

## Original Article

# Clinical Epidemiology of Type 2 Diabetes Mellitus in Kuwait

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**ABSTRACT**

**Objective:** The aims of this study were to a) describe personal and clinical characteristics of Type 2 diabetic patients in Hawalli health area in Kuwait; b) detect the prevalence of selected co-existing clinical conditions among these patients, including the metabolic syndrome and c) describe glycemic control and lipid profile for these patients.

**Methods and Subjects:** Personal data and history of co-existing medical conditions were collected. A total of 256 adult diabetic patients (Type 2) were included in the study from South Hawalli primary health care center in Kuwait. Measurements of weight, height, waist and hip circumference, blood pressure, glycated hemoglobin (HbA1c), total cholesterol, high density lipoprotein HDL-cholesterol, low density lipoprotein LDL-cholesterol and triglycerides were done.

**Results:** Out of the total subjects, 44.5% were women and 55.5% were men; 31.6% were Kuwaiti and 68.4% were expatriates. The mean age of the patients was found to be 51.7 years ( $\pm$  10.8 years) with an average range of age between 23 - 84 years. The mean duration of diabetes was 6.1 years ( $\pm$  5.5 years) with an average range of duration between 0 - 22 years. The mean BMI ( $\pm$  SD) was  $32.56 \pm 5.85$  kg/m<sup>2</sup> among women and  $27.83 \pm 4.84$  kg/m<sup>2</sup> among men. Obesity (BMI  $\geq 30$ ) was found in 44.7% (114 /255) patients whereas 33.7% (86 /255) individuals were overweight (25  $\leq$  BMI  $< 30$ ). Past history of hypertension was recorded in 46.5% (119/256), ischemic heart disease (IHD) in 12.9% (33/256), and hyperlipidemia in 45.5% (116/255) of the patients. Among men, the most significantly prevalent characteristic was smoking (38.6% in expatriates and 35.7% in Kuwaitis). Among women, the most prevalent characteristics were the presence of family history of diabetes in first-degree relatives (81.1% in Kuwaitis and 52.5% in expatriates); dieting (72.1% in

expatriates and 68.8% in Kuwaitis); obesity (71.3% in Kuwaitis and 59% in expatriates); hyperlipidemia (61.5% in Kuwaitis and 50.8% in expatriates). In addition, obesity measured by waist circumference ( $> 102$  cm in men and  $> 88$  cm in women) was found in 63.2% