpectedly strong association between glucose intolerance and raised plasma total cholesterol level was found. In European populations, diabetes is generally associated with raised triglyceride and with low HDL cholesterol but not with raised plasma total cholesterol.

Table 6.45 Logistic regression for Plasma lipids association with Diabetes and IGT

	Men			Women		
Risk factor	OR	P	95% CI	OR	P	95% CI
Total cholesterol groups						
<5.2 mmol/l	1.0	(Reference)		1.0	(Reference)	
5.2-6.2 mmol/l	1.4	0.006	1.11, 1.90	1.8	<0.001	1.30, 2.47
>6.2 mmol/l	2.7	<0.001	1.98, 3.82	2.9	<0.001	2.06, 4.30
Triglycerides						
<2.8 mmol/l	1.0	(Reference)		1.0	(Reference)	
2.8-3.1 mmol/l	1.5	0.263	0.79, 2.86	2.8	0.106	0.79, 10.4
>6.2 mmol/l	2.9	<0.001	1.97, 4.22	2.6	0.004	1.36, 4.89

6.7.12 Relationship of parity with obesity and diabetes

The prevalence rates of diabetes among nulliparous women and women with history of single and multiple pregnancies are shown in Table 6.46. There was no obvious relationship between parity and prevalence of diabetes.

Table 6.46 Prevalence of diabetes by parity in Bahrain women aged 50-69 yr

	No children	1-4 child	5-7 children	8 or more
Number surveyed	(N=31)	(N=375)	(N=300)	(N=122)
Prevalence of diabetes				
Age-group 50-59 yr	5/19 (26%)	64/188 (34%)	61/170 (36%)	19/59 (34%)
Age-group 60-69 yr	4/10 (40%)	71/169 (42%)	42/125 (34%)	16/55 (29%)
Prevalence of Obesity$^{\Phi}$				
Age-group 50-59 yr	2/21 (10%)	81/197 (41%)	61/172 (35%)	20/61 (33%)
Age-group 60-69 yr	2/10 (20%)	49/174 (28%)	43/127 (34%)	15/60 (25%)

$^{\Phi}$ *Obesity defined by BMI >30 Kg/m^2*

6.7.13 Relationship of menopause with diabetes

In the age-group 50-54 years, 22% (95 of 434) women reported that they were still having periods (Table 6.47). The small number of women who reported still having periods after age 60 years may have misunderstood the question (Are you still having your periods?).

Table 6.47 Prevalence of diabetes among pre- and post menopausal women

	Pre - menopausal			Post - menopausal		
		Not- diabetic	Diabetic		Not- Diabetic	Diabetic
Age-group	N	N (%)	N (%)	N	N (%)	N (%)
50-54 yr	**51**	38 (75)	13 (25)	**136**	92 (68)	44 (32)
54-59 yr	**44**	33 (75)	11 (25)	**203**	213 (61)	80 (39)
60-64 yr	**12**	8 (67)	4 (33)	**172**	108 (63)	64 (37)
65-69 yr	**4**	2 (50)	2 (50)	**170**	107 (63)	63 (37)

In women aged 50-59 years diabetes rates were lower in premenopausal women than in post-menopausal women: 25% Versus 32% in those aged 50-54 yr and 25% Versus 39% in those aged 55-59 years old (Table 6.47).

When associations of menopause with diabetes prevalence were examined in a logistic regression analysis adjusting for age and body mass index there was an association between postmenopausal status and diabetes (odds ratios 1.68, P<0.03, 95% confidence interval 1.04, 2.71).

6.7.14 Multivariate analysis of risk factors for diabetes

Table 6.48 shows the results of logistic regression analyses with diabetes as dependent variable, examining associations with risk factors one at a time in a model with age as the only other independent variable. Body mass index, waist girth and waist-height ratio were strongly associated with diabetes. In men cycling, coded either as a binary variable or as the average distance cycled per day, was the only physical activity variable to show a significant inverse relationship with diabetes.

Table 6.48 Odds ratios for univariate associations of risk factors with diabetes in men

	Age-Adjusted			Age + BMI-Adjusted		
Risk factor	**OR**	**P**	**95% CI**	**OR**	**P**	**95% CI**
BMI (Kg/m2)	1.05	<0.001	1.02, 1.08			
WHR	27.9	<0.001	5.64, 138.1	15.6	0.001	3.07, 79.5
WHTR	126.5	<0.001	19.2,829.88	388.2	<0.001	14.67, 10321.3
Cholesterol (mmol/l)	1.44	<0.001	1.27, 1.63	1.42	<0.001	1.23, 1.59
Triglycerides (mmol/l)	1.29	<0.001	1.17, 1.42	1.27	<0.001	1.16, 1.41
HDL-CHOLESTEROL (mmol/l)	1.77	0.01	1.11, 2.82	2.19	0.001	1.35, 3.56
TC-LDL (mmol/l)	1.18	0.01	1.03, 1.36	1.14	0.067	0.99, 1.1
Km walked/week*	0.99	0.663	0.98, 1.01	0.99	0.553	0.97, 1.01
Km cycling/week*	0.97	0.03	0.95, 0.99	0.97	0.04	0.95, 0.99
Calories expenditure/dayⱡ	0.93	0.84	0.99, 1.02	0.92	0.112	0.84, 1.01
F history of diabetes (yes/no)	2.83	<0.001	2.14, 3.76	2.78	<0.001	2.09, 3.68
Income ⁕	1.02	0.744	0.87, 1.16	0.99	0.991	0.87, 1.14
Education•	0.96	0.454	0.87, 1.06	0.94	0.303	0.86, 1.04
Hours of TV†	1.12	0.058	0.99, 1.26	1.10	0.109	0.97, 1.24

** Number of kilometers walking on average weekend, and on average week day defined by 3 category:*
a) <1 km b) 1-3 km c) 4 km or more.
** Number of kilometers cycling on average weekend, and on average weekday defined by 3 category:*
a) <2 km b) 2-6 km c) 7 km or more.
ⱡ Calories expenditure/day from walking and cycling
⁕ Income defined by groups of Bahrain currency by 4 category:
a) <BD 250 b) 250-499 c) 500-750 d) more than BD 750.
' Family history of diabetes (Yes/no)
• Education and defined by a)illiterate b) school c) university
† TV= Number of hours watching television/day, and defined by 5 categories:
a) <1 hours b) 1-3 hours c) 4-8 hours d) 9-15 hours e) 16 hours or more

The inverse association of cycling with diabetes persisted after adjusting for body mass index. Family history of diabetes was associated with diabetes in men (OR=2.83, P<0.001, 95% CI 2.14, 3.76) and in women (OR=2.78, P<0.001, 95% CI 2.09, 3.68), and the relationship persisted after adjusting for BMI. After adjusting for body mass index , waist to hip ratio was not associated with diabetes in women, whereas waist-height ratio, plasma cholesterol and triglycerides were strongly associated with diabetes (Table 6.49). As few women were cyclists, cycling could not be examined for association with diabetes.

Table 6.49 Univariate logistic regression associations of risk factors with diabetes in women

	Age-Adjusted			Age + BMI-Adjusted		
Risk factor	**OR**	**P**	**95% CI**	**OR**	**P**	**95% CI**
BMI (Kg/m2)	1.0	0.361	0.98, 1.03			
WHR	3.2	0.176	0.59, 17.5	1.9	0.439	0.34, 11.3
WHTR	118.1	<0.001	19.5,714.8	6.6	0.167	0.45, 95.8
Cholesterol (mmol/l)	1.3	<0.001	1.18, 1.52	1.3	<0.001	1.14, 1.48
Triglycerides (mmol/l)	1.8	<0.001	1.51, 2.13	1.7	<0.001	1.45, 2.05
HDL-CHOLESTEROL (mmol/l)	0.98	0.966	0.62, 1.57	0.95	0.841	0.58, 1.54
TC-LDL (mmol/l)	1.26	0.002	1.09, 1.46	1.23	0.006	1.06, 1.44
Km walked/week⁺	0.99	0.814	0.94, 1.04	1.00	0.921	0.95, 1.05
Km cycling/week*	0.89	0.411	0.68, 1.16	0.89	0.416	0.68, 1.179
Calories expenditure/day‡	0.91	0.660	0.98, 1.26	0.96	0.827	0.70, 1.32
F history of diabetes (yes/no)	2.80	<0.001	2.05, 3.83	2.59	<0.001	1.88, 3.57
Education♣	0.91	0.454	0.87, 1.06	0.87	0.107	0.74, 1.02
Hours of TV†	1.05	0.442	0.92, 1.20	1.02	0.743	0.89, 1.17

⁺Number of kilometers walking on average weekend, and on average week day defined by 3 category:
a) <1 km b) 1-3 km c) 4 km or more.

**** Number of kilometers cycling on average weekend, and on average weekday defined by 3 category:***
a) <2 km b) 2-6 km c) 7 km or more.

‡ Calories expenditure/day⁷ from walking and cycling

⁑ Income defined by groups of Bahrain currency by 4 category:
a) <BD 250 b) 250-499 c) 500-750 d) more than BD 750.

' Family history of diabetes (Yes/no)

♣ Education and defined by a)illiterate b) school c) university

† TV= Number of hours watching television/day, and defined by 5 categories:
a) <1 hours b) 1-3 hours c) 4-8 hours d) 9-15 hours e) 16 hours or more

The independent relationships of risk factors to diabetes were examined in multivariate logistic regression analyses for men and women separately. In men, age, ethnic origin, family history of diabetes, waist, waist-height ratio, and plasma cholesterol were the only statistically significant independent predictors of diabetes. Body mass index did not show any positive relationship to diabetes when these other predictors were included in the model (Table 6.50).

Table 6.50 Multivariate logistic regression associations of risk factors with diabetes in men

	Age-Adjusted		
Risk factor	OR	P	95% CI
Age	1.04	<0.001	1.02, 1.07
Shi'ite Arabs	0.56	<0.03	0.34, 0.94
Mixed	0.50	<0.007	0.30, 0.82
Iranian	0.46	<0.009	0.26,0.82
Family history of DM	2.74	<0.001	2.02, 3.73
BMI (kg/m^2)	0.95	0.05	0.90, 0.99
Waist	1.04	<0.001	1.02, 1.07
Cholesterol (mmol/l)	1.36	<0.001	1.18, 1.56

In women, ethnic origin, family history of diabetes, body mass index, menopause and plasma cholesterol. Waist-height ratio or waist girth were not statistically significant as independent predictors when these other variables were included (Table 6.51).

Table 6.51 Multivariate logistic regression associations of risk factors with diabetes in women

	Age-Adjusted		
Risk factor	OR	P	95% CI
Age	1.01	0.479	0.98, 1.04
Shi'ite Arabs	0.34	<0.004	0.18, 0.73
Mixed	0.47	<0.03	0.24, 0.91
Iranian	0.23	<0.001	0.11,0.49
Family history of DM	2.40	<0.001	1.66, 3.44
BMI (kg/m^2)	1.08	<0.001	1.05, 1.11
Postmeopause (Yes/no)	2.08	<0.009	1.20, 3.61
Cholesterol (mmol/l)	1.26	<0.002	1.09, 1.46

6.8 PLASMA LIPIDS

The mean of plasma cholesterol was higher in women than in men: 5.5 (SD 1.3) Versus 5.2 (SD 1.0) when the same age-group was compared. This sex difference was mainly in the LDL fraction (Table 6.52). Geometric mean plasma triglyceride was higher in men than women, 1.46 (95% C.I 1.41, 1.51) Versus 1.32 (95% C.I 1.28, 1.37).

Table 6.52 Characteristics of clinical variables from questionnaires among Bahraini natives

	Men		Women	
	40-49 years	50-59 years	50-59 years	60-69 years
Number surveyed	699	522	487	390
Laboratory data				
Mean(SD) Total Cholesterol(mmol/l)	5.1 ± 1.0	**5.2 ± 1.0**	**5.5 ± 1.3**	5.6 ± 1.1
Mean(SD) HDL-Cholesterol(mmol/l)	0.94 ± 0.25	**0.99 ± 0.30**	**1.10 ± 0.30**	1.13 ± 0.30
Mean(SD) LDL-Cholesterol(mmol/l)	3.41 ± 0.92	**3.52 ± 0.98**	**3.71 ± 0.98**	3.91 ± 0.96
Mean(SD)Triglyceride(mmol/l)	1.46 (1.41, 1.51)†		1.32 (1.28, 1.37) †	

† Geometric means for triglycerides to reduce the skewness of the abnormal distribution, and (95% C.I.)

The distribution of plasma cholesterol is presented in Table 6.53. In both men and women the proportion who had plasma cholesterol >6 mmol/l was about twice as high in Sunni Arabs as in Iranians or Shi'ite Arabs.

Table 6.53 Distribution plasma cholesterol/mmol by sex and ethnic groups

	Sunni	Shi'ite Arabs	Mixed	Iranian
Men				
Plasma cholesterol				
< 5 mmol/l	49 (42%)	227 (60%)	246 (53%)	88 (52%)
5-6 mmol/l	36 (31%)	99 (26%)	142 (30%)	51 (30%)
> 6 mmol/l	32 (37%)	52 (14%)	78 (17%)	30 (18%)
Women				
Plasma cholesterol				
< 5 mmol/l	15 (25%)	114 (43%)	123 (38%)	44 (32%)
5-6 mmol/l	21 (36%)	88 (33%)	117 (36%)	59 (43%)
> 6 mmol/l	23 (39%)	63 (24%)	87 (27%)	34 (25%)

6.9 CORONARY HEART DISEASE

6.9.1 *Prevalence of ECG abnormalities and diagnosed CHD*

The prevalence of ECG abnormalities suggesting CHD was high in the study population (Table 6.54). In the age group 50-59 years, prevalence of major Q waves was higher in men (3.5%) than in women (1.7%). Prevalence of positive ECG was higher in women 48% than in men 26%. This is consistent with other surveys suggesting that S-T and T wave abnormalities in women are not specific for coronary disease.

Table 6.54 Prevalence† of Coronary Heart Disease in Bahraini native population

	Men				Women			
	40-49 years		50-59 years		59-59 years		60-69 years	
	No	(%)	No	(%)	No	(%)	No	(%)
Major Q								
1.1 Q and QS	5/657	(0.7%)	1/487	(0.2%)	0/460	(0%)	4/366	(1.1%)
1.2 Q and QS	11/657	(1.7%)	16/487	(3.2%)	8/460	(1.7%)	12/366	(3.3%)
All	16/657	(2.4%)	17/487	(3.5%)	8/460	(1.7%)	16/366	(4.4%)
Positive ECG								
1.3 Q and QS	17/657	(3%)	15/487	(3%)	16/460	(3%)	13/366	(3%)
4.1-4.4 ST	27/657	(4%)	29/487	(6%)	67/460	(14%)	67/366	(18%)
5.1-5.3 T	65/657	(10%)	58/487	(12%)	119/460	(26%)	107/366	(29%)
7.1 LBBB	5/657	(1%)	10/487	(2%)	13/460	(3%)	17/366	(5%)
All	114/657	(17%)	112/487	(23%)	215/460	(46%)	204/366	(55%)
Total (Possible)	140/657	(21%)	129/487	(26%)	223/460	(48%)	220/366	(60%)

† CHD defined according to Minnesota criteria
****Prevalence rates for men are standardized to age distribution of Survey men population***
*****Prevalence rates for women are standardized to age distribution of Survey women population***
LBBB= Left Bundle Branch Block

Table 6.55 shows a cross-tabulation of positive history or diagnosis by physician of coronary heart disease with Minnesota-coded major Q waves on ECG. Fewer than half of those with major Q waves on ECG had been diagnosed with CHD.

Table 6.55 Number and percentage of history of heart disease reported by subjects and diagnosis detected by Survey coder according to Minnesota Criteria

	Major Q wave diagnosis					
History of heart	Negative		Positive		Total	
disease	No	(%)	No	(%)	No	(%)
No	1800	96	36	61	1836	95
Yes	79	4	23	39	102	5
Total	1878	100	59	100	1938	100

Age-specific prevalence rates of major Q waves and probable CHD are shown in (Table 6.56).The prevalence of probable CHD (defined as major Q wave on ECG or diagnosis of physician) was higher in men (4.8%). Similar in men (7.7%) and women (7.4%).

Table 6.56 Prevalence of Major Q, and Probable CHD by age-group and gender

	Men			Women		
	40-49 yr	50-59 years		50- 59 years	60-69 years	
	No (%)	No (%)	P*	No (%)	No (%)	P
Major Q[a]	16/657(2.4%)	17/487 (3.5%)	0.14	8/460 (1.7%)	16/366 (4.4%)	0.073
Probable[b]	29/638(4.5%)	37/475 (7.7%)	0.004	33/447 (7.4%)	43/359 (11.9%)	0.161

[a] Major Q and QS items: codes 1.1 and 1.2
[b] Probable CHD diagnosed by physicians or major Q wave
** P- value for difference between age-groups*

Age-specific prevalence rates of major Q waves and probable CHD by ethnic group are shown in (Table 6.57). The prevalence of probable CHD (defined as major Q wave on ECG or diagnosis of physician) was highest in Iranian men (8.2%), and highest in Sunni Arabs women (17%).

Table 6.57 Prevalence of Coronary Heart Disease in Bahraini native population by ethnic groups

	CHD on ECG							
	Major Q wave				Probable CHD			
	Men		Women		Men		Women	
Ethnic groups	No	(%)	No	(%)	No	(%)	No	(%)
Sunni Arab	2/113	(1.8)	2/58	(3.4)	8/113	(7.1)	10/59	(16.9)
Shi'ite Arabs	8/357	(2.2)	5/258	(1.9)	16/358	(4.5)	21/258	(8.1)
Mixed	15/446	(3.4)	11/308	(3.6)	26/447	(5.8)	25/308	(8.1)
Iranian	8/157	(5.1)	5/129	(3.9)	13/158	(8.2)	13/130	(11.5)

Because the numbers of cases were small, ethnic differences were examined after combining both sexes and adjusting for age and sex in logistic regression analyses. Prevalence of probable CHD was significantly lower in Shi'ite Arabs than in Sunni Arabs (OR 0.51 (95% CI 0.28, 0.93). Prevalence in Iranians was similar to that in Sunni Arabs (Table 6.58).

Table 6.58 Prevalence of CHD in Bahraini native population by ethnic groups for both sexes

	CHD on ECG					
	Major Q wave			Probable CHD		
Ethnic groups	No	(%)	OR* (95% C I)	No	(%)	OR (95% C I)
Sunni Arab	4/171	(2.3)	1.0 (Reference)	18/172	(10.5)	1.0 (Reference)
Shi'ite Arabs	13/615	(2.2)	0.89 (0.28, 2.78)	37/616	(6.0)	0.51 (0.28, 0.93)
Mixed	26/754	(3.4)	1.48 (0.51, 4.31)	51/755	(6.7)	0.59 (0.33, 1.03)
Iranian	13/286	(4.5)	1.99 (0.63, 6.22)	28/9.7	(9.7)	0.87 (0.46, 1.64)

** OR= age-adjusted odds ratio by univariate logistic regression combined for both sexes*

6.9.2 Comparison prevalence of major Q waves with other populations

Table 6.60 compares prevalence of major Q waves in Bahrain Survey with other populations (South Asians, Europeans and Scottish). All prevalence rates are standardized to the age distribution of Bahraini men in Bahrain Survey.

The prevalence of 2.8% among Bahraini natives men aged 40-59 years old is similar to the age-standardized prevalence of 2.2% reported from Southall Study (McKeigue et al. 1993) among Europeans. The highest prevalence rate of major Q waves was 3.9% among South Asians in Southall Study.

Table 6.59 Comparison with other surveys prevalence of Minnesota coded major Q wave for men.

Population	Age-group	n	Prevalence	Prevalence Ratio	Reference
Bahrain	40-59 years	1,221	2.8	1	
Southall (England)					
Europeans	40-59 years	1,202	2.2	0.8	(McKeigue et al. 1993)
South Asians	40-59 years	1,222	3.9	1.4	
Scotland	40-59 years	5,071	1.8	0.6	(Smith et al. 1990)

All prevalence rates are standardized to the age distribution of men in the Bahrain Heart Health and Diabetes Survey (BHHDS)
Ratio of prevalence in index population to prevalence in Bahraini men in the BHHDS

6.9.3 Major Q wave and diabetes by tertiles of risk factors

Prevalence rates of Major Q wave, diabetes and hypertension in men and women by tertiles of BMI, WHR, plasma cholesterol and triglycerides are shown in (Table 6.60). The only statistically significant association was between "probable CHD" and BMI in women.

Table 6.60 Prevalence of Major Q wave diabetes and hypertension in men and women by tertiles of BMI, WHR, Systolic BP, diastolic BP, plasma cholesterol and triglycerides

	Prevalence (%)							
	Men				Women			
Tertile with sex-group	1	2	3	P	1	2	3	P
Body mass index								
Major Q wave	2.6	3.0	3.5	0.788	2.6	1.7	4.3	0.178
Probable CHD	5.9	5.9	6.1	0.999	7.8	7.5	12.3	<0.009
Waist-hip ratio								
Major Q wave	3.1	2.1	3.9	0.349	2.6	3.3	3.1	0.854
Probable CHD	6.1	4.5	7.5	0.209	8.9	8.8	10.5	0.769
Plasma cholesterol								
Major Q wave	3.3	2.0	3.6	0.388	3.2	2.7	3.0	0.942
Probable CHD	4.9	6.1	7.4	0.350	8.5	8.5	10.7	0.581
Plasma triglycerides								
Major Q wave	3.3	2.0	3.6	0.388	3.2	2.7	3.0	0.942
Probable CHD	6.0	5.8	6.2	0.142	8.2	9.8	10.4	0.271
Plasma HDL-cholesterol								
Major Q wave	3.3	2.5	3.2	0.783	1.3	3.4	3.4	0.404
Probable CHD	7.5	5.1	5.3	0.674	6.6	12.6	8.4	0.077
Plasma LDL-cholesterol								
Major Q wave	2.9	3.2	2.8	0.946	3.1	2.5	3.2	0.879
Probable CHD	6.3	4.8	6.6	0.550	7.3	9.7	10.9	0.099

6.9.4 Diabetes as a risk factor for CHD

There were no statistically significant associations of major Q waves with diabetes or glucose intolerance (Table 6.62). When IGT, known diabetes, and newly-diagnosed diabetes were examined separately, a statistically significant association (odds ratio 1.8) of probable CHD with newly-diagnosed diabetes was observed (Table 6.62).

Table 6.61 Prevalence of Major Q, Probable and possible CHD with and without diabetes

	Men			Women		
	Normal	IGT	diabetic	Normal	IGT	diabetic
	OR⟠	OR⟠	OR⟠	OR⟠	OR⟠	OR⟠
Major Q[a]	1.0	1.15	1.22	1.0	0.93	1.20
Probable[b]	1.0	1.05	1.37	1.0	1.29	1.50

[a] Major Q and QS items: codes 1.1 and 1.2

[b] Probable CHD diagnosed by physicians or major Q wave

⟠ OR= Odds ratios(adjusted for age)

Table 6.62 Univariate age-adjusted logistic regression analysis for glucose intolerance as a risk factor with probable CHD in both men and women

	OR.	P value	95% Confidence Interval
Glucose intolerance			
Normoglycemic	1.0	(Reference)	
IGT	1.17	0.514	0.72, 1.65
Old diabetics	0.76	0.450	0.38, 1.52
New diabetics	1.79	0.006	1.18, 2.71

6.9.5 Smoking as a risk factor for CHD

53% of men and 94% of women had never smoked cigarettes. Smoking rates in women were too low to examine further. The frequency of current cigarette smoking was 32% among Sunni men, 33% among Iranian men and 21% among Shi'ite men (Table 6.63).

Table 6.63 Distribution No of smoking status in men by ethnic groups

	Sunni	Shi'ite Arabs	Mixed	Iranian
Men				
Status of smoking habit[Φ]				
Never smoke	52 (44%)	235 (62%)	233 (50%)	82 (49%)
Ex- smoker	28 (24%)	66 (17%)	96 (20%)	31 (18%)
Current smoker	37 (32%)	79 (21%)	140 (30%)	56 (33%)

[Φ] *Status of smoking habit for women not accurately reported in this survey*

The rates of current cigarette smoking were lower (19%) among men who were university graduates than among men with no educational qualifications beyond school level (Table 6.64).

Table 6.64 Distribution No of smoking status in men by education status

	N	Education level		
		Illiterate	School	University
Men				
Status of smoking habit[Φ]				
Never smoke	192	96 (50%)	375 (49%)	159 (67%)
Ex- smoker	768	38 (20%)	165 (21%)	33 (14%)
Current smoker	237	58 (30%)	228 (30%)	45 (19%)

[Φ] *Status of smoking habit for women not accurately reported in this survey*

The relationship between smoking and prevalence of CHD (major Q wave and probable CHD) in men was significant in a logistic regression analysis (Table 6.65 and 6.66).

Table 6.65 Prevalence of Major Q, Probable CHD by status of smoking habit in men

	Never smoke		Ex-smoker		Current smoker		
	No	(%)	No	(%)	No	(%)	P
Major Q[a]	8/594	(1.3)	8/222	(3.6)	19/315	(6.0)	<0.001
Probable[b]	18/630	(2.8)	19/235	(8.1)	11/332	(3.3)	0.002

Major Q and QS items: codes 1.1 and 1.2
Probable CHD diagnosed by physicians, variable created for positive major Q wave

Table 6.66 Univariate logistic regression for association of cigarette smoking association with major Q wave and probable CHD among Bahraini natives by gender

	Men			Women		
Smoking status	OR	P	95% CI	OR	P	95% CI
Major Q wave						
Never smoke	1.0	(Reference)		NA		
Ex-smoker	2.61	0.058	0.96, 7.07	NA	NA	NA
Current smoker	4.65	<0.001	2.01, 10.7	NA	NA	NA
Probable CHD						
Never smoke	1.0	(Reference)		NA		
Ex-smoker	2.34	0.006	1.27, 4.31	NA	NA	NA
Current smoker	1.93	0.02	1.07, 3.47	NA	NA	NA

6.9.6 Relation of CHD to plasma lipids

Table 6.67 shows the results of logistic regression analyses with probable CHD as dependent variable, with cholesterol grouped into three categories and age as the only other independent variable. The level of plasma total cholesterol >6.2 was strongly associated with probable CHD in men, whereas in women there was no association between prevalence of probable CHD and plasma cholesterol.

Table 6.67 Univariate logistic regression for plasma total cholesterol association with probable CHD among Bahraini natives by gender

	Men			Women		
Smoking status	OR	P	95% CI	OR	P	95% CI
Plasma cholesterol						
<5.2 mmol/l	1.0	(Reference)		1.0	(Reference)	
5.2-6.2 mmol/l	1.06	0.831	0.58, 1.94	1.15	0.603	0.66, 2.00
>6.2 mmol/l	2.02	0.02	1.11, 3.68	0.99	0.976	0.53, 1.83

6.9.7 Relation of CHD to hypertension

Univariate logistic regression analysis was used to test the association between hypertension and prevalence of both major Q wave and probable CHD. The association of hypertension with prevalence of both major Q wave and probable CHD was significant after age-adjusting (P<0.001) in both sexes (Table 6.68).

Table 6.68 Univariate logistic regression for hypertension association with major Q wave and probable CHD among Bahraini natives by gender

	Men			Women		
Hypertension risk factor	OR	P	95% CI	OR	P	95% CI
Major Q wave						
Normotensive	1.0	(Reference)		1.0	(Reference)	
Borderline BP	1.15	0.436	0.80, 1.67	1.02	0.897	0.67, 1.55
Untreated hypertensive	1.27	0.222	0.80, 1.88	1.84	0.005	1.20, 2.81
Treated hypertensive	2.89	<0.001	1.91, 4.38	2.13	<0.001	1.47, 3.09
Probable CHD						
Normotensive	1.0	(Reference)		1.0	(Reference)	
Borderline BP	0.94	0.890	0.44, 2.03	1.61	0.162	0.82, 3.18
Untreated hypertensive	1.35	0.436	0.62, 2.92	1.15	0.717	0.52, 2.57
Treated hypertensive	3.88	<0.001	2.08, 7.25	2.74	0.001	1.53, 4.92

6.9.8 Relation of CHD to family history

In comparison with men and women who did not have a family history of diabetes, both men and women with a family history of CHD had higher average weight, body mass index, total plasma cholesterol and triglycerids. In addition, women with a family history of CHD had higher average and hip girth. (Table 6.69). In both men and women, mean plasma cholesterol was 0.2 mmol/l higher in those with positive than in those with negative family history of CHD.

Table 6.69 Mean values of risk factors in those with and without a family history of CHD

	Family history of CHD		P
	No	Yes	value*
Men			
Number surveyed	(N=966)	(n=220)	
Mean (SD) age (year	50 ± 5.8	48 ± 5.4	<0.001
Clinical examination data			
Mean (SD) height (cm)	166.8 ± 7.2	167.4 ± 7.4	0.601
Mean (SD) weight (Kg)	75.4 ± 14.3	78.2 ± 13.5	<0.04
Mean (SD) waist (cm)	94.7 ± 11.9	96.3 ± 11.7	0.073
Mean (SD) hips (cm)	98.2 ± 11.1	99.9 ± 11.8	0.055
Mean (SD) BMI (Kg/m^2)	27 ± 4.7	28 ± 4.4	0.055
Mean (SD) WHR	0.97 ± 0.08	0.96 ± 0.07	0.943
Mean (SD) WHTR	0.56 ± 0.07	0.57 ± 1.1	0.198
Mean (SD) Cholesterol(mmol/l)	5.1 ±1. 0	5.3 ± 1.1	<0.02
Mean (SD) HDL- Cholesterol(mmol/l)	0.97 ± 0.3	0.92 ± 0.3	<0.02
Mean (SD) LDL- Cholesterol(mmol/l)	3.4 ± 0.9	3.4 ± 0.9	0.504
Geometric mean(95% CI) Triglyceride (mmol/l)	1.16 (1.14, 1.18)	1.24 (1.20, 1.29)	<0.001
Women			
Number surveyed	(N=710)	(n=126)	
Mean (SD) age (year	60 ± 5.3	59 ± 5.4	0.242
Clinical examination data			
Mean (SD) height (cm)	153.8 ± 5.8	154.0 ± 5.4	0.749
Mean (SD) weight (Kg)	65.7 ± 15.0	69.0 ± 14.3	<0.03
Mean (SD) waist (cm)	95.5 ± 13.2	97.7 ± 14.3	0.092
Mean (SD) hips (cm)	100.6 ± 12.9	104.0 ± 12.1	<0.01
Mean (SD) BMI (Kg/m^2)	28 ± 5.7	29 ± 5.6	<0.02
Mean (SD) WHR	0.95 ± 0.08	0.94 ± 0.09	0.248
Mean (SD) WHTR	0.62 ± 0.08	0.63 ± 0.09	0.105
Mean (SD) Cholesterol(mmol/l)	5.5 ±1. 1	5.9 ± 1.7	<0.007
Mean (SD) HDL- Cholesterol(mmol/l)	1.2 ± 0.3	1.1 ± 0.3	0.090
Mean (SD) LDL- Cholesterol(mmol/l)	3.7 ± 0.9	3.9 ± 0.8	0.093
Geometric mean(95% CI) Triglyceride (mmol/l)	1.12 (1.10, 1.14)	1.17 (1.12, 1.23)	<0.03

*** P value based on univariate age-adjusted least-sguare regression of risk factors and family history of CHD*

Association between family history and the prevalence of high BP and probable CHD was examined. Unvariate logistic regression analysis shows an association of family history with both major Q waves and probable CHD (Table 6.70). Positive family history of diabetes was associated with OR of 1.6 for probable CHD (95% CI 1.10 to 2.25). This effect disappears when family history of CHD is included in the model.

Table 6.70 Univariate Logistic regression for family history of diabetes, hypertension, and CHD association with diabetes, hypertension, major Q and probable CHD in Bahraini natives by gender

	Men			Women		
Risk factor	OR	P	95% CI	OR	P	95% CI
Family history of CHD	**Major Q**					
No	1.0	(Reference)		1.0	(Reference)	
Yes	2.33	0.02	1.11, 4.89	1.12	0.219	0.37, 3.37
Family history of CHD	**Probable CHD**					
No	1.0	(Reference)		1.0	(Reference)	
Yes	2.73	<0.001	1.60, 4.67	2.06	0.01	1.16, 3.67

6.9.9 Multivariate analyses of risk factors for CHD

Table 6.71 shows the results of logistic regression analyses for each sex separately with major Q wave as dependent variable, examining associations with risk factors one at a time in a model with age as the only other independent variable. Current smokers, ex-smokers, family history of CHD and hypertension were strongly associated with major Q wave only in men. Body mass index, and waist-height ratio were not associated with major Q wave.

Walking and cycling did not show any significant inverse relationship with major Q wave in men or women. Total plasma cholesterol, HDL-cholesterol, LDL-cholesterol and plasma triglycerides were not associated with major Q wave in men or women.

Table 6.71 Age adjusted univariate logistic regression of risk factors for Major Q by gender

	Men			Women		
Risk factor	OR	P	95% CI	OR	P	95% CI
Age						
diabetes (Yes/no)	1.05	0.891	0.48, 2.30	1.30	0.546	0.55, 3.09
Current smoking (Yes/no)	2.11	<0.001	1.41, 3.16	1.71	0.096	0.90, 3.35
Ever smoker (Yes/no)	3.78	0.001	1.70, 8.41	2.19	0.217	0.63, 7.61
hypertension (Normal/ high)	2.64	0.006	1.33, 5.24	2.07	0.082	0.91, 4.69
BMI (Kg/m^2)	1.02	0.471	0.95, 1.10	1.05	0.090	0.99, 1.12
WHR	0.79	0.914	0.01, 52.8	0.20	0.516	0.01, 24.8
Cholesterol (mmol/l)	1.19	0.243	0.88, 1.62	0.78	0.215	0.53, 1.15
HDL-cholesterol (mmol/l)	0.80	0.741	0.22, 2.89	1.83	0.323	0.54, 6.12
LDL -cholesterol (mmol/l)	1.12	0.495	0.79, 1.59	0.87	0.549	0.57, 1.34
Triglycerides (mmol/l)	1.03	0.789	0.82, 1.28	0.84	0.518	0.51, 1.39
Km walked/ week*	1.00	0.657	0.97, 1.04	0.97	0.758	0.81, 1.15
Km cycled/week*	1.02	0.074	0.99, 1.05	---	---	-- --
calories expenditure/day⁄	1.02	0.183	0.94, 1.05	0.77	0.698	0.22, 2.73
Education•	1.09	0.429	0.86, 1.39	1.04	0.841	0.69, 1.54
income*	1.29	0.113	0.94, 1.77	NA	NA	NA
Family history of CHD	2.33	0.02	1.11, 4.89	1.12	0.827	0.37, 3.37
No hours view TV'	0.98	0.899	0.72, 1.33	1.12	0.523	0.79, 1.58

** Number of kilometers walking on average weekend, and on average week day defined by 3 category:*
a) <1 km b) 1-3 km c) 4 km or more.
** Number of kilometers cycling on average weekend, and on average weekday defined by 3 category:*
a) <2 km b) 2-6 km c) 7 km or more.
⁄ Calories expenditure/day from walking and cycling
** Income defined by groups of Bahrain currency by 4 category:*
a) <BD 250 b) 250-499 c) 500-750 d) more than BD 750.
' Family history of coronary heart disease (Yes/no)
• Education and defined by a)illiterate b) school c) university
' TV= Number of hours watching television/day, and defined by 5 categories:
a) <1 hours b) 1-3 hours c) 4-8 hours d) 9-15 hours e) 16 hours or more

Table 6.72 shows the results of logistic regression analyses with major Q wave as dependent variable and both sexes combined examining associations with risk factors after adjusting for age, sex, and ethnicity in a model with age as the only other independent variable. Smoking, hypertension and family history of CHD remained strongly associated with major Q waves.

Table 6.72 Age adjusted multivariate logistic regression of risk factors for Major Q wave

	Age + sex-adjusted			Age + sex + ethnic-adjusted		
Risk factor	OR	P	95% CI	OR	P	95% CI
Age						
diabetes (Yes/no)	1.16	0.603	0.65, 2.06	1.23	0.477	0.68, 2.24
Current smoking (Yes/no)	1.99	<0.001	1.43, 2.78	1.93	<0.001	1.37, 2.71
Ever smoker (Yes/no)	3.20	<0.001	1.70, 6.00	3.09	0.001	1.62, 5.88
High Blood pressure	2.39	0.001	1.41, 4.07	2.92	<0.001	1.68, 5.07
BMI (Kg/m^2)	1.04	0.079	0.99, 1.09	1.04	0.068	0.99, 1.10
WHR	0.41	0.589	0.06, 10.4	0.59	0.763	0.02,17.1
WHTR	3.22	0.496	0.11, 93.9	3.97	0.437	0.12, 128.9
Cholesterol (mmol/l)	0.99	0.998	0.79, 1.26	0.97	0.858	0.76, 1.24
Triglycerides (mmol/l)	0.98	0.898	0.79, 1.22	0.97	0.853	0.72, 1.52
HDL-cholesterol (mmol/l)	1.20	0.672	0.50, 2.91	1.21	0.683	0.47, 3.08
LDL-cholesterol (mmol/l)	1.01	0.897	0.77, 1.33	1.01	0.937	0.76, 1.33
Km walked/ week*	1.00	0.745	0.96, 1.04	1.00	0.905	0.96, 1.04
Km cycling /week*	1.02	0.093	0.99, 1.05	1.02	0.085	0.99, 1.05
calories expenditure/day/	1.11	0.248	0.92, 1.33	1.10	0.295	0.91, 1.34
Education*	1.06	0.539	0.87, 1.30	1.07	0.508	0.86, 1.32
income*	1.15	0.309	0.87, 1.53	1.09	0.550	0.81, 1.47
Family history of CHD'	1.70	0.058	1.27, 3.21	1.80	0.060	1.71, 1.89
No hours view TV'	1.03	0.762	0.82, 1.30	1.02	0.827	0.80, 1.31

**** Number of kilometers walking on average weekend, and on average week day defined by 3 category:***
a) <1 km b) 1-3 km c) 4 km or more.
**** Number of kilometers cycling on average weekend, and on average weekday defined by 3 category:***
a) <2 km b) 2-6 km c) 7 km or more.
/ Calories expenditure/km[7] from walking and cycling
**** Income defined by groups of Bahrain currency by 4 category:***
a) <BD 250 b) 250-499 c) 500-750 d) more than BD 750.
' Family history of coronary heart disease (Yes/no)
**** Education and defined by a)illiterate b) school c) university***
' TV= Number of hours watching television/day, and defined by 5 categories:
a) <1 hours b) 1-3 hours c) 4-8 hours d) 9-15 hours e) 16 hours or more

Table 6.73 shows the results of logistic regression analyses for each sex separately with probable CHD as dependent variable, examining associations with risk factors one at a time in a model with age as the only other independent variable. Current smoking, past smoking, family history of CHD and hypertension were strongly associated with probable CHD in both men and women. Body mass index, was associated with probable CHD only in men.

Table 6.73 Age adjusted univariate logistic regression of risk factors for probable CHD

	Men			Women		
Risk factor	OR	P	95% CI	OR	P	95% CI
Age						
diabetes (Yes/no)	1.21	0.478	0.70, 2.09	1.13	0.614	0.69, 1.86
Smoking (Yes/no)	1.39	0.01	1.05, 1.83	1.39	0.157	0.87, 2.82
Ever smoker (Yes/no)	2.10	0.004	1.26, 3.83	1.56	0.298	0.67, 3.60
Hypertension (normal/high)	2.44	0.001	1.46, 4.06	1.75	0.02	1.08, 2.82
BMI (Kg/m^2)	1.01	0.669	0.96, 1.06	1.05	0.006	1.01, 1.09
WHR	0.75	0.858	0.03, 15.7	0.43	0.559	0.02, 6.99
WHTR	3.94	0.429	0.13, 118.8	4.61	0.287	0.27, 76.6
Cholesterol (mmol/l)	1.14	0.226	0.91, 1.43	1.43	1.02	0.84, 1.23
Triglycerides (mmol/l)	1.02	0.789	0.86, 1.20	1.05	0.673	0.83, 1.31
HDL -cholesterol (mmol/l)	0.66	0.404	0.25, 1.72	0.82	0.631	0.37, 1.82
LDL -cholesterol (mmol/l)	1.13	0.336	0.87, 1.45	1.08	0.527	0.84, 1.37
Km walked/ week*	1.03	0.004	1.01, 1.06	0.95	0.424	0.84, 1.07
Km cycling /week*	1.01	0.100	0.99, 1.04	NA	NA	NA
calories expenditure/day‡	1.22	0.001	1.08, 1.38	0.65	0.352	0.26, 1.59
Education•	1.04	0.643	0.87, 1.23	0.93	0.619	0.72, 1.21
income*	1.08	0.482	0.85, 1.37	NA	NA	NA
Family history of CHD'	2.73	<0.001	1.60, 4.67	2.06	0.01	1.16, 3.67
No hours view TV†	0.99	0.934	0.79, 1.23	1.02	0.853	0.81, 1.27

***** ***Number of kilometers walking on average weekend, and on average week day defined by 3 category:***
a) <1 km b) 1-3 km c) 4 km or more.

***** ***Number of kilometers cycling on average weekend, and on average weekday defined by 3 category:***
a) <2 km b) 2-6 km c) 7 km or more.

‡ Calories expenditure/day from walking and cycling

***** ***Income defined by groups of Bahrain currency by 4 category:***
a) <BD 250 b) 250-499 c) 500-750 d) more than BD 750

' Family history of coronary heart disease (Yes/no)

• Education and defined by a)illiterate b) school c) university

† TV= Number of hours watching television/day, and defined by 5 categories:
a) <1 hours b) 1-3 hours c) 4-8 hours d) 9-15 hours e) 16 hours or more

Table 6.74 shows the results of logistic regression analyses with probable CHD dependent variable, examining associations with risk factors after adjusting for age, sex, and ethnicity in a model with age as the only other independent variable. Current smoking, past smoking, hypertension and family history of CHD persisted strongly associated with probable CHD. Body mass index was associated with probable CHD after adjusting for age, sex, and ethnicity.

The waist-height ratio and waist-hip ratio were not associated with probable CHD. Total plasma cholesterol, HDL-cholesterol, LDL-cholesterol and plasma triglycerides were not associated with probable CHD in both men and women. Distance walked was positively associated with probable CHD but not with major Q.

Table 6.74 Age adjusted multivariate logistic regression of risk factors for probable CHD

	Age + sex-adjusted			Age + sex + ethnic-adjusted		
Risk factor	OR	P	95% CI	OR	P	95% CI
Age						
diabetes (Yes/no)	1.17	0.390	0.81, 1.69	1.24	0.259	0.85, 1.82
Current smoking (Yes/no)	1.39	0.006	1.10, 1.76	2.12	<0.001	1.04, 1.71
Ever smoker (Yes/no)	1.93	0.002	1.26, 2.96	1.80	0.009	1.16, 2.81
High Blood pressure	2.04	<0.001	1.43, 2.91	2.12	<0.001	1.47, 3.06
BMI (Kg/m^2)	1.03	0.01	1.01, 1.07	1.04	0.008	1.01, 1.07
WHR	0.54	0.565	0.06, 4.30	0.95	0.965	0.11, 8.13
WHTR	4.51	0.171	0.52, 39.2	6.01	0.117	0.63, 56.8
Cholesterol (mmol/l)	1.07	0.339	0.92, 1.23	1.06	0.434	0.91, 1.22
Triglycerides (mmol/l)	1.03	0.661	0.90, 1.17	1.03	0.618	0.89, 1.20
HDL -cholesterol (mmol/l)	0.75	0.363	0.40, 1.38	0.67	0.231	0.35, 1.28
LDL -cholesterol (mmol/l)	1.10	0.261	0.92, 1.31	1.12	0.215	0.93, 1.34
Km walked/ week•	1.03	0.01	1.01, 1.05	1.03	0.01	1.02, 1.07
Km cycling /week*	1.01	0.142	0.99, 1.03	1.01	0.081	0.99, 1.04
calories expenditure/day ƒ	1.18	0.006	1.05, 1.34	1.20	0.005	1.05, 1.37
Education•	0.99	0.965	0.86, 1.14	1.01	0.808	0.88, 1.17
income*	1.01	0.849	0.83, 1.24	NA	NA	NA
Family history of CHD'	2.38	<0.001	1.61, 3.52	2.40	<0.001	1.60, 3.59
No hours view TV'	1.00	0.945	0.85, 1.17	1.00	0.973	0.84, 1.18

• Number of kilometers walking on average weekend, and on average week day defined by 3 category:
a) <1 km b) 1-3 km c) 4 km or more.
** Number of kilometers cycling on average weekend, and on average weekday defined by 3 category:*
a) <2 km b) 2-6 km c) 7 km or more.
ƒ Calories expenditure/day[7] from walking and cycling
** Income defined by groups of Bahrain currency by 4 category:*
a) <BD 250 b) 250-499 c) 500-750 d) more than BD 750
' Family history of coronary heart disease (Yes/no)
• Education and defined by a)illiterate b) school c) university
' TV= Number of hours watching television/day, and defined by 5 categories:
a) <1 hours b) 1-3 hours c) 4-8 hours d) 9-15 hours e) 16 hours or more

Table 6.75 shows the results of multivariate logistic regression analyses with major Q wave dependent variable, examining associations with risk factors after adjusting for age, sex, and ethnicity in a model with age as the only other independent variable. Smoking, and hypertension remained strongly associated with major Q waves.

Table 6.75 Adjusted* multivariate logistic regression of risk factors for Major Q wave

Risk factor	OR	P	95% CI
Age	1.01	0.695	0.96, 1.06
Sex (male/female)	1.30	0.525	0.57, 2.99
Hypertension (normal/high)	3.18	<0.001	1.79, 5.64
Ever smoker (Yes/no)	0.97	0.974	0.19, 4.77

** Adjusted age + sex +ethnic + high BP + ever smoke +family history of heart disease + diabetes + cholesterol*

The independent relationships of risk factors to probable CHD were examined in multivariate logistic regression analyses for men and women separately. In men, cigarette smoking, hypertension and family history of CHD were the only statistically significant independent predictors of probable CHD. Diabetes, plasma cholesterol and body mass index did not show any positive relationship to probable CHD when these other predictors were included in the model (Table 6.76).

Table 6.76 Multivariate logistic regression associations of risk factors with probable CHD in men

	Age-Adjusted		
Risk factor	**OR**	**P**	**95% CI**
Age	1.04	0.070	0.99, 1.09
No cigarette ever smoked	1.01	<0.03	1.01, 1.03
hypertension (yes/no)	2.33	<0.003	1.34, 4.05
Family history of CHD	2.73	<0.001	1.56, 4.76

In women, , cigarette smoking, hypertension, family history of CHD and body mass index were the only statistically significant independent predictors of probable CHD. Menopause, diabetes and plasma cholesterol did not show any positive relationship to probable CHD when these other predictors were included in the model (Table 6.77).

Table 6.77 Multivariate logistic regression associations of risk factors with probable CHD in women

	Age-Adjusted		
Risk factor	**OR**	**P**	**95% CI**
Age	1.04	0.100	0.99, 1.09
No cigarette ever smoked	1.06	<0.02	1.01, 1.12
hypertension (yes/no)	1.75	<0.03	1.04, 2.97
Family history of CHD	1.98	<0.02	1.08, 3.64
BMI (kg/m^2)	1.04	<0.04	1.01, 1.09

Chapter 7

DISCUSSION

7.1 INTRODUCTION

The data presented in the previous chapters show that diabetes and cardiovascular diseases are major public health problems in Bahrain today. IHD is the most important single cause of death within the CVD group, and the male/female ratio for IHD mortality is approximately 3 to 1.

In comparison with developed countries such as England & Wales or the USA, IHD mortality in early middle age is markedly higher in Bahrain, even though at later ages IHD mortality rates in Bahrain are lower than in England & Wales. This high mortality in middle age causes serious social and economic problems, evident in the high proportion of women who are widowed by age 60 years.

The accuracy of diagnoses on death certificates is uncertain. For deaths in hospital, the validation study we undertook suggests that death certification in hospital does not markedly overemphasize IHD mortality. Unfortunately we were unable to make any equivalent check on the validity of death certificates for deaths outside hospital.

7.2 LIMITATIONS OF METHODS

7.2.1 Chance

Because of the large number of statistical tests in this report, it is likely that some findings reported as statistically significant are due to random error. Where the hypothesis was specified in advance, and where the result is plausible and supported by other studies, this is less likely.

7.2.2 Selection bias and response rate

Bias may be defined as systematic error in estimation. This broad definition of bias thus includes errors in analytical methodology and errors of interpretation. Selection bias may arise in several ways (Kalton 1983). The sample may not be a true random sample either because of errors in sample selection or because the sampling frame fails to include some units of the population (i.e 'non-coverage' of the population).

No information may be collected from some members of the sample, referred to as unit or total non-response, because of failure to locate or contact them, denial of access to them, their refusal to participate, their inability to co-operate due to age, illness, language barrier, etc. or other problems such as distance or loss of questionnaire.

There is no standard definition of response rate. There are two proportions that should be distinguished: the completion rate and the response rate (Kviz 1977). The completion rate is the proportion of all persons selected for the study who are eligible and who participate: 2128 participants out of the 4060 individuals to whom invitation letters were sent in this study.

The response rate is the proportion of participants among those who were invited to participate and were eligible. In this survey, of 3045 eligible people who received invitations, 2128 (70%) participated in the survey interview (Fig 6.1). The reasons for non-response rate are unknown.

Selection bias it could have resulted from exclusion of those who never received invitations because their addresses were incorrect in the population register, or from non-response among those who received their invitations. In this survey a 70% response rate was specified in advance as acceptable.

7.2.3 Information bias

Information bias can arise from systematic differences among the study groups in the way that data are obtained, reported, or interpreted. Information bias in the outcome and on the exposures originate from respondents, data collection instruments and procedures, or observers.

This cross-sectional study is based on data from questionnaires, clinical and laboratory examination. The questionnaires were completed by trained nurses who had interviewed the subjects. All questions were translated into Arabic to ensure that subjects understood the questions.

The information collected from the physical tests, was checked several times by the nurse supervisor specially for anthropometric measurements. One possible source of bias in the measurement of glucose tolerance test is that participants were allowed to walk between consuming the glucose load and the fasting sample taken 2 hours later. This could have reduced their 2 hours glucose levels, and thus underestimate number of subjects with IGT and NIDDM (Glatthaar et al. 1985). Thus, for IGT and NIDDM, the estimates of prevalence are minimums.

7.2.4 Confounding

Many factors are involved in the aetiology of diabetes and CHD, and most of them are mutually correlated. To estimate the independent effect of any one risk factor, it is therefore necessary to take into account confounders. In this study, several approaches were used: restriction, stratification (men and women separately, and combined estimates produced only when no interaction was found) and multivariate analysis (multiple linear regression or logistic regression)

Two limitation of these approaches need to be mentioned. Firstly (and obvious), only factors which were measured can be taken into account. "Independent" associations can still be confounded by an unknown confounder. And second, because of measurement error, multivariate analysis may give imprecise quantitative estimates or even fail to identify the correct "independent" factors. It has been demonstrated that in multivariate analysis, factors measured with better precision appear to be more strongly (and "independently") associated with outcome than factors measured less precisely (Phillips and Davey Smith 1991), just because of misclassification.

7.3 PREVALENCE OF DIABETES

7.3.1 Diabetes and IGT

The main finding is the extremely high prevalence of diabetes in the Bahraini native population. Although there are variations in rates of diabetes by ethnic origin, even in the groups at lower risk the prevalence is among the highest in the world. Diabetes mellitus is present in 26% of men aged 40-59 years and 36% of women aged 50-69 years. When prevalence rates for the same age group (50-59 years) are compared, women had higher rates (35%) than men (29%). This sex difference in diabetes prevalence was removed by adjusting for BMI.

Prevalence of IGT (19% in women and 16% in men aged 50-59 years) was approximately twofold higher than the prevalence of newly diagnosed NIDDM in this study. This in accordance with previously published studies of high-risk populations (Zimmet et al. 1981; Knowler et al. 1981; King et al. 1984). IGT is a relatively new clinical category, and its clinical significance is still under study. Several follow-up studies in middle-aged and younger populations have indicated that ~50% of IGT subjects revert to normal glucose tolerance, 25% remain permanently glucose intolerant, and <25% progress to diabetes (Jarrett et al. 1979; Keen 1982; Ohlson et al. 1987). However, middle-aged subjects with IGT have an approximately fourfold risk for developing diabetes compared with normoglycaemic subjects (Jarrett et al. 1979; King et al. 1984). It has been suggested that high prevalence of IGT in relation to prevalence of NIDDM is an indicator that prevalence of NIDDM is increasing (Dowse et al. 1990). This would be consistent with the increase in hospital admissions for diabetes during the last 20 years and with the changes of socioeconomic status and life-style which have led to high prevalence rates of obesity and to low physical activity.

Based on the present survey data, about 35% of those with diabetes aged 40-69 years in Bahrain are undiagnosed. For comparison, 48% of all cases of diabetes in the USA and about one-third of all cases in England in this age group are undiagnosed (Harris 1987, McKeigue 1993).

7.3.2 Comparison with other Arab populations

Socioeconomic development and changes in lifestyles have been accompanied by the emergence of diabetes as a major problem in the region defined by WHO as "Eastern Mediterranean" (Abdella et al. 1995), but reliable epidemiological data are still scarce and comparability is generally poor. Small-scale studies suggest that prevalence of diabetes mellitus is high throughout the countries of the Arabian Peninsula (Abdella et al.1995; Basshus et al.1982; Bell et al. 1984; El-Mugamer et al.1995; Famuyiwa et al.1992; Fatani et al. 1987). Prevalence is generally higher in urban than in rural populations.

The prevalence of diabetes and IGT in Bahrain is similar to that in recent surveys in Saudi Arabia (Al-Nuaim et al. 1995) and Oman (Asfour 1993) (Table 7.1). The highest prevalence rates have been reported from Saudi Arabia, where the prevalence of diabetes is even higher than for the same age groups in Bahrain. The highest crude prevalence rates of diabetes in the Saudi population were found in the eastern province of the country (18% for overall men aged 15-60+ years old and 15% in women with same age). No age-specific or age-standardized rates are available for comparison by region.

Although no studies of genetic markers are available, it is likely that the populations of Bahrain and eastern Saudi Arabia are closely related. During the third millennium BC the eastern coast of what is now Saudi Arabia was part of the Dilmun empire centered on Bahrain (Bibby and Ceoffrey 1970; Coady and Marguerite 1973). The Utub tribe who migrated to Bahrain in 1782 originate from Nejd in central Saudi Arabia: most of the present-day Sunni Arab population of Bahrain is descended from this ethnic group.

Table 7.1 Prevalence of diabetes among Arab populations in the Arabian Peninsula

Year	Country	Population criteria	Diagnostic criteria	Sex	Age(years)	Prevalence (%) Male	Prevalence (%) Female
1991[a]	Oman	General pop Omani	WHO 1985 criteria	M&F	30-64	19%	24%
1995[b]	Saudi A	Cross-sectional survey	WHO 1985 criteria	Male &	41-50	28%	--
				Female	51-60	--	40%
1995[c]	Bahrain	Cross-sectional survey	WHO 1985 criteria	Male &	40-49	23%	--
				Female	50-59	--	35%

[a] *(Asfour 1993)* [b] *(Al-Nuaim et al. 1995)* [c] *(Present survey 1995)*

The prevalence of diabetes in Bahrain is higher than rates reported in Egyptian men (22%) aged 45 years or more, whereas the prevalence rates of diabetes were lower in Bahrain than Egyptian women (52%) (Herman et al. 1995). A stepwise increase in sedentary lifestyle observed in those living in rural areas (52%) to those living in lower socioeconomic standard urban areas (73%) to those living in higher socioeconomic standard areas (89%) in the Egyptian study. The obesity prevalence rates (BMI >30 kg/m2) reported in urban Egyptians were higher than in Bahraini people. In the lower socioeconomic groups, 24% of Egyptian men aged 45+ years were obese, and in the higher socioeconomic groups 36% were obese. Women in urban Egypt were extremely obese: in the lower socioeconomic groups, 75% of Egyptian women aged 45+ years were obese, and in the higher socioeconomic groups 73% of women were obese.

7.3.3 Comparison with non-Arab populations

The World Health Organization (King and Rewers 1993) has been collecting standardized information on the prevalence of diabetes mellitus and impaired glucose tolerance in adult communities worldwide. Prevalence varies from country to country, in different ethnic groups within the same country, and between the same ethnic group undergoing internal or external migration (Taylor and Zimmet; Cheah and Tan 1979).

Within the age range 30 to 64 years, diabetes and impaired glucose tolerance were found to be absent or rare in some traditional communities in Melanesia, East Africa, and South America. In communities of European origin, the prevalence of diabetes and impaired glucose tolerance were in the range of 3% to 10% and 3% to 15%, respectively, but migrant Indian, Chinese, and Hispanic American groups were at higher risk (15% to 20%).

The highest risk was found among the Pima Indians of Arizona and the urbanized Micronesians of Nauru, where up to half of the population aged 30 to 64 years had diabetes.

The prevalence of total glucose intolerance (diabetes and impaired glucose tolerance combined) was greater than 10% in almost all populations, and was within the 11% to 20% range for European and US white populations. However, the prevalence of total glucose intolerance reached almost 30% in Arab Omanis and US blacks and affected one third of all adult Chinese Mauritians, migrant Indians, urban Micronesians, and lower-income urban US Hispanics.

In Nauruans and Pima Indians, approximately two thirds of all adults aged 30 to 64 years were affected. Thus an apparent epidemic of diabetes has occurred, or is occurring in adults through the world,. This trend appears to be strongly related to life-style and socioeconomic change.

Comparison of the results of this survey with other studies that have used WHO criteria shows that age-specific prevalence rates of diabetes in native Bahraini men and women are among the highest in the world - higher, for instance than in urban Indian population. Only in Pima American Natives are the rates higher than in Bahrainis. The rates in Bahrainis are similar to those in Aboriginal Australians.

7.3.4 Effect of age, sex and socioeconomic status

The prevalence of diabetes was significantly related to age in men but not in women. This may be because the age range studied was narrow (50-69 years in women) and because the relationship of diabetes prevalence to age is steepest before age 50 years.

Table 7.2 Gender as a risk factor for diabetes among Bahrain and Oman populations aged 50-59 years

	Age-standardized* prevalence of diabetes		
Country	**Women**	**Men**	**Ratio of women/men**
Bahrain	35	29	1.2
Oman	24	19	1.3

** Age-adjusted according Bahrain survey population*

In Bahrain as in Oman, the age-specific prevalence rate appears to be higher in women than in men. The sex difference in prevalence was removed by adjusting for body mass index. Higher average BMI in women than in men has been reported in other populations in the Arabian Peninsula; thus sex differences in diabetes prevalence throughout the region may reflect sex differences in obesity. This in turn may reflect sex differences in physical activity: while at least some men expend additional energy in occupational physical activity or walking between home and workplace, 90% of Bahraini women do not work outside the home. There was no association between socioeconomic status and diabetes prevalence in this population, after ethnic origin had been taken into account. In some other populations, such as Mexican Americans, those of low SES have a higher prevalence of NIDDM than those of higher SES (Haffner SM et al. 1989). This however has been attributed to the effect of Native American genetic admixture, rather than SES.

7.3.5 Effect of region and ethnic origin

When districts of residence were grouped as Sunni, Shi'ite or mixed, the highest rates of diabetes were found in residents of Sunni districts, and the lowest rates in predominantly Shi'ite districts. Religious denomination classified as Sunni or Shi'ite by the survey team did not predict diabetes independently of district of residence category. The reasons for this are not clear, but it may be that religious denomination was not classified accurately. Because of the civil rest in Bahrain at the time, a direct question on religious denomination could not be included in the questionnaire.

Although average socioeconomic status was higher in Sunni districts than in Shi'ite districts, adjusting for household income, distance walked and occupational physical activity did not account for the higher diabetes prevalence in residents of Sunni districts. The Sunni population of Bahrain consists of two groups: Sunni Arabs and Sunni Iranians. Sunni Arabs are a mixture of the Sunni Arab Hawalas who lived as a minority in Bahrain and neighbouring countries during the 18th century, and the Utub, originating from central Arabia, who conquered the country in 1782-83. Sunni Iranians migrated during the 20th century from western Iran, where they were a minority: they are not of Arab descent. There has been some intermarriage between Sunni Arabs and Sunni Iranians.

When grandparental country of birth was used to distinguish Sunni Arabs from Iranians, the highest rates of diabetes were found to be in Sunni Arabs. In Iranians the prevalence was as low as in Shi'ite Arabs. In comparison with other ethnic groups, Sunni Arabs spent more time watching television, had less physically active occupations, and had higher average body mass index and prevalence of obesity. Adjusting for these factors however did not make much difference to the ethnic differences in diabetes prevalence. Although average body mass index was higher in Sunnis, average waist girth and waist-height ratio were no higher in Sunnis than in other groups. The higher average plasma cholesterol in Sunni Arabs was not accounted for by adjusting for obesity.

7.4 PREVALENCE OF OBESITY AND ITS RELATION TO DIABETES

Average body mass index, and prevalence of obesity (defined as BMI > 30) were high in the Bahraini population, and higher in women (37%) than in men (22%). The prevalence of obesity and the average body mass index were lower than reported in surveys of population samples in Saudi Arabia (Al-Nuaim AR et al. 1995), and Kuwait (Al-Esa AN 1995), but similar to a study in the United Arab Emirates (El-Mugamer et al. 1995), where a community based survey among a Bedouin-derived population found that 27% of all urban residents aged 30-64 year old were obese (BMI ≥ 30).

In adult Kuwaitis (Al-Esa AN 1995). the mean BMI (± standard deviation) was 28.3 (± 5.3). the prevalence of overweight was found to be 70% (BMI >25) and the prevalence of obesity was 36% (BMI > 30). Prevalence of obesity was higher among women than men.

In a study of Saudi Arabian women attending 15 health centers in urban and rural areas in the Riyadh region (Al-Shammari et al. 1994) whose mean age was 32.2 ± 11.7 years, the mean BMI was 29.2 ± 7.0 kg m-2. Only 26% of subjects were ideal weight (BMI < 25 kg m-2), while 27% were overweight (BMI 25-29.9 kg m-2), 42% were moderately obese (BMI 30-40 kg m-2) and 5% were morbidly obese (BMI > 40 kg m-2).

Patients living in rural areas had higher average BMIs than those living in urban areas (P < 0.01). Thirty per cent of overweight participants did not think they were overweight. The mean BMI for Kuwaiti and Saudi women in these surveys is similar to that in Sunni Arab Bahraini women.

Comparison data for an Iranian population are available from a cross-sectional study, of a randomly selected sample population, aged 20-74 years resident in the southern province of Fars in Iran (Pishdad GR 1996). The mean body mass index was 22.8 ± 4.6 for mean and 23.6 ± 6.6 for women. For comparison, the mean body mass index in Bahrainis of Iranian descent in this study was 27 ± 4.6 for mean and 28 ± 5.7 for women.

Independent predictors of BMI in Bahraini men were age, physical activity at work and ethnic origin. The effect of income on BMI was accounted for by physical activity at work. In women age, ethnic origin and education were the only independent predictors of BMI. The relation of BMI to hours watching television was accounted for by adjusting for ethnic origin. The inverse relationship of BMI to age in both men and women may be a "cohort effect" in which older generations have been less obese throughout their lives than younger generations. The positive relationship of educational status with BMI in Bahraini women is the opposite of the inverse relationship between obesity and socioeconomic status usually found in Western populations. One possible explanations is that women with low educational status in Bahrain have higher energy expenditure in daily tasks, even if they are not working outside the home.

Historical studies (Al-Awadi and Amine 1989; Prakash and Shubber 1982; Al-Awadi et al. 1985; Emara et al. 1988) suggest that the high rates of obesity in the Arabian Peninsula are a relatively recent phenomenon. It has been hypothesized that native Arabs have a genetic predisposition to overweight in an environment of abundant food and decreased energy expenditure. Continuing high fat intakes in combination with low physical activity may contribute to increasing prevalence of obesity.

Obesity is the most important determinant of risk of NIDDM within populations. Central obesity, as measured by the waist girth, the waist/hip ratio or the waist/height ratio, has generally been found to show stronger associations than body mass index with diabetes (Golay A et al.1990; Blades B and Garg A 1995).

Several epidemiological studies have shown associations between WHR and prevalence of diabetes, independent of BMI (Ohlson et al. 1985, Haffner et al. 1987). In Bahrainis prevalence of diabetes was strongly related to waist girth and waist-height ratio in both men and women.

Waist-hip girth ratio was related to diabetes in men but not in women: as both waist and hip girth were associated with glucose intolerance. The reason for this is not clear: it may be that waist-hip girth ratio does not reliably discriminate women with central obesity from women with peripheral obesity in this population. It is notable that the average waist-hip ratios in women in this population were far higher than in other populations, even in comparison with studies of South Asian women who have a pronounced tendency to central obesity.

7.4.1 Family history and diabetes

The threefold odds ratio for the association of NIDDM with positive family history suggests that genetic influences on diabetes risk may be important in this population. Comparison of clinical and biochemical features in non-diabetic persons with a family history of NIDDM to non-diabetic persons without a family history of diabetes showed that family history of diabetes was associated with higher mean BMI and with higher plasma cholesterol., but not with central obesity as measured by waist or waist-height ratio. These results suggest that some of the effect of family history on NIDDM risk may be mediated through obesity. The lack of relationship between family history and waist grith contrasts with studies in European populations which have found that first-degree relatives of patients with NIDDM have more abdominal obesity than controls (Groop L et al. 1996).

7.4.2 Plasma cholesterol in relation to diabetes

An unexpected finding in this study was the strong association of glucose intolerance with raised plasma total cholesterol levels in Bahrainis, unexplained by adjusting for age, sex and obesity. In European populations glucose intolerance is generally associated with raised plasma triglyceride and with low high-density lipoprotein cholesterol levels, but not with raised plasma total cholesterol levels (Laakso M 1987, Blades B and Garg A 1995; Austin A et al. 1995; Watts GF et al 1995; Sutherland WH et al. 1994).

The ethnic differences in diabetes prevalence are paralleled by ethnic differences in plasma cholesterol levels. Average plasma cholesterol was higher in Sunni Arabs than in other ethnic groups, and this difference was not accounted for by obesity or physical activity. It is possible that an underlying metabolic defect causes both raised plasma cholesterol levels and increased susceptibility to diabetes. Alternatively some unknown factor in the diet may be responsible for both raised cholesterol levels and increased risk of diabetes.

An association of NIDDM with raised plasma total cholesterol levels has been reported in two previous studies of populations originating in the Arabian Peninsula In Kuwait, plasma lipids were compared in 55 women with NIDDM who were treated with insulin and 70 controls (Al-Muhtaseb 1989) . Plasma total cholesterol was 5.9 mmol/l in women with NIDDM and 4.3 mmol/l in the controls. In Israel, 306 Yemenite Jewish immigrants were studied 25 years after arrival in Israel (Cohen 1979). Average plasma cholesterol was higher in diabetic than in non-diabetic individuals in men but not in women: however the numbers of diabetic subjects studied (13 men and 11 women) were small.

In another study, plasma total cholesterol reported in Egyptian higher in diabetic men and women than non-diabetic ones. The plasma cholesterol >6.1 mmol/l was 7% in non-diabetic and 31% in diabetic (Herman et al. 1995) The association of NIDDM with raised plasma total cholesterol levels found in this study is thus consistent with two previous studies of Arabian Peninsula populations. It is not possible to establish in this cross-sectional survey whether raised cholesterol levels precede the development of glucose intolerance. However, the observation that a positive family history of diabetes is associated with raised plasma cholesterol levels even in non-diabetic individuals suggests that raised plasma cholesterol levels may be present before glucose intolerance develops.

7.4.3 Physical activity

Levels of physical activity in the population were generally low, especially in women. After adjusting for age and ethnic origin, two physical activity variables were significantly related to obesity. The activity at work score, based on time spent walking versus time spent sitting at work, was inversely related to BMI in men. In women this variable could not be recorded as few women worked outside the home. Number of hours spent watching television was positively related to BMI in men and women combined, after adjusting for sex, ethnic origin and educational status. After adjusting for ethnicity, no relationships between physical activity and diabetes could be demonstrated in this population. Cycling was inversely associated with NIDDM in men (P<0.04).

This association disappeared after adjusting for ethnic origin. It is possible that answers to questions about distance walked may have been inaccurate, or that in this population the range of usual physical activity levels is too narrow for associations with glucose intolerance to be detected. In populations where physical activity levels are very low, questions about physical inactivity - such as time spent sitting at work or watching television - may be more useful measures of energy expenditure than questions about physical activity. Low physical activity is likely to predispose to NIDDM through its effect on obesity, and possibly also through effects on insulin sensitivity that are not mediated through effects on obesity. Physical activity has been advocated (Lynch et al. 1996) for primary prevention of NIDDM, but randomized trials to establish the specific intensities and duration that are protective are not available. The inverse association of physical activity with obesity is consistent with a protective effect on NIDDM.

The strong positive relationship of BMI to educational status in both men and women is likely to result from an inverse association of educational status with physical activity. In men the effect of educational status on BMI was no longer significant when the activity at work score was added to the model. For women the activity at work score was not applicable, but it is possible that women with higher educational status were less active in daily living. Most families in Bahrain employ housemaids for housework and care of children at home, this probably results in lower energy expenditure among housewives who employ housemaids than in those who do not.

Correlations between obesity and number of hours spent watching television have been reported in the USA (Rissel CE 1991). While people watch TV, physical activity tends to be minimal and snacking is prevalent (Rissel CE 1991). Number of hours of television viewing per week was higher in Sunni Arabs than in other groups, but the association between BMI and television viewing remained statistically significant after adjusting for ethnic origin. In the last few years many houses in Bahrain have acquired satellite dishes and access to cable channels. This is likely to increase the problem of obesity.

7.4.4 Is high prevalence of NIDDM in Bahrain attributable to genes or environment?

The etiology of NIDDM is still controversial, with both insulin resistance and decreased insulin secretion implicated in pathogenesis. It is probable that NIDDM has a multifactorial origin in which environmental factors hasten the progression of the disease in genetically-predisposed individuals. Evidence for a genetic contribution to NIDDM has come from studies of concordance of disease in twins, siblings and offspring of affected individuals (Hitman and McCarthy 1991).

There is also evidence that insulin resistance and central obesity, which are risk factors for NIDDM, are under genetic influence. The frequency of NIDDM is higher in some ethnic groups than in others (Cruickshank JK et al.1991; Dowse GK et al. 1991; Haffner SM et al. 1986; King H et al. 1984a). Migrant studies suggest that genetic factors are likely to account for some of these ethnic differences. An alternative to genetic explanations for NIDDM has been suggested by the "fetal origins" hypothesis (Law CM, Gordon GS, Shiell AW, Barker DJ, Hales CN 1995). They have shown that reduced size at birth predicts NIDDM in middle age. This finding has been confirmed by others (Valdez R et al .1994). They argue that epidemics of NIDDM have typically coincided with a relatively rapid change from a traditional lifestyle to a modernized lifestyle, in which undernutrition in early life is followed by high prevalence of obesity and overweight in adult life. This sequence of events has been observed, for example, in Pima Indians (Knowler et al. 1981), and in Ethiopian Jewish immigrants to Israel (Raz I et al. 1993). The impact of rapid improvement in socioeconomic standards has been shown in several susceptible communities (Prior and Davidson 1966; Zimmet et al. 1981).

7.4.4.1 Evidence for an environmental explanation

One environmental factor predisposing to NIDDM in this population is the very low level of physical activity, especially in women. Only 6% of women aged 50-69 years walked at least 1 km/day. This is likely to be one factor in the high prevalence of obesity among Bahrainis. Although the occurrence of obesity in individuals reflects the interaction of dietary and other environmental factors with inherited predisposition, there is little evidence that some populations are more susceptible than others to obesity for genetic reasons. Differences in prevalence of obesity in different populations are largely attributable to environmental factors, especially dietary fat intake and physical activity. Most obese Bahrainis in this study did not even rate themselves as overweight, suggesting that cultural beliefs and attitudes in this population favour the development of obesity. Even though few individuals are now undernourished, it is possible that many individuals aged 50 years and over were undernourished in early life. During 1942-43, food shortages and undernourishment were widespread in Bahrain (Al-Khalifa and Rice). If the "fetal origins" hypothesis is correct, this could be another factor predisposing to high rates of NIDDM in Bahrain.

7.4.4.2 Evidence for a genetic explanation

Although obesity can account for some of the high risk of NIDDM in Bahrain, at any level of body mass index the age-specific prevalence of diabetes in Bahrainis was far higher than in European populations. In those whose BMI was between 20 and 25 kg/m2, the prevalence of diabetes was more than 20%.in men and women aged 50-59 years. For comparison, the prevalence in a British population with mean BMI of 25.5 kg/m2 in this age group was 5% (McKeigue 1993).

Although Sunni Arabs had higher prevalence of obesity and lower levels of physical activity than other ethnic groups, the excess risk of diabetes in Sunni Arabs was not accounted for by adjusting for these risk factors. This is consistent with a genetic explanation, as the origin of Sunni Arabs in Bahrain is likely to be different from that of Shi'ite Arab Bahrainis or Iranian immigrants.

Communities of Arab origin should not be perceived as homogeneous. Evolutionary selection pressure for the ability to survive food scarcity, leading to a "thrifty genotype" (Takahashi N and Neel JV 1993), is likely to have been especially strong among nomadic herdsmen in the adverse conditions of the Arabian desert. If most Sunni Arab Bahrainis are the descendants of the Utub tribe originating in central Saudi Arabia, they may have been exposed to such selection pressure.

The strong association of NIDDM with positive family history of diabetes in the Bahraini population is also consistent with a genetic explanation. Even among those who were not diabetic, positive family history of diabetes was associated with higher BMI and higher average plasma cholesterol. Sunni Arabs, with the highest risk of NIDDM also had higher average BMI and higher plasma cholesterol levels than other groups. This suggests that genes predisposing to NIDDM may also predispose to obesity and raised cholesterol levels. The lack of relationship between consanguinity and risk of NIDDM does not exclude a genetic explanation for NIDDM, but does exclude a genetic model based on inheritance of rare alleles with a recessive mode of action.

Although there has been a rapid change in socioeconomic status and lifestyle in Bahrain, it is unlikely that undernutrition in early life can account for the high risk of NIDDM in those aged less than 45 years, or for the high risk in Sunni Arabs who have long been the most affluent group in the population.

In summary, the high rates of NIDDM in Bahrain are likely to result from an interaction of genetic susceptibility with environmental factors. The genetic susceptibility appears to be greatest in Sunni Arabs, and least in Iranian immigrants. The environmental factors include low physical activity, and attitudes to body weight, leading to high prevalence of obesity. Undernutrition in early life may also contribute to the high risk.

7.5 CORONARY HEART DISEASE

7.5.1 Prevalence and comparison with other populations

There are no data available on prevalence of CHD according to Minnesota-coded ECG signs for any other country in the Arabian Peninsula region. The prevalence of Minnesota-coded major Q waves in Bahraini men aged 40-59 was 2.8%, higher than in comparable surveys of British populations in which the prevalence in men in this age group was around 2%. Prevalence in Bahraini men was not as high as the 3.9% found in South Asians in England. Comparison with prevalence in developing countries can be made with a cross-sectional population survey (Li N et al. 1994) carried out in 15 population groups in 9 developing countries: Fiji, Nauru, Kiribati, Cook Island, Niue, Western Samoa, New Caledonia, Mauritius and China (Beijing) between 1978 and 1987. Ethnicity included Melanesian, Polynesian, Micronesian, Asian Indian and Chinese. The total sample included 4594 men aged 35-59 years. The overall prevalence of major Q waves in these men was 1.6%. Although the age group studied in Bahrain was 40-59 years rather than 35-59 years as in the pooled survey of developing countries, this comparison of prevalence rates suggests that prevalence of IHD in Bahrain is higher than in most developing countries.

7.5.2 Relation of coronary heart disease to risk factors

7.5.2.1 Relation with established risk factors for CHD

One objective of the present survey was to test the hypothesis that the high rates of CHD in the Bahraini population are attributable to complications of obesity, such as NIDDM, rather than to smoking and raised plasma cholesterol levels.

Smoking, hypertension and family history of coronary heart disease were the only risk factors to show statistically significant associations with major Q waves. Despite the high prevalence of NIDDM, no association of diabetes or IGT with prevalence of major Q waves was detectable. When major Q waves and diagnosed CHD were combined as a single category of "probable CHD" there was still no association with diabetes or IGT. There was a significant association of probable CHD with newly-diagnosed diabetes. There was a significant association of BMI with probable CHD in a logistic regression model controlling for age, sex and ethnic origin, but this association was no longer significant when hypertension was included in the model.

The explanation for the lack of association of prevalent CHD with diabetes, and the association with newly-diagnosed diabetes is not clear. Comparison based on positive history of CHD may be biased because patients diagnosed with heart disease are more likely to be tested for diabetes, but this cannot account for the association between diagnosed CHD and undiagnosed diabetes. If the case-fatality rate of IHD is higher in those with long-standing diabetes than in the rest of the population, the association of diagnosed diabetes with IHD will not be detectable in a cross-sectional survey such as this one. No relationship of prevalence of major Q waves or "probable CHD" with plasma cholesterol, triglyceride or HDL cholesterol was found. However, positive family history of CHD was associated with higher total cholesterol, higher triglyceride and lower HDL cholesterol levels. In turn, positive family history of CHD was a strong predictor of both major Q waves and "probable CHD".

Lack of association between risk factors and IHD in cross-sectional studies is not unusual. For example the Framingham study (Friedman et al. 1966) showed no association between prevalence of CHD and total cholesterol. Prospective studies have shown that clinically manifest diabetes mellitus is a powerful risk factor for cardiovascular outcomes including CHD (Vokonas PS and Kannel WB 1996). The failure to detect these associations in a cross-sectional study may be because levels of risk factors fall after the onset of IHD. The strong association of family history of CHD with lipid disturbances, especially raised triglyceride, suggests that these risk factors are commoner in those who are at higher risk of developing CHD in future.

To establish whether risk factors related to obesity - such as NIDDM and raised triglyceride levels - predict CHD in this population will require a prospective study. Although the association of CHD with raised BMI was no longer significant after hypertension was included in the model., as hypertension is a complication of obesity this is compatible with the idea that complications of obesity are an important factor in the high CHD rates in Bahrain.

7.5.2.2 Relation with socioeconomic status and ethnic origin

In most developed countries the risk of coronary heart disease is inversely related to socioeconomic status, whereas in developing countries inverse associations are not consistently found. In Bahrainis there was no relationship between CHD prevalence and measures of socioeconomic status such as household income or educational status. Of CHD risk factors, obesity was positively related to educational status and income, whereas smoking was least common in those of high educational status.

Prevalence of "probable CHD", adjusted for age and sex, was lower in Shi'ite Arabs than in Sunni Arabs. Several risk factors - smoking, BMI, hypertension, plasma cholesterol and physical inactivity - were more unfavourably distributed in Sunnis than Shi'ites. The ethnic difference in CHD prevalence was no longer significant after adjusting for smoking and BMI. Thus there is no reason to invoke genetic explanations for ethnic differences in CHD risk., as the differences are accounted for by risk factors related to lifestyle. Clinical studies suggest the existence of a syndrome of coronary risk factors associated with glucose intolerance and insulin resistance.

7.6 PREVALENCE OF HYPERTENSION

7.6.1 *Prevalence and control of hypertension*

As expected in a population where obesity is common, the prevalence of hypertension (defined as systolic >160 mmHg or diastolic >95 mmHg) was high. Prevalence was highest in Sunni Arabs and lowest in Iranians. These ethnic differences were not accounted for by adjusting for age, sex, BMI, waist girth, and glucose tolerance. Lack of standardization of methods between different studies makes it difficult to compare prevalence in this survey with prevalence in other studies. The prevalence rates in Bahrain (men 29% and women 32% aged 50-59 years) are higher than those reported in the Saudi Arabian population: men 25% and women 28% aged 45-59 years (Abolfotouh MA et al. 1996). For comparison, the prevalence of hypertension (based on the same definition as in this survey) in a recent survey in the southern USA was 31% in White men and 27% in White women aged 45-54 years (Lackland DT 1992). This suggests that prevalence in Bahrain is similar to that in the US White population

Of the 30% of the population who were hypertensive in this survey, 62% had been previously diagnosed. Of these 85% were on treatment, but only 41% of those on treatment were adequately treated, as defined by systolic ≤ 140 mmHg and diastolic ≤ 90 mmHg. In comparison with the "rule of halves", therefore, the proportion in whom hypertension has been detected and treated is acceptable, but the adequacy of control is poor. The reasons for inadequate control are not clear: possible explanations are non-compliance, inappropriate prescribing, or hypertension that responds poorly to therapy.

There was a linear increase in prevalence of hypertension with increasing BMI or waist girth. The relationship is present in all ethnic groups, although the magnitude of the association appears weaker in Sunni Arabs than in Shi'ite Arabs or Iranians and weaker in older than in younger age groups. It is estimated that as much as one-third of all hypertension may be attributable to obesity in populations where both hypertension and obesity are common. NIDDM and impaired glucose tolerance were associated with increased prevalence of hypertension, even after adjusting for BMI and waist girth. This is consistent with other studies in which the association of NIDDM with hypertension is not accounted for by obesity or body fat pattern (Fuller JH 1985; Ferrannini E and Nataali

A 1991). Whether diabetes or hypertension occurs first cannot be determined from this cross-sectional survey.

7.7 PARITY AND MENOPAUSE

7.7.1 *Parity and obesity*

Associations between parity and obesity have been described in many populations (Rossner S and Ohlin A 1995; Arroyo 1995). Pregnancy and maternal body weight development are intertwined in complicated patterns. In most studies, an increase in maternal body weight with age and parity has been reported.

The effect appears to be greatest in low and middle socioeconomic level urban women (Arroyo P et al. 1995). Average weight increments are generally less than 1.5 kg (3 lb) during a single reproductive cycle (from before pregnancy to 1 year postpartum), but obese women tend to have larger weight changes (both increases and decreases) than lower-weight women. This is not necessarily a direct effect of pregnancy, as some women gain weight postpartum, suggesting that life-style factors are important determinants of weight gain during a reproductive cycle. Pregnancy-related increases in weight are thought to contribute to the higher prevalence of obesity in women compared with men in many populations. In this study, average body mass index was higher in parous women than in nulliparous women, but there was no trend in body mass index with increasing number of pregnancies. Parity was not associated with increased risk of NIDDM in Bahraini women. However the statistical power to detect a difference in diabetes prevalence between parous and nulliparous women was low as the number of nulliparous women was small. No relationships of parity with total cholesterol, low density lipoprotein cholesterol or triglyceride levels were observed.

7.7.2 *Menopausal status*

In comparison with premenopausal women, post-menopausal women had higher average plasma cholesterol and triglyceride, after adjusting for age in a regression analysis. After adjusting for age, BMI, ethnic origin and family history of diabetes, post-menopausal status was associated with an odds ratio of 2.2 for diabetes. These results suggest that menopause in Bahraini women is associated with worsening of the metabolic disturbances that predispose to diabetes and raised plasma cholesterol in this population. A prospective study following women through the menopause would be needed to confirm this. Administration of oestrogen replacement therapy to post-menopausal women has been shown to improve the lipid profile and to reverse some of the changes that are associated with increased risk of cardiovascular disease. Epidemiological studies suggest that the postmenopausal use of oestrogen reduces the risk of CHD (Stampfer MJ et al 1985). One possible approach to the prevention of diabetes and coronary heart disease in Bahraini women would be to provide post-menopausal hormone replacement therapy, if this can be shown to reverse the metabolic disturbances that predispose to diabetes and coronary heart disease in this population.

Chapter 8

CONCLUSIONS AND RECOMMENDATIONS

8.1 IMPLICATIONS FOR PUBLIC HEALTH

Diabetes is a growing threat to the world's public health. In the past, it was described as a "disease of affluence". The highest prevalence of diabetes is now to be found in developing countries, and in non-European ethnic minorities.

Before the discovery of oil in 1932, employment in Bahrain relied on pearl diving, fishing and agriculture (Fig 8.1). A sedentary life-style for most people in Bahrain is a fairly recent phenomenon, as Bahraini people have begun working in non-manual occupations and manual jobs have been taken by expatriate workers. Increased availability of cars has reduced activity levels still further.

Figure 8.1 The view of Bahrain Fort, old history of Bahrain

For most Bahrainis (Fig 8.2), modern life-style is characterized by low physical activity and an energy-dense diet (high in refined carbohydrate and fat). This modernized life-style is associated with high prevalence rates of obesity, NIDDM, impaired glucose tolerance, hypertriglyceridemia and hypertension,. Insulin resistance may have an underlying role in this cluster of conditions associated with increased risk of cardiovascular disease. Population-wide modification of levels of these risk factors could result in substantially lower occurrence of NIDDM (and IGT).

Figure 8.2 The view of modern life in Bahrain (Diplomatic Area built during 1980s)

Measures for prevention of diabetes and CHD may be seen as an economic burden on the community. However, the costs of treating diabetes and CHD and their complications are so high that prevention would have economic benefits as well as health benefits. In the light of the results of the present survey in Bahrain, this thesis makes the following recommendations:

Figure 7.3 Traditional Bahraini dish, "Khouzi" similar to home food daily cooked

8.2 Recommendations

8.2.1 Research on diabetes and CHD in Bahrain

The results of this study suggest several questions for further research:-

Does insulin resistance account for the high rates of diabetes in Bahrain?

Measurements of plasma insulin levels during a glucose tolerance test are proxy measures of insulin resistance. Frozen samples from the present study could be used for these measurements. This would allow comparison with levels of insulin resistance in other populations.

What is the basis of the ethnic differences in diabetes prevalence, obesity and plasma cholesterol levels?

Diet surveys of the different ethnic groups in Bahrain could be used to test whether the ethnic differences can be explained by diet.

Why is NIDDM in Bahrain associated with increased levels of total cholesterol and HDL cholesterol, in contrast to the pattern in Europeans?

A study of young adults or children for whom records of birth weight are available could test whether low birth weight predicts higher glucose levels and whether this could account for the Sunni-Shi'ite difference.

Would hormone replacement therapy prevent the increased risk of diabetes in post-menopausal compared with premenopausal women?

Post-menopausal status was associated with a twofold higher risk of NIDDM in Bahraini women. A trial could examine whether hormone replacement therapy can increase insulin sensitivity in women at high risk.

Why is the control of blood pressure so poor in people treated for hypertension?

An audit of hypertension control could examine whether appropriate drugs have been prescribed, and whether patients are taking medication as prescribed.

Do plasma cholesterol, triglyceride and HDL cholesterol predict CHD incidence or mortality in this population, when they do not show cross-sectional associations with CHD?

This question could be answered by long-term follow-up of the present study cohort.

8.2.2 Diabetes prevention and control

8.2.2.1 National diabetes program in Bahrain

Prevention and control of diabetes in Bahrain will require a diabetes programme implemented through the Ministry of Health. The programme objectives, budget and time frame should be developed by a programme director working with an advisory group. No prevention program should be commenced without a properly constituted evaluation component. This means making baseline measurements to establish the prevalence in the community of NIDDM, CHD and risk factors. These risk factors should be reassessed at the predetermined end of the study, e.g. after 5-10 years.

8.2.2.2 Primary prevention of diabetes

As established NIDDM cannot usually be reversed, attention has been given to the possibility of primary prevention of diabetes (Tuomilehto J, Wolfe E 1987; Zimmet P 1988). High prevalence of NIDDM is consistently associated with high prevalence of obesity in Bahrain and other Arab societies. Obesity appears to be the most important single target variable to control if the incidence of diabetes in Bahrain and neighboring countries in the Arabian Peninsula is to be reduced. Although there has not been any randomized trial to show that control of obesity can reduce the incidence of diabetes, the relationships of diabetes to obesity and low physical activity are widely regarded as causal. Control of obesity would also help to reduce the prevalence of hypertension and to reverse the lipid disturbances that are associated with obesity.

Most obese Bahrainis did not rate themselves as overweight; although those with higher incomes and those of Iranian origin were more likely to rate themselves overweight at a given body mass index. Obesity is commonly regarded as a desirable attribute in populations which have undergone a recent transition from scarcity to affluence.

Although temporary reductions in weight can be achieved by dietary restraint, long-term control of obesity appears to depend on maintaining higher energy expenditure through higher physical activity. Where most occupations are sedentary, walking and cycling are the two forms of activity through which energy expenditure can most easily be increased (Nutrition and Physical Activity Task Forces 1995). In the extreme heat of the Arabian Peninsula, it is easier to achieve high levels of energy expenditure by cycling than by walking, but cycling by men and women is not at present culturally acceptable.

This highlights the difficulty of reversing the adverse effects of lifestyle change in rapidly modernizing populations. Alternatively, physical activity could be increased by regular participation in exercise training programmes, but long-term participation in such programmes would require high levels of motivation. Vigorous physical activity of sufficient frequency and intensity to improve fitness may have other benefits, such as reduced CHD risk, even if it does not increase total energy expenditure or reverse obesity.

Reducing the incidence of diabetes in Bahrainis is likely to depend on communicating awareness of the adverse health consequences of obesity and on identifying appropriate strategies for increasing energy expenditure in the population. Regular physical activity should be a part of normal daily life.

8.2.2.3 Secondary and tertiary prevention of diabetes and its complications

Prevalence of undiagnosed diabetes was 11% in this survey. Although these individuals could easily be detected by a screening programme it is not certain that early detection and treatment of these individuals would be an effective way to improve outcome. Case-finding in primary care through urine tests and random blood glucose measurements might be an alternative means of increasing the proportion of cases who are diagnosed. Most diabetes is managed in primary care, rather than in diabetic clinics, and the quality of care of diabetes in primary care is probably not high. A diabetic register should be set up in each of the primary health care center and out-patient clinics in the government and private hospitals.

Diabetic clinics could be set up in hospital primary care, staffed by physicians with special training.

The measures most likely to reduce morbidity from diabetes and its complications are:-

1. Education of patients: dietary measures to maintain glycaemic control, foot care, and importance of prompt contact with health care providers when problems develop.

2. Treatment of hypertension. In those with signs of early nephropathy even mild hypertension should be treated. In randomized trials, ACE inhibitors have been shown to reduce the risk of progression to renal failure (Pinol C et al. 1996).

3. Provision of suitable footwear for those with signs of neuropathy

4. Early detection and treatment of proliferative retinopathy, as outlined in a recent WHO position paper (Porta M. 1992).

8.2.3 Cardiovascular disease prevention and control

8.2.3.1 Primary prevention of CHD

Control of smoking

In this study cigarette smoking was strongly associated with CHD in Bahrainis. Smoking rates are low in women, but this may change in future. Measures to reduce smoking in men could include: health education campaigns, restrictions on smoking in public places such as buses and workplaces, and increased taxation. The objective should be for non-smoking to be regarded as normal behavior.

Prevention and control of high plasma lipids

The relationships between habitual diet, raised blood cholesterol levels and CHD are well established and are widely agreed to be causal. The average plasma cholesterol levels in Bahraini men and women are not high in comparison with countries such as the UK, and this survey did not show any association between prevalence CHD and plasma cholesterol below 6.2 mmol/l. The population distribution of blood-cholesterol levels could probably be lowered either through reducing saturated fat intake, or through control of obesity as plasma cholesterol is strongly associated with obesity. Lipid-lowering drugs such as statins are not widely used in Bahrain. Guidelines for their rational use could be introduced: a minimum recommendation would be for their use in people with plasma cholesterol >6.2 mmol/l who have other risk factors for CHD.

Prevention and control of high blood pressure

Even a small reduction in the average blood pressure of the population could bring about a large reduction in CHD. The two measures that might lower the average blood pressure are control of obesity and reduction of sodium intake, but at present no data are available on the present sodium intake of the Bahraini population. Although the proportion of people with hypertension who are detected and treated appears to be relatively high in Bahrain, the proportion of treated hypertensive individuals who are adequately-controlled appears to be low. Guidelines for the rational management of hypertension in primary care, especially in people with diabetes, should be introduced. The management of diabetes and hypertension could be combined in "chronic disease clinics" or "risk factor clinics" based in primary care.

8.2.3.2 Secondary prevention of CHD

'Secondary prevention' is a term used to describe treatment aimed at reducing the risk of sudden death or re-infarction in a patient who has already had one or more attacks of CHD. For patients with CHD there is great potential for secondary prevention. More precise identification of patients most likely to benefit from secondary prevention and other therapeutic measures should reduce morbidity and mortality. The most useful measures are: education of patients, encouragement of regular physical activity, discouragement of smoking, increased dietary intake of oily fish, use of beta-blockers for the first year after infarction, and use of lipid-lowering drugs even when plasma cholesterol is only moderately raised. For most of these there is evidence of benefit in randomized trials.

Most of these interventions are already used. Even for physical activity there is evidence that those who have been diagnosed with heart disease are walking more than others. The possibilities for lowering CHD mortality further by these measures may be limited.

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Appendix 1

DEATH CERTIFICATE FORM USED IN BAHRAIN

STATE OF BAHRAIN

PUBLIC HEALTH DIRECTORATE

MEDICAL CERTIFICATE OF CAUSE OF DEATH

Name : .... Nationality : ....

Age : Sex : Address :

Place of Death : .... Date : .... Time : ....

CAUSE OF DEATH		Approximate interval between onset and death
I Disease or condition directly leading to death.*	(a) .... due to (or as a consequence of) :	....
Antecedent causes Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last.	(b) .... due to (or as a consequence of) :	....
	(c)	....
II Other significant conditions contributing to the disease or condition causing it.	....	....

* This does not mean the mode of dying, e.g. heart failure, asthenic, etc. It means the disease, injury, or complication which caused death.

I hereby certify that I was in medical attendance during the above named diceased's last illness, and that the particulars and cause of death above written are true in the best of my knowledge and belief.

Name & Signature : .... Qualification : ....

Status : ....

Date : ....

Note :

COPY TO :
BIRTH & DEATH
RECORDING OFFICE

Appendix 2

HOSPITAL CLINICAL RECORDS EVALUATION FORM

STATE OF BAHRAIN

MINISTRY OF HEALTH

Public Health Directorate

RELIABILITY AND VALIDITY OF CORONARY HEART DISEASE DEATH CERTIFICATE DIAGNOSIS

HOSPITAL CLINICAL RECORDS EVALUATION FORM

Bahrain 1993

I- SOCIODEMOGRAPHIC CHARACTERSTICS

Age: .... [y] [D.O.B: / /19]

Sex: .... Male[ ] Female [ ]

Nationality: .... Bah [ ] Non-Bah[ ]

Address: .... House[ ] Road[ ] Block[ ]

Occupation: .... [ ]

Length of hospital stay: .... [days]

Place of death .... SMC ....[ ]

.... BDF ....[ ]

......International hospital ....[ ]

......American hospital ....[ ]

......Awali hospital ....[ ]

Hospital record No. ....[ ]

Rank of initial certifier:

Rotating resident .... [ ]

Resident .... [ ]

Senior resident .... [ ]

II- CLINICAL FINDINGS

1-Present complaints:

Chest pain: .... Yes[ ] No[ ]

If yes: .... Duration.....................[ ] minutes

....[ ] hours

....[ ] days

.... Character.....................[ ] sharp

....[ ] stabbing

.... [ ] compressing

.... [ ] heaviness

Vomiting: .... Yes[ ] No[ ]

Sweating: .... Yes[ ] No[ ]

Shock: .... Yes[ ] No[ ]

Hypotension: .... Yes[ ] No[ ]

Heart failure: ....Yes[ ] No[ ]

Pericarditis: .... Yes[ ] No[ ]

Arrhythmia: ....Yes[ ] No[ ]

Hemiplegia: ....Yes[ ] No[ ]

Dysarthria: .... Yes[No[ ]

Coma: .... Yes[ ] No[ ]

Convulsions: ....Yes[ ] No[ ]

Associated significant illness:

Malignancy .... Yes[ ] No[ ]

Pulmonary .... Yes[ ] No[ ]

Gastrointestinal .... Yes[ ] No[ ]

Liver .... Yes[ ] No[ ]

Musculo-skeletal .... Yes[ ] No[ ]

Genito-urinary .... Yes[ ] No[ ]

2-Past Medical History

Angina .... Yes[ ] No[ ]

Old Cardiovascular Diseases......................... Yes[ ] No[ ]

Old Myocardial Infarction .... Yes[ ] No[ ]

Coronary Artery Bypass Surgery .... Yes[ ] No[ ]

Other condition .... Yes[ ] No[ ]

3- Risk Factors

Diabetes mellitus .... Yes[ ] No[ ]

Type .... IDDM .... Yes[ ] No[ ]

.... NIDDM .... Yes[ ] No[ ]

Duration ....[ ]months [ ]years

Hypercholesterolemia .... Yes[ ] No[ ]

Family History of CHD .... Yes[ ] No[ ]

Smoking .... Yes[ ] No[ ]

Obesity .... Weight [Kg]

.... Height [cm]

......................................Body mass index [Kg/m^2]

4-Laboratory Investigations

ECG Finding .... [ ] ve+ [ ] ve-

Serum enzymes for MI .... [ ] ve+ [ ] ve-

Lumber Puncture Blood .... [ ] ve+ [ ] ve-

CT Scan .... [ ] ve+ [ ] ve-

Rank of initial certifier:

Rotating resident ....[ ]

Resident .... [ ]

Senior resident .... [ ]

III- FINAL DIAGNOSIS BEFORE DEATH ON DECEASED MEDICAL RECORD MADE BY HOSPITAL DOCTORS:

#Acute Myocardial Infarction AMI .... [ ] ve+ [ ] ve-

#Old MI .... [ ] ve+ [ ] ve-

#Stroke .... [ ] ve+ [ ] ve-

#Diabetes .... [ ] ve+ [ ] ve-

#Hypertension .... [ ] ve+ [ ] ve-

#Asthma .... [ ] ve+ [ ] ve-

#Neoplasm .... [ ] ve+ [ ] ve-

#Infection .... [ ] ve+ [ ] ve-

IV- DIAGNOSIS MADE AFTER REASSESSMENT OF THE DECEASED HOSPITAL MEDICAL RECORD:

#AMI .... [ ] ve+ [ ] ve-

#IHD .... [ ] ve+ [ ] ve-

#Stroke .... [ ] ve+ [ ] ve-

#Diabetes .... [ ] ve+ [ ] ve-

#Hypertension .... [ ] ve+ [ ] ve-

#Asthma .... [ ] ve+ [ ] ve-

#Neoplasm .... [ ] ve+ [ ] ve-

Appendix 3

BAHRAIN HEART HEALTH AND DIABETES SURVEY QUESTIONNAIRE

STATE OF BAHRAIN

MINISTRY OF HEALTH

BAHRAIN HEART HEALTH AND DIABETES SURVEY

1995

Questionnaire
Prepared by
Dr Faisal Al-Mahroos

Serial Number

☐☐☐☐☐☐

DIABETES AND CORONARY HEART DISEASE RISK SURVEY IN BAHRAIN

State of Bahrain - Ministry of Health - Directorate of Training
And Department of Epidemiology
London School of Hygiene & Tropical Medicine
Keppel Street London WC1E 7HT UK
Tel: 0171-927 2406

SURNAME: ______________________________ اسم العائلة :

FORENAMES (in full): __________________________ الاسم الكامل :

CPR NUMBER: __________________________ الرقم الشخصي :

AREA NUMBER: __________________________ رقم المنطقة :

ADDRESS: HOUSE_____ FLAT______ ROAD_______ BLOCK_______

Telephone: (Home______________________) (Office______________________)

Within about four weeks of your examination we will send you a letter about your results, with advice if needed. With your agreement, we will also send a copy to your family doctor. Again we wish to assure you that such information will be kept absolutely confidential. Under no circumstances will your records be made available to anyone else.

Consent given (tick one box) 1. ☐ Yes 2. ☐ No

If you have given your consent, please sign your name here.

إذا وافق الشخص يجب أخذ توقيعه

Signature:______________________ توقيع

Please contact Dr. Faisal Al-Mahroos, or Community Nurse Mrs Asma Al-Bani if you need any inquiry about the Questionnaire on Telephone number 451194 and bleep number 9485580 and 292141 Hoora health centre.

______________________________ : اسم ممرضة صحة المجتمع

______________________________ : اسم المركز

رقم التسلسل
SERIAL NUMBER: 01 ☐ ☐ ☐ ☐ ☐ ☐

تاريخ الميلاد
DATE OF BIRTH: 02 ☐ ☐ Day ☐ ☐ Month ☐ ☐ Year

تاريخ المقابلة أو الفحص
DATE OF EXAMINATION: 03 ☐ ☐ Day ☐ ☐ Month ☐ ☐ Year

SEX: 1. ☐ Male 2. ☐ Female 04 ☐

رقم المنطقة
GEOGRAPHIC NUMBER: 05 ☐ ☐

1 ☐ Hidd 2 ☐ Muharraq 3 ☐ Manama

4 ☐ Jidhafs 5 ☐ Northern 6 ☐ Sitra

7 ☐ Central 8 ☐ Isa Town 9 ☐ Riffa

10 ☐ Western 11 ☐ Eastern 12 ☐ Hamad Town

هام جداً

* إذا كانت الإجابة (لا أعلم، أو لا أعرف) ضع في المربع المخصص للسؤال رقم تسعة إذا كان مربعاً واحداً [9] وإذا كان إثنين [9] [9]

* إذا كان الجواب لا ينطبق ضع رقم 8 [8]

SECTION 1. HEALTH

1.1 What do you think your present state of health is? It is

كيف ترى صحتك في الوقت الحاضر؟

1. ☐ Very good جيد جداً
2. ☐ Good جيدة
3. ☐ Average متوسطة
4. ☐ Poor ضعيفة
5. ☐ Very poor ضعيفة جداً

06 ☐

1.2 (a) Have you ever been told that you had high blood pressure?

هل سبق لك العلم بأنك مصاب بارتفاع في ضغط الدم؟

1.☐ Yes نعم 2.☐ No لا If No, go to Question 1.3 07 ☐

If Yes:

متى كانت أول مرة (رجاء ذكر السنة)

(b) When was the first time (give year)? 19 ☐ ☐ ☐☐

08

إذا كانت الإجابة نعم، هل بدأت علاجاً لارتفاع ضغط الدم؟

(c) Were you started on treatment for high blood pressure?

1.☐ Yes,but not on drug treatment now. نعم ولكن بدون أدوية الآن

2.☐ Yes, still continuing drug treatment نعم، ولا أزال أتناول أدوية 09 ☐

3.☐ No لا

هل سبق لك العلم بأنك مصاب بالسكر ؟

1.3 (a) Have you ever been told that you had diabetes?

1.☐ Yes 2.☐ No If No, go to Question 1.4 10 ☐

If Yes:

متى كان أول مرة (رجاء ذكر السنة)

(b) When was the first time (give year)? 19☐☐ ☐☐

إذا كان الجواب نعم هل تأخذ علاجاً للسكر ؟

(c) were you started on treatment for diabetes? 11

1.☐ Yes, but not on treatment now.
نعم ولكن لست على أدوية الآن

2.☐ Yes, still continuing on diet
نعم ولكن على برنامج الحمية فقط

3.☐ Yes, now treated with tablets نعم الآن أتناول علاجاً أقراص فقط 12 ☐

4.☐ Yes, now treated with insulin نعم الآن آخذ حقن الأنسولين

نعم أتناول أقراص وحقن الأنسولين معاً
5.☐ Yes, now treated with tablets and insulin

1.4 (a) Have you ever been told by a doctor that you had heart trouble?
هل سبق وأن أخبرك طبيبك بأنك مصاب بمرض القلب ؟

1.☐ Yes 2.☐ No If No, go to Question 1.5 13 ☐

If Yes:

متى كان أول مرة (إذكر السنة)

(b) When was the first time (give year)? 19☐☐ 14 ☐☐

ما هو هذا المرض ؟

(c) What did the doctor say it was?

1.☐ Heart attack
نوبة قلبية

2.☐ Angina ذبحة صدرية

فشل في القلب
3.☐ Heart failure

ارتفاع في ضغط الدم
4.☐ High blood pressure 15 ☐

مرض صمام القلب
5.☐ Valve disease

ثقب خلقي في القلب
6.☐ Hole in the heart

7.☐ Other-Please specify:________________
أشياء أخرى

هل سبق وأن أخبرك طبيبك بأنك مصاب بأحد الأمراض الآتية

1.5 Have you ever been told by a doctor that you had any of the following:

(a) Asthma الربو	1. ☐ Yes	2. ☐ Yes	16 ☐
(b) An ulcer (stomach or duodenal) قرحة المعدة	1. ☐	2. ☐	17 ☐
(c) A stroke الشلل النصفي	1. ☐	2. ☐	18 ☐
(d) Arthritis التهاب المفاصل	1. ☐	2. ☐	19 ☐
(e) Kidney stones حصوة الكلى	1. ☐	2. ☐	20 ☐
(f) Sickle cell disease مرض الساكلر (فقر الدم المنجلي)	1. ☐	2. ☐	21 ☐
(g) Sicle cell trait حامل الساكلر	1. ☐	2. ☐	22 ☐

1.6 Have you ever had blood cholesterol measured ?

هل سبق وأن أجري لك فحص لتحديد مستوى الكولسترول في الدم ؟

1. ☐ Yes 2. ☐ No — 23 ☐

24 ☐

هل سبق وأن أخبرك الطبيب أو أحد العاملين الصحيين بأن الكولسترول عالي في دمك ؟

1.7 (a) Have you ever been told by a doctor or other health worker that you have high blood cholesterol?

1. ☐ Yes 2. ☐ No If No, go to Question 1.8 If Yes:

متى كانت أول مرة (اذكر السنة)

(b) When was that time (give year)? 19 ☐ ☐ — 25 ☐ ☐

هل تتبع في الوقت الحاضر نظام غذائي صحي معين إعدة لك الطبيب أو الفني الصحي من أجل خفض الكولسترول في الدم ؟

1.8 Are you on a special diet prescribed by a doctor or other health worker to lower your blood cholesterol level?

1. ☐ Yes 2. ☐ No

26 ☐

1.9 Please list any serious illnesses not yet mentioned that you have had in the last 12 months

إذكر أية أمراض خطيرة أخرى أصبت بها خلال ١٢ شهر الماضية

____

____

27 ☐☐

28 ☐☐

1.10 Please list any other serious illnesses you had before 12 months ago.

Illness	Year of onset
____________________	19 ☐☐
____________________	19 ☐☐

29 30

☐☐☐☐

31 32

☐☐☐☐

إذكر أية أمراض خطيرة أصبت بها قبل السنة الماضية ؟

إذا أجريت عمليات جراحية ، رجاء ذكرها وفي أية عام ؟

1.11 Please list any major operations you have had, and the year of each operation.

Operation	Year	
______________	19☐☐	33 ☐☐ 34 ☐☐
______________	19☐☐	35 ☐☐ 36 ☐☐

1.12 In the last twelve months how many times have you been off work for illness lasting a week or more?

كم عدد المرات التي تغيبت فيها عن العمل بسبب المرض لمدة أسبوع أو أكثر خلال الاثني عشر شهراً الماضية ؟

Enter total number of weeks: ☐☐ — 37 ☐

1.13 Are you taking any medicines at the moment, either prescribed by doctor or something you buy yourself?

1. ☐ Yes 2. ☐ No

No — If No, go to Question 1.14 — 38 ☐

If Yes:

رجاء دون أية أدوية يستعملها الشخص فقط

Please list the names of all the drugs used <u>by the subject below.</u>
You need not include creams or ointments that you are using on your skin or eyes.

FOR OFFICE USE

1.________________ 5.________________

2.________________ 6.________________

3.________________ 7.________________

4.________________ 8.________________

For each class code 1. = Yes 2. = No

(a) Beta-blockers

39 ☐

☐ Tenormin ☐ Lopressor

☐ Inderal ☐ Sectral ☐ Trandate

(b) Diuretics

40 ☐

☐ Hygroton ☐ Natrilix ☐ Burinex

☐ Esidrex k ☐ Lasix ☐ Aldactone

☐ Salurex ☐ Diuresal

(c) Cardiac stimulants

41 ☐

☐ Digoxin ☐ Cardilor ☐ Mexitil

☐ Lanicor

(d) Calcium channel blockers

42 ☐

☐ Adalat ☐ Nicardipine ☐ Amlodipine

☐ Verapamil ☐ Diltazem

(e) Insulin preparations

☐ NPH ☐ Humulin 43 ☐

(f) Lipid-Lowering

☐ Lopid ☐ Bezalip ☐ Zocor 44 ☐

☐ Duolip ☐ Regulip ☐ Lurselle

(g) Vasodilator

☐ Nitrate(GTN) ☐ Isordil 45 ☐

☐ Nifalat ☐ Coracten ☐ Stugeron

(h) Oral Hypoglycaemic

☐ Daonil ☐ Diamicron ☐ Glucophage 46 ☐

☐ Euglucon ☐ Mindiab ☐ Diabenase

(i) Antihypertensives

☐ Aldomet ☐ renitec ☐ Capoten 47 ☐

☐ Minipress ☐ Zestril ☐ Dilzem

(j) Glucocorticoid

☐ Prednisolone ☐ Betamethasone 48 ☐

☐ Hydrocortisone

هل سبق وأن شعرت بأية آلام أو مضايقات في الصدر ؟

1.14 (a) **Have you ever had any pain or discomfort in your chest?**

1. ☐ Yes 2. ☐ No If No, go to Question 1.15 49 ☐

If Yes:

(b) **Do you get this pain or discomfort when you walk uphill or hurry?**

هل تشعر بهذا الألم وعدم الراحة عندما تصعد الى أعلى أو تسرع ؟

1. ☐ Yes 2. ☐ No 3. ☐ Never walk uphill or hurry 50 ☐

(c) **Do you get it when you walk an ordinary pace on the level?**

هل تشعر بهذا الألم عندما تسير على سطح مستو ؟

1. ☐ Yes 2. ☐ No 51 ☐

(d) **What do you do if you get it while you are walking?**

ماذا تفعل عندما تشعر بهذا الألم ؟

1. ☐ Stop تتوقف

2. ☐ Slow down تهدأ السير 52 ☐

3. ☐ Carry on at the same pace تواصل بنفس السير

(e) **Dose it go away when you stop?**

هل يختفي الألم عندما تتوقف عن السير ؟

1. ☐ Yes 2. ☐ No If No, go to Question 1.15 53 ☐

If Yes:

(f) **How soon dose it go away?** كم فترة من الزمن يحتاج هذا الألم الى أن يختفي ؟

1. ☐ More than 10 minutes أكثر من عشرة دقائق 54 ☐

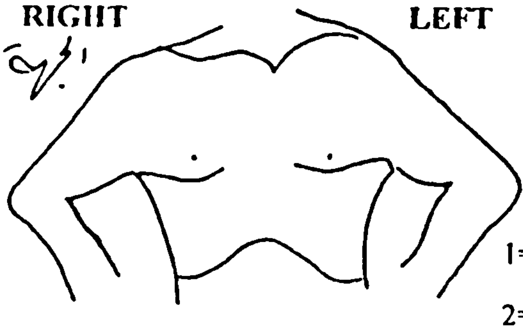
2. ☐ 10 minutes or less عشرة دقائق أو أقل

في أية جهة يحصل لك الألم؟

(g) Where do you get this pain or discomfort?
(Mark the place(s) with 'X' on the diagram)

ضع علامة على جهة الألم فوق الرسمة:

RIGHT الجهة اليمنى　　**LEFT** الجهة اليسرى



FRONT VIEW

1= Central chest or left + left arm 55 ☐

2= Any where else

1.15 (a) In winter, do you usually bring up phlegm from your chest first thing in the morning?

هل تبدأ صباحك عادة في فصل الشتاء ببصق بلغم من صدرك ؟

1. ☐ Yes 2. ☐ No If No, go to Question 1.16 56 ☐

If Yes,

كم شهراً في السنة تستمر معك هذه الحالة ؟

(b) For how many months of the year dose this usually happen?

أقل من ٣ أشهر　　ثلاثة أشهر أو أكثر

1. ☐ Less than 3 months 2. ☐ three months or more 57 ☐

1.16 (a) Are you troubled by shortness of breath when hurrying on level ground or walking up a slight hill?

هل تشعر بضيق في التنفس عندما تسرع أو تصعد أرضاً مرتفعة من سطح الأرض قليلاً ؟

1. ☐ Yes 2. ☐ No If No, go to Question 1.17 58 ☐

If Yes,

(b) Are you short of breath when walking with other people of your own age on level ground?

هل تشعر بضيق في التنفس عندما تمشي مع أفراد من نفس عمرك؟

1. ☐ Yes 2. ☐ No 59 ☐

(c) **Are you troubled by breathlessness when lying down at night?**

هل تشعر بضيق في التنفس عندما تستلقي للنوم ليلاً ؟

1. ☐ Yes 2. ☐ No 60 ☐

1.17 Do you suffer from swollen ankles?

هل تشكو من انتفاخات في كعبي قدميك ؟

1. ☐ Yes 2. ☐ No 61 ☐

1.18 Do you have difficulty in falling asleep?

هل تعاني من صعوبة عندما تريد أن تنام ؟

1. ☐ Yes 2. ☐ No 62 ☐

1.19 Do you usually wake up too early?

هل تستيقظ من النوم مبكراً في العادة كل يوم ؟

1. ☐ Yes 2. ☐ No 63 ☐

1.20 Do you still feel tired when you wake up in the morning?

هل لا تزال تشعر بالتعب عندما تستيقظ من نومك صباحاً ؟

1. ☐ Yes 2. ☐ No 64 ☐

1.21 How often do you snore at night? هل تشخر أثناء نومك ليلاً ؟

1. ☐ Never snore مطلقاً
2. ☐ Occasionally snore أحياناً
3. ☐ Often snore غالباً
4. ☐ Almost always snore دائماً تقريباً
5. ☐ Don't know لا أعرف

65 ☐

هذا الجزء خاص بالنساء فقط

FOR WOMEN ONLY

1.22 (a) Did you ever take contraceptive pills?

هل سبق لك وأن تناولت أقراص منع الحمل ؟

1. ☐ Yes 2. ☐ No If No, go to 1.23 66 ☐

If Yes,

(b) For how many years altogether did you take contraceptive pills? 67

ما عدد السنوات التي تناولت فيها أقراص منع الحمل ؟

enter ☐ ☐☐

1.23 (a) Are you still having your periods?

هل لا تزال الدورة الشهرية (العادة) تزورك ؟

1. ☐ Yes 2. ☐ No If Ye, go to Section 2 68 ☐

If No,

(b) At what age did you stop? 69

كم كان عمرك عندما توقفت عنك الدورة الشهرية ؟

enter age ☐ ☐☐

ما هو سبب انقطاع الدورة ؟

(c) What was the cause of menopause?

1. ☐ Natural menopause السن الطبيعي لليأس

2. ☐ Hysterectomy (removal of womb only) استئصال الرحم 70 ☐

3. ☐ Hysterectomy plus removal of ovaries استئصال الرحم والمبيضين

(d) Did you ever take hormone replacement pills?

هل تناولت من قبل هرمونات عن طريق الأقراص؟

1. ☐ Yes 2. ☐ No If Yes: 71 ☐

(e) What type of hormone you use?

ما هو نوع الهرمون

1. ☐ Oestrogen الاستروجين 72 ☐

2. ☐ Progesterone البروجيستيرون

3. ☐ Both الاثنين معاً

1.24 (a) Have you ever been told by a doctor that you had Polycystic disease of the ovary?

هل سبق لك أن أخبرك الطبيب بأنك مصابة بمرض أكياس المبيض؟

1. ☐ Yes 2. ☐ No If Yes: 73 ☐

متى كانت أول مرة؟

(b) When was the first time (give year) ☐☐ 74 ☐☐

1.25 (a) Have you ever been pregnant?

هل سبق لك الحمل؟

1. ☐ Yes 2. ☐ No If Yes: 75 ☐

كم مولوداً أنجبت من ذلك الحمل

(b) How many children did you give birth to? ☐☐ 76 ☐☐

(c) How many other times have you been pregnant without

كم مرة حملت ولم يستمر معك ذلك الحمل؟

givin the pregnancy leading to birth of a child? ☐ 77 ☐

تاريخ العائلة الصحي والطبي ؟

SECTION 2. FAMILY HISTORY

2.1 Has anyone in your family ever had diabetes?

هل يوجد أحد بين أفراد العائلة مصاب بمرض السكر ؟

1. ☐ Yes
2. ☐ No

78 ☐

If No, go to Question 2.2

If Yes:

1. ☐ Father الأب

79 ☐

2. ☐ Mother الأم
3. ☐ Brother/sister الأخ / الأخت
4. ☐ Children الأطفال

2.2 Has any one in your family ever had hypertension?

هل يوجد أحد بين أفراد العائلة مصاب بارتفاع ضغط الدم ؟

1. ☐ Yes
2. ☐ No

80 ☐

If No, go to Question 2.3

If Yes:

1. ☐ Father الأب

81 ☐

2. ☐ Mother الأم
3. ☐ Brother/sister الأخ / الأخت
4. ☐ Children الأطفال

2.3 Has any one in your family ever had heart disease?

هل يوجد أحد بين أفراد العائلة مصاب بمرض القلب ؟

1. ☐ Yes

2. ☐ No If Yes: was this إذا كان الجواب نعم 82 ☐

(1) Coronary/ angina/ heart attack

نوبة قلبية أو ذبحة صدرية بالأوعية التاجية

أمراض قلب أخرى

(2) Other heart disease 83 ☐

(9) Don't know لا أعلم

If no, go to **Section 3**

If Yes:

1. ☐ Father الأب

2. ☐ Mother الأم 84 ☐

3. ☐ Brother/sister الأخ / الأخت

4. ☐ Children الأطفال

2.4 Was there a blood relationship (Consanguinity) between your father and your mother?

هل هنالك صلة قرابة بين والدك ووالدتك ؟

1. ☐ **Yes** 2. ☐ **No** 85 ☐

If Yes:

2.5 What was of this relation? ما نوع هذه القرابة

1. ☐ **Doble first cousins**
أبناء عمومة من الدرجة الأولى بالمباشرة من طرف الجد والجدة

2. ☐ **First cousins**
أبناء عمومة من الدرجة الأولى من طرف الأب والأم فقط 86 ☐

3. ☐ **Other relationship**
قرابة من بعيد

SECTION 3. DIET

3.1 On how many of the last seven days did you eat each of the following foods?
In each row, tick one of the four choices given: even if the food is something you never eat, remember to tick the appropriate box.

Animal products	Not at all in last 7 days مطلقاً	On one day only يوم واحد فقط	2 or 3 days in last 7 يومين أو ثلاثة	On most days معظم الأيام	
البيض (a) Eggs	1. ☐	2. ☐	3. ☐	4. ☐	87 ☐
الحليب، الزبدة، الجبنة (b) Milk, butter or cheese	1. ☐	2. ☐	3. ☐	4. ☐	88 ☐
السمك أو الأكلات البحرية (c) Fish or other seafood	1. ☐	2. ☐	3. ☐	4. ☐	89 ☐
(d) Chicken الدجاج	1. ☐	2. ☐	3. ☐	4. ☐	90 ☐
(e) Lamb الخروف	1. ☐	2. ☐	3. ☐	4. ☐	91 ☐
لحم الأبقار (f) Beef (including burgers)	1. ☐	2. ☐	3. ☐	4. ☐	92 ☐

Fruit and vegetables الفواكه والخضار

Fruit and vegetables	Not at all in last 7 days	On one day only	2 or 3 days in last 7	On most days	
الخضار الطازجة (g) Fresh green vegetables	1. ☐	2. ☐	3. ☐	4. ☐	93 ☐
الفواكه الطازجة (h) Fresh fruit	1. ☐	2. ☐	3. ☐	4. ☐	94 ☐
عصائر الفواكه (i) Fruit juices	1. ☐	2. ☐	3. ☐	4. ☐	95 ☐

Sweets and backed confectionery الحلويات والمعمولات :

المربى، الجلي أو العسل (j) Jam, jellies, or honey	1. ☐	2. ☐	3. ☐	4. ☐	96 ☐
الكعك والجاتوه (k) Cakes or sweet buns	1. ☐	2. ☐	3. ☐	4. ☐	97 ☐
البسكويت المحلى (l) Sweet biscuits	1. ☐	2. ☐	3. ☐	4. ☐	98 ☐
الحلوى أو الرهش (m) Halwa or rahaesh	1. ☐	2. ☐	3. ☐	4. ☐	99 ☐
الأچار والمخللات (n) Achaar or mukhalil	1. ☐	2. ☐	3. ☐	4. ☐	100 ☐
المهياوة (m) Mahyaw	1. ☐	2. ☐	3. ☐	4. ☐	101 ☐
المكسرات (o) Bastac or Kasho	1. ☐	2. ☐	3. ☐	4. ☐	102 ☐
الشيكولاتة (p) Chocolate, boiled sweets	1. ☐	2. ☐	3. ☐	4. ☐	103 ☐
المرطبات الغازية (q) Coca-cola, lemonade	1. ☐	2. ☐	3. ☐	4. ☐	104 ☐
(r) Zalabia الزلابية	1. ☐	2. ☐	3. ☐	4. ☐	105 ☐

3.2 How many teaspoons of sugar do you usually add ?

كم ملعقة سكر تضيفها عادة إلى كل ما يلي :

قدح القهوة

(a) to a cup of coffee? number of teaspoons: ☐ 106 ☐

قدح الشاي

(b) to a cup of tea? number of teaspoons: ☐ 107 ☐

كم ملعقة سكر تضيفها إلى القهوة أو الشاي بشكل إجمالي في اليوم ؟

3.3 In total, how many teaspoons of sugar do you usually use each day in drinks like tea and coffee

1. ☐ None بدون سكر
2. ☐ 1-2 teaspoons ١-٢ ملعقة
3. ☐ 3-5 teaspoons ٣-٥ ملعقة
4. ☐ 6-10 teaspoons ٦-١٠ ملاعق
5. ☐ 11-20 teaspoons ١١-٢٠ ملعقة
6. ☐ More than 20 teaspoons أكثر من ٢٠ ملعقة

108 ☐

3.4 Which of the following kinds of fat or oil do you use at home, either in cooking or on your food?

Please tick either Yes or No for each kind of fat or oil

أي أنواع الزيوت أو الدهون تستخدم في بيتك للطبخ أو الأكل ؟

(a) Corn oil, soya oil, sunflower oil زيت الذرة ، زيت عباد الشمس ، زيت الصويا	1. ☐	2. ☐	109 ☐
(b) Olive oil زيت الزيتون	1. ☐	2. ☐	110 ☐
زيت المكسرات أو الفول السوداني (c) Peanut oil or groundnut oil	1. ☐	2. ☐	111 ☐
دهن جوز الهند (d) Creamed coconut	1. ☐	2. ☐	112 ☐
(e) Butter الزبدة	1. ☐	2. ☐	113 ☐
الدهن الحيواني (الخالدي) (f) Pure animal fat (Khalidi)	1. ☐	2. ☐	114 ☐

3.5 (a) Are you following any kind of special diet different from what you usually eat: for instance to lose weight or for medical reasons?

هل تتبع نظاماً غذائياً خاصاً غير الذي تعودت عليه وذلك بهدف انقاص وزنك أو لأسباب طبية؟

1. ☐ Yes 2. ☐ No If No, go to Question 3.6 115 ☐

أي مما يلي يصف بصورة أفضل النظام الغذائي الخاص الذي تتبع؟

If Yes:

(b) Which of the following best describes the diet you are on?

1. ☐ Slimming diet غذاء لانقاص الوزن
2. ☐ Diabetic diet غذاء مرضى السكر
3. ☐ Cholesterol-lowering diet غذاء لخفض الكولسترول 116 ☐
4. ☐ Fasting or abstaining for religious reasons الصيام لغرض ديني
5. ☐ Other kind of special diet: ________________ أغذية أخرى

3.6 Which of the following do you think best describes your weight?

أي مما يلي يصف بصورة أفضل وزنك؟

1. ☐ Underweight خفيف الوزن
2. ☐ About the right weight وزناً طبيعياً 117 ☐
3. ☐ A little overweight سمين قليلاً
4. ☐ Very overweight سمين جداً

SECTION 4. SMOKING HABITS

4.1 (a) Do you smoke cigarettes now? هل تدخن في الوقت الحاضر؟

1. ☐ Yes 2. ☐ No If No, go to Question 4.2 118 ☐

If Yes: إذا كان نعم

(b) How many cigarettes a day do you usually smoke? 119
كم سيجارة تدخن عادة كل يوم في الوقت الحاضر؟

enter number: ☐☐ ☐☐

4.2 (a) Have you ever smoked cigarettes regularly?
هل مارست عادة التدخين بشكل منتظم مسبقاً؟

1. ☐ Yes 2. ☐ No If No, go to Question 4.3 120 ☐

If Yes: كم سيجارة كنت تدخن في اليوم
(b) About how many cigarettes did you smoke in a day when you smoked them regularly? 121

enter number: ☐☐ ☐☐

(c) How old were you when you stopped smoking cigarettes regularly? كم كان عمرك عندما توقفت عن التدخين 122

enter age: ☐☐ ☐☐

(d) How old were you when you began to smoke cigarettes regularly in the past? كم كان عمرك عندما بدأت التدخين سابقاً؟ 123

enter age: ☐☐ ☐☐

4.3 (a) **Do you smoke cigars?** هل تدخن بسيجار (الحجم الكبير)

1. ☐ Yes 2. ☐ No If No, go to Question 4.4 124 ☐

If Yes:

(b) **How many cigars per week?** كم سيجار؟ تدخن في الأسبوع

125

enter number: ☐☐ ☐☐

4.4 (a) **Do you smoke Hubble bubble (Gaduo)?**

هل تدخن بشيشة شعبية (الكدو)

1. ☐ Yes 2. ☐ No If No, go to Question 4.5 126 ☐

If Yes:

كم مرة في اليوم تمارس هذه العادة؟

(b) **How many times a day you smoke?**

127

enter times number ☐☐ ☐☐

4.5 **Do you smoke a pipe?** هل تدخن بالبايب (الغليون)

1. ☐ Yes 2. ☐ No If No, go to section 5 128 ☐

If Yes:

(b) **How many times a day do you smoke?**

كم مرة في اليوم تمارس هذه العادة؟

129

enter times number ☐☐ ☐☐

تعاطي المشروبات الكحولية:
اذا كان الشخص لا يتعاطى أو لم يتعاطى أبداً في حياته
الرجاء الانتقال الى الجزء السادس

SECTION 5. DRINKING HABITS

5.1 (a) In the past 12 months have you taken an alcoholic drink:
هل تناولت مشروباً كحولياً خلال الاثني عشر شهراً الأخيرة؟

1. ☐ Not at all مطلقاً
2. ☐ Twice a day or more مرتين أو أكثر في اليوم
3. ☐ Almost daily معظم الأيام
4. ☐ Once or twice a week مرة أو مرتين في الأسبوع 130 ☐
5. ☐ Once or twice a month مرة أو مرتين في الشهر
6. ☐ On special occasions only في المناسبات الخاصة فقط

If you have ever taken alcohol:

(b) Comparing now with 5 years ago would you say that you are:
مقارنة بالخمس سنوات الأخيرة هل ترى انك تتعاطى الكحول في الوقت الحاضر:

1. ☐ Drinking about the same now as 5 years ago
بنفس الصورة التي كنت عليها من ٥ سنوات مضت
2. ☐ Drinking more now than 5 years ago بصورة أكبر مما كنت عليه من ٥ سنوات مضت 131 ☐
3. ☐ Drinking less now than 5 years ago بصورة أقل مما كنت عليه من ٥ سنوات مضت

If you have given up drinking or you are drinking less,

(c) What was the reason?
اذا كنت قد تخليت عن الشرب أو تتناول أقل، ماذا كان السبب؟

1. ☐ Illness/doctor's advice
بسبب المرض ونصائح الطبيب
2. ☐ Concerned about health
الاهتمام بالصحة
3. ☐ Too expensive غالي الثمن 132 ☐
4. ☐ Other reason -Please specify: ____________
أسباب أخرى

IF YOU NEVER DRINK ALCOHOL PLEASE GO TO SECTION 6

أي مما يلي يصف بصورة أفضل كمية المشروب الكحولي الذي تتناوله ؟

5.2 Which of the following best describes the amount you drink?

1. ☐ Hardly drink at all — قليل جداً
2. ☐ Drink a little — قليل
3. ☐ Drink a moderate amount — كمية معتدلة ☐ 133
4. ☐ Drinking quite a lot — أشرب كثيراً
5. ☐ Drink heavily — أشرب كثيراً جداً

5.3 (a) How often you had a drink or beer during the last 12 months?

ما عدد المرات التي تعاطيت فيها مشروبة كحولية أو بيرة خلال ١٢ شهراً الماضية؟

1. ☐ Most days — معظم الأيام
2. ☐ Three or four times per week — ٣-٤ مرات في الأسبوع
3. ☐ Once or twice a week — مرة إلى مرتين في الأسبوع
4. ☐ Once or twice a month — مرة إلى مرتين في الشهر ☐ 134
5. ☐ Once or twice in 6 months — مرة إلى مرتين خلال ٦ شهور
6. ☐ One or twice a year — مرة إلى مرتين في السنة
7. ☐ Not at all in the last 12 months — أبداً خلال ١٢ شهر

عندما تناولت مشروباً كحولياً (وبيرة) خلال ١٢ شهراً كم كأساً كنت تتناول عادة كل مرة؟ (البانيت = لتراً من الماء)

If not at all in the last 12 months, go to Question 5.4

(b) When you have had a drink of beer or cider in the last 12 months, how many pints have you usually drunk on any one occasion?

1. ☐ 1/2-1 pint — ½ - واحد
2. ☐ 1-2 pints — ١ - ٢
3. ☐ 3-4 pints — ٣ - ٤
4. ☐ 5 pints or more — ٥ أو أكثر

135 ☐

5.4 (a) How often have you had a drink of wine during the last 12 months? هل تعاطيت خمراً خلال ١٢ شهراً الماضية؟

1. ☐ Most days — معظم الأيام
2. ☐ 3 or 4 times per week — ٣-٤ مرات في الأسبوع
3. ☐ Once or twice a week — واحد أو اثنين في الأسبوع
4. ☐ Once or twice a month — مرة أو مرتين في الشهر
5. ☐ Once or twice in 6 months — مرة أو مرتين خلال ٦ شهور
6. ☐ Once or twice a year — مرة أو مرتين كل سنة
7. ☐ Not at all in the last 12 months — أبداً خلال ١٢ شهراً

136 ☐

If not at all in the last 12 months, go to Question 5.5

(b) When have had a drink of wine in the last 12 months, how many glasses have you usually drunk on any one occasion?

(1 bottle of wine contain 6 glasses).

عندما كنت تتعاطى النبيذ خلال ١٢ شهراً الماضية ما عدد الأكواب؟

1. ☐ 1-2 glasses
2. ☐ 3-4 glasses
3. ☐ 5 glasses or more

137 ☐

ما عدد المرات التي تناولت فيها شراب الكحولي، الويسكي، الجن أو الرم أو البراندي خلال ١٢ شهراً الماضية؟

5.5 (a) How often have you had a drink of spirits-gin, whisky, rum, brandy or vodka during the last 12 months?

1. ☐ Most days — معظم الأيام
2. ☐ 3 or 4 times per week — ٣-٤ مرة في الأسبوع
3. ☐ Once or twice a week — ١-٢ مرة في الأسبوع
4. ☐ Once or twice a month — مرة أو مرتين في الشهر
5. ☐ Once or twice in 6 months — مرة أو مرتين في ٦ شهور
6. ☐ Once or twice a year — مرة أو مرتين في السنة
7. ☐ Not at all in the last 12 months — مطلقاً خلال ١٢ شهراً

☐ 138

If not at all in the last 12 months, go to section 6

كم مكيالاً كنت عادة تتناول في كل مرة؟

(b) When you had a drink of spirits in the last 12 months, how many measures have you usually drunk on any one occasion?

يرجى ملاحظة أن مقياس مشروب في المنزل يمكن أن يعادل مرتين أو ثلاث من المقاييس المستخدمة في الحانة

(Please remember that a drink poured at home could be equivalent to two or three pub measures).

1. ☐ 1-2 measures — ١-٢ مكيال
2. ☐ 3-4 measures — ٣-٤ مكيال
3. ☐ 5 measures or more — ٥ مكيال أو أكثر

☐ 139

القسم السادس: ممارسة التمارين الرياضية

SECTION 6. EXERCISE

6.1 Which of the answer below best describe your activity at work? Please tick one of the boxes in answer to each Question.

	Never مطلقاً	Seldom نادراً	Sometimes أحياناً	often غالباً	Always دائماً	
هل تجلس في العمل؟ (a) Do you sit	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐	140 ☐
هل تقف؟ (b) Do you stand	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐	141 ☐
هل تمشي؟ (c) Do you walk	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐	142 ☐
هل تحمل أثقالاً؟ (d) Do you lift heavy loads	1. ☐	2. ☐	3. ☐	4. ☐	5. ☐	143 ☐

6.2 While travelling to and from work, or in your spare time:

(a) How many kilometre (Km) do you walk on average weekday?

أثناء ذهابك وعودتك من العمل أو وقت فراغك كم من مسافة الكيلومتر تقطع سيراً كل أسبوع؟

أقل من كيلومتر 1. ☐ Less than 1 Km

١ - ٣ 2. ☐ 1 to 3 Km

٤ أو أكثر 3. ☐ 4 Km or more

144 ☐

(b) How many Km do you walk in an average weekend?

كم كيلومتراً تقطع سيراً في عطلة نهاية الأسبوع أي يوم الخميس والجمعة؟

1. ☐ Less than 1 Km 2. ☐ 1 to 3 Km

3. ☐ 4 Km or more

145 ☐

6.3 **(a) Do you ride a bicycle regularly?**

هل تركب الدراجة الهوائية بشكل منتظم؟

1.☐ Yes 2.☐ No If No, go to Question 6.4 146 ☐

If Yes,

(b) How many Km do you cycle on an average weekday?

كم كيلومتراً تقطع بالدراجة اسبوعياً؟

1.☐ Less than 2 Km أقل من ٢ كيلو

2.☐ 2 to 6 Km ٢-٦ 147 ☐

3.☐ 7 Km or more ٧ أو أكثر

(c) How many Km do you cycle in an average weekend?

كم كيلومتراً تقطع بالدراجة في عطلة نهاية الأسبوع؟

1.☐ Less than 2 Km أقل من ٢ كيلو

2.☐ 2 to 6 Km ٢-٦ 148 ☐

3.☐ 7 Km or more ٧ أو أكثر

6.4 **(a) Do you play any sport (or other recreational exercise such as swimming or aerobic exercise)?**

هل تمارس أي نوع من أنواع الرياضة (أو أية تمارين ترفيهية كالسباحة وتمارين في الهواء الطلق؟

نعم 1.☐ Yes 149 ☐

لا 2.☐ No

If No, go Question 6.5

إذا كان الجواب بنعم

If Yes,

(b) Which sport do you play most frequently?

أي من الألعاب تمارس بصورة دائمة تقريباً ؟

01. ☐ Bowling البولينج
06. ☐ Aerobics تمارين السويدية

02. ☐ Football or rugby كرة القدم أو الرجبي
07. ☐ Cricket كرة المضرب 150

03. ☐ Golf الجولف
08. ☐ Badminton الريشة

04. ☐ Swimming السباحة
09. ☐ Tennis التنس الأرضي

05. ☐ Jogging الهرولة
10. ☐ Squash الاسكواش

Other sport- please specify: ________________

(c) How many hours a week do you play it?

كم ساعة تمارس هذه اللعبة أسبوعياً ؟

1. ☐ Less than 1 hour/week أقل من ساعة في الأسبوع
2. ☐ 1 to 2 hour/week ١-٢ ساعة/في الأسبوع
3. ☐ 3 to 4 hour/week ٣-٤ ساعة/الأسبوع 151
4. ☐ 5 hours/week or more ٥ ساعات أو أكثر أسبوعياً

(d) How many months a year? كم شهراً في السنة تمارس اللعبة ؟

1. ☐ Less than 1 month in a year أقل من شهر
2. ☐ 1 to 3 months/year ١-٣ شهر
3. ☐ 4 to 6 months/year ٤-٦ شهراً 152
4. ☐ More than 6 months of the year أكثر من ٦ شهور

هل تمارس رياضة أخرى؟

6.5 (a) Do you play a second sport?

1. ☐ Yes 2. ☐ No If No, go to Question 6.6 153 ☐

If Yes,

(b) Which sport is it? 154 ☐☐

01. ☐ Bowling البولينج 06. ☐ Aerobics تمارين سويدية
02. ☐ Football كرة القدم 07. ☐ Cricket كرة المضرب
03. ☐ Golf الجولف 08. ☐ Badminton الريشة
04. ☐ Swimming السباحة 09. ☐ Tennis التنس الأرضي
05. ☐ Jogging الهرولة 10. ☐ Squash السكواش

Other sport- please specify: ____________________

(c) How many hours a week do you play it? كم ساعة تمارس هذه اللعبة في الأسبوع؟

1. ☐ Less than 1 hour/week أقل من ساعة
2. ☐ 1 to 2 hour/week ١-٢ ساعة
3. ☐ 3 to 4 hours/week ٣-٤ ساعة 155 ☐
4. ☐ 5 hours/week or more ٥ ساعات أو أكثر

(d) How many months a year? كم شهراً في السنة

1. ☐ Less than 1 month in a year أقل من شهر 2. ☐ 1 to 3 months/year ١-٢ شهر
3. ☐ 4 to 6 months/year ٤-٦ شهور 156 ☐
4. ☐ More than 6 months of the year أكثر من ٦ شهور

هل تمارس أية أنشطة مجهدة خلال وقت فراغك؟
مثل قطع الأخشاب بواسطة منشار يدوي أو ترفع أوزان ثقيلة؟

6.6 (a) **Do you undertake in your spare time any other strenuous activities, such as the following:**

Sawing wood with a handsaw
Lifting heavy loads

1. ☐ Yes 2. ☐ No If No, go to Question 5.7 157 ☐

If Yes,
(b) **How many hours a week do you spend in activities like these?** كم ساعة تقضيها أسبوعياً في ممارسة هذه الأنشطة؟ 158

enter number of hours: ☐☐ ☐☐

كم عدد الساعات التي تقضيها في مشاهدة التلفزيون أو الفيديو في الأسبوع؟
6.7 **For how many hours in an average week do you watch television or video?**

1. ☐ Less than 1 hour a week أقل من ساعة

2. ☐ 1-3 hour a week ١ - ٣

3. ☐ 4-8 hours a week ٤ - ٨ 159 ☐

4. ☐ 9-15 hours a week ٩ - ١٥

5. ☐ 16 hours a week or more أكثر من ١٦ ساعة

6.8 **Either at work or in leisure time:** خلال وقت فراغك أو العمل:
(a) At least once a week do you engage in any regular activity similar to brisk walking, jogging, cycling, etc long enough
هل تمارس نشاط منتظم مثل المشي، أو الهرولة أو ركوب الدراجة إلى درجة أن يعرق جسمك؟
to work up sweat? 1. ☐ Yes 2. ☐ No 160 ☐

If Yes,
(b) **How many times per week?** كم مرة في الأسبوع 161

enter number of times: ☐ ☐☐

6.9 (a) **Is your activity limited by any disability?**

هل أنشطتك محدودة بسبب العاهة ؟

1. ☐ Yes 2. ☐ No

162 ☐

If Yes,

أي من الإعاقات التالية تحد من نشاطك ؟

(b) **Which of these most limits your activity?**

1. ☐ Old injury إصابة قديمة
2. ☐ Arthritis التهاب المفاصل
3. ☐ Back pain آلام الظهر
4. ☐ Foot problems such as bunions or corns مشاكل في القدمين مثل مسمار الرجل
5. ☐ Chest trouble such as asthma or bronchitis مشاكل التنفس مثل الربو
6. ☐ Heart trouble أمراض القلب
7. ☐ Other disability أشياء أخرى
   -please specify: ____________

163 ☐

معلومات عن العمل :

SECTION 7. WORK CHARACTERISTICS

7.1 (a) What is your usual occupation? ما هو عملك المعتاد ؟ 164

اذكر وظيفتك الرئيسية

Please give the title of your job: ______________

ما طبيعة عملك

(b) What kind of work do you do in this job? 165

Your main activity: ______________

(c) How many years training (beyond leaving school at age 16) are required by your job?

كم عدد سنوات التدريب التي تحتاجها بعد تخرجك من المدرسة بعمر ١٦ عام -

1. ☐ Less than 1 year أقل من سنة

2. ☐ At least 1 year but less than 3 years ١-٢

3. ☐ At least 3 years but less than 5 years ٢ - ٥ 166

4. ☐ 5 years or more أكثر من خمس

(d) Dose your job require any special qualifications, training or apprenticeship?

هل يتطلب عملك مؤهلات أو تدريب أو تدريب مهني خاص؟

1. ☐ No special training لا يتطلب تدريباً

2. ☐ Apprenticeship يتطلب تدريباً

3. ☐ Certificate, diploma or professional qualification- يتطلب شهادة (دبلوما) أو شهادات تخصصية 167

أرجو ذكرها / Please specify: ______________

هل يتطلب عملك إشرافاً على أفراد آخرين ؟

(e) Do you have to supervise other workers?

1. ☐ Yes 2. ☐ No — 168 ☐

(f) Do you have to do same thing over and over again?

هل يتضمن عملك إعادة لما تقوم به مرات ومرات عديدة

1. ☐ Yes 2. ☐ No — 169 ☐

(g) Do you have to ask permission if you need about half an hour during working hours to attend to your own affairs?

لو أردت قضاء عمل شخصي خارج عملك ويستغرق حوالي نصف ساعة

هل تحتاج إلى إذن لذلك ؟

1. ☐ Yes 2. ☐ No — 170 ☐

7.2 Are you employed at present? هل أنت موظف في الوقت الحاضر ؟

1. ☐ Yes 2. ☐ No إذا كان الجواب لا ما السبب ؟ — 171 ☐

If No, which one of the following reasons applies?

1. ☐ Waiting to take up a job already accepted — أنتظر الالتحاق بعمل قبلت فيه
2. ☐ Unemployed and seeking work — غير موظف وأبحث عن فرصة عمل
3. ☐ Prevented by temporary sickness from seeking work — ممتنع بسبب المرض بشكل مؤقت
4. ☐ Permanently sick or disabled — مرض مزمن أو إعاقة — 172 ☐
5. ☐ Retired — متقاعد
6. ☐ A full-time student — طالب نظامي
7. ☐ Housewife — ربة بيت
8. ☐ Not working for any other reason — لا أعمل بدون سبب

7.3 On average how many hours do you work per week? — 1 7 3

ما متوسط عدد الساعات التي تمارس فيها عملك أسبوعياً ؟

Number of hours: ☐☐ — ☐☐

إذا كان الشخص غير متزوج ضع رقم $\boxed{8}$ في المربع

إذا كنت متزوجاً

IF YOU ARE MARRIED

7.4 **(a) What is your husband's usual occupation?** 174

ما المهنة المعتادة لزوجك؟

Please give the exact title of his job: ____________

هل يتطلب عمله أية مؤهلات أو تدريب مهني؟

(b) Dose his job require any special qualifications, training or apprenticeship?

1. ☐ No special training لا يحتاج

2. ☐ Apprenticeship تدريب مهني 175

يتطلب شهادة دبلوم أو مؤهلات تخصصية

3. ☐ Certificate, diploma or professional qualification-

Please specify: ____________

(c) Dose he have to supervise other workers?

هل يتطلب عمله الإشراف على أفراد آخرين

1. ☐ Yes 2. ☐ No 176

الدخل الشهري للأسرة

MONTHLY FAMILY INCOME

7.5 **What is your family income monthly?** كم الدخل الشهري؟

أقل من ٢٥٠ دينار 1. ☐ Less than BD 250 2. ☐ BD 250-499 ٢٥٠ - ٤٩٩

٥٠٠ - ٧٥٠ دينار 3. ☐ 500-750 177 ☐

أكثر من ٧٥٠ دينار 4. ☐ More than BD 750

لا أعلم 5. ☐ Don't know

LEVEL OF EDUCATION المستوى التعليمي

7.6 **What level of education you have reached?** ما المستوى التعليمي الذي وصلت إليه؟

لم ألتحق بالمدرسة لا أجيد القراءة أو الكتابة 1. ☐ No schooling (not read or write)

2. ☐ No schooling (read and write) لم التحق بالمدرسة لكن أجيد القراءة والكتابة

ابتدائي فقط 3. ☐ Primary school

ثانوي 4. ☐ Secondary school 178 ☐

دبلوم عالي 5. ☐ High diploma

بكالوريوس 6. ☐ BSc

ماجستير 7. ☐ Master degree

دكتوراه 8. ☐ Doctorate degree

7.7 **At what age did you start school?** في أية سن التحقت بالمدرسة 179

enter age: ☐☐ ☐☐

7.8 **At what age did you finish your full-time education?** 180

enter age ☐☐ ☐☐

في أية سن أنهيت تعليمك النظامي؟

الجزء الثامن : معلومات عامة

SECTION 8. GENERAL BACKGROUND INFORMATION

8.1 (a) What country were you born in? في أية بلد ولدت؟

1. ☐ Bahrain البحرين
2. ☐ Saudi Arabia المملكة العربية السعودية
3. ☐ Iran ايران
4. ☐ India الهند 181
5. ☐ Pakistan الباكستان
6. ☐ Egypt مصر
7. ☐ Other please specify: بلد آخر ____________

8.2 Please indicate your marital status. ما هي حالتك الاجتماعية؟

1. ☐ Married متزوج 2. ☐ Single اعزب
3. ☐ Widowed أرمل 182
4. ☐ Divorced مطلق 5. ☐ Separated منفصل

8.3 Is your home owned by you or your family, or rented? ماهو وضع منزلك الذي تقيم به؟

1. ☐ Owned ملك
2. ☐ Rented (from Housing Ministry) ايجار من وزارة الاسكان 183
3. ☐ Rented from a private landlord ايجار من مالك خاص

8.4 What is your religion? ماهي ديانتك؟

1. ☐ Muslim مسلم

2. ☐ Christian مسيحي

3. ☐ Jewish يهودي

4. ☐ Other- please specify: ديانة أخرى ____________

184 ☐

8.5 How often do you attend a Mosque (masjid), Mattam (Hussinya), Church, synagogue, temple for religious observance? كم مرة تزور المسجد أو الكنيسة أو المعبد

1. ☐ Daily يومياً

2. ☐ Three times a week or more ٣ مرات في الاسبوع أو أكثر

3. ☐ At least once a week على الأقل مرة في الأسبوع

4. ☐ At least once a month على الأقل مرة في الشهر

5. ☐ At least once a year على الأقل مرة في السنة

6. ☐ Never, or only for weddings and funerals (Fatteha) مطلقاً ما عدا المناسبات الاجتماعية

185 ☐

8.6 How often do you make religious observance (Al-sala) at home? كم مرة تؤدي الصلاة في المنزل

1. ☐ Daily all times جميع الأوقات

2. ☐ Weekly only (Friday) أسبوعياً يوم الجمعة

3. ☐ At least once a month على الأقل مرة في الشهر

4. ☐ Occasionally أحياناً

5. ☐ Never مطلقاً

186 ☐

يرجى ملاحظة أن الأسئلة القليلة القادمة تدور حول أمور تخص ظروف أسرتك عندما كان عمرك ١٢ عاماً

The next few questions ask about your family's <u>circumstances at the time when you were 12 years old:</u>

8.7 **(a) what was your father's main job at the time you were 12 years old (or his last job if he died before this time)?** 187

ما عمل والدك آن ذاك ؟

Title of job: ______________

☐☐

هل كان عمله يتطلب أي مؤهلات أو تدريب خاص ؟

(b) Did this job require any special qualifications or training?

1. ☐ No special training لا يحتاج تدريب
2. ☐ Apprenticeship يحتاج تدريب 188
3. ☐ Certificate, diploma, degree or professional qualification- please specify: ______________ يحتاج شهادات تخصصية

☐

(c) Did he have to supervise other workers? 189

هل كان يشرف على آخرين في العمل ؟

1. ☐ Yes 2. ☐ No

☐

(d) Was he self-employed (running his own business) or working for an employer? هل كان يدير عملاً خاصاً به أم كان موظفاً لطرف آخر ؟ 190

☐

1. ☐ Working for employer يعمل لطرف آخر
2. ☐ Self-employed له عمل خاص

If he was self-employed:

(e) Did he employ anyone else apart from his own family? 191

هل كان يوظف أشخاص آخرين من غير أفراد أسرته

1. ☐ Yes 2. ☐ No

☐

كيف كان وضع منزلك ذلك الوقت ؟

8.8 At the time you were 12 years old was your family home:

1. ☐ Owned by your family ملكاً لأسرتك

2. ☐ Rented from government إيجار من الحكومة 192 ☐

3. ☐ Rented from private landlord إيجار من مالك خاص

8.9 Did your family own any land, or property apart from their own house? هل كانت أسرتك تملك أية عقارات غير منزل الأسرة؟

1. ☐ Owned land or houses rented to others
تملك أراضي أو بيوت مؤجرة للآخرين

2. ☐ Owned land for their own cultivation only 193 ☐
تملك أراضي للاستعمال الشخصي

3. ☐ Owned no land
لا تملك أية أراضي

8.10 How many people lived in the family home at this time?
كم فرداً كان يعيش في منزل الأسرة في ذلك الوقت

194

enter number: ☐ ☐ ☐

8.11 How many rooms (bedrooms or living rooms) did the family home have at this time?
كم عدد غرف منزل الأسرة في ذلك الوقت

195

enter number: ☐ ☐ ☐

8.12 Did your family home have:
هل كان يوجد تلفزيون بمنزل الأسرة ذلك الوقت ؟

تلفزيون واحد 1. ☐ one television

٢-٣ تلفزيون 2. ☐ 2-3 televisions 196 ☐

أكثر من ٣ تلفزيون 3. ☐ More than 3 televisions 4. ☐ No at all
لا يوجد إطلاقاً

8.13 Did your family home have bathroom?
هل كان يوجد بمنزل الأسرة حمام ؟

1. ☐ Yes 2. ☐ No 197 ☐

8.14 Did your family home have toilet?
هل كان يوجد بمنزل الأسرة مرحاض ؟

1. ☐ Yes 2. ☐ No 198 ☐

8.15 Did your family home have water supply?
هل كانت إمدادات المياه متوفرة في منزل الأسرة في ذلك الوقت ؟

1. ☐ Yes 2. ☐ No 199 ☐

8.16 (a) At what age did you come to Bahrain to live? 200
في أية سن من عمرك قدمت للعيش في البحرين

enter age: ☐☐ ☐☐

(b) In the past before you came to Bahrain, which country did you live in for the most time?
قبل مجيئك إلى البحرين ما البلد الذي كنت تعيش فيه من قبل

1. ☐ Saudi Arabia السعودية 2. ☐ Iran ايران

3. ☐ Pakistan باكستان 201 ☐

4. ☐ India الهند

5. ☐ Other please specify: بلد آخر ________________

ما هي اللغة التي كنت قد تحدثت بها عندما كنت طفلاً؟

(d) **What language did you first speak as a child?**

1.☐ Arabic العربية 2.☐ Persian الفارسية

3.☐ Urdu الأردو 202 ☐

لغة أخرى

4.☐ English الانجليزية 5.☐ Other enter language: ______

(e) **Which one language do you usually speak at home with your spouse?**

ما هي اللغة الرئيسية التي تتخاطب بها عادة مع زوجك في المنزل؟

العربية 1.☐ Arabic 2.☐ Persian الفارسية

3.☐ Urdu الأردو 203 ☐

لغة أخرى

الانجليزية 4.☐ English 5.☐ Other enter language: ______

6.☐ No spouse لا يوجد زوج

(f) **Which one language do you usually speak at home with your children?**

ما هي اللغة التي تتخاطب بها مع أبنائك في المنزل؟

1.☐ Arabic العربية

2.☐ Persian الفارسية

3.☐ Urdu الهندية 204 ☐

4.☐ English الانجليزية

لغة أخرى 5.☐ Other enter language: ______

6.☐ No children لا يوجد أطفال

(g) **From which country did each of your grandparents come?**

اذكر من أية بلد أصلاً جاء أجدادك؟

Father's father والد أبيك	1= Bahrain البحرين	2= Other Arabian Peninsula دول الخليج الأخرى	205 ☐
	3= Iran ايران	4= Other بلد آخر	
Father's mother والد أمك	1= Bahrain	2= Other Arabian Peninsula	206 ☐
	3= Iran	4= Other	
Mother's father أم أبيك	1= Bahrain	2= Other Arabian Peninsula	207 ☐
	3= Iran	4= Other	
Mother's mother أم أمك	1= Bahrain	2= Other Arabian Peninsula	208 ☐
	3= Iran	4= Other	

SECTION 9: PHYSICAL EXAMINATION

Serial number

☐☐☐☐☐☐

9.1 Date of visit: ☐☐ ☐☐ ☐☐ 220

9.2 Pulse obliteration: ☐☐☐ 209

9.3 Peak inflation: ☐☐☐ 210

9.4 Systolic Pressure 1: ☐☐☐ 211

9.5 Systolic Pressure 2: ☐☐☐ 212

9.6 Diastolic Pressure 1: ☐☐☐ 213

9.7 Diastolic Pressure 2: ☐☐☐ 214

9.8 ECG recorded: 1. ☐ Yes 2. ☐ No 219 ☐

9.9 Height: ☐☐☐.☐ 215

9.10 Weight: ☐☐☐.☐ 216

9.11 Waist: L3 - L4 ☐☐☐.☐ 217

9.12 Hip: trochanters ☐☐☐.☐ 218

SECTION 10: LABORATORY DATA

هل أنت مصاب بالسكر

10.1 Known case of diabetes?

1. ☐ Yes   2. ☐ No   3. ☐ Don't know

(If. Yes Please don't do the second glucose test)

إذا كانت الإجابة بنعم، الرجاء عدم إعطاء الشخص محلول السكر وانتقل للتحليل الثاني

☐☐.☐☐ 221

10.2 Time last ate (any thing except water)

آخر وقت أكل فيه الغذاء البارحة (ما عدا الماء)

222 ☐

10.3 Fasting sample taken: 1. ☐ Yes   2. ☐ No

رجاء ذكر وقت إعطاء السكر

☐☐.☐☐ 223

10.4 Time started glucose

10.5 Two Hour sample taken   1. ☐ Yes   2. ☐ No   224 ☐

رجاء ذكر وقت سحب العينة الثانية

225 ☐☐.☐☐

10.6 Time 2 hour sample

SECTION 11: LABORATORY RESULTS

11.1	**Fasting blood sugar**	226 ☐☐☐	mg/dl
11.2	**Two hours load blood sugar**	227 ☐☐☐	mg/dl
11.3	**Cholesterol**	228 ☐☐☐	mg/dl
11.4	**HDL-Cholesterol**	229 ☐☐☐	mg/dl
11.5	**LDL-Cholesterol**	230 ☐☐☐	mg/dl
11.6	**Triglycerides**	231 ☐☐☐	mg/dl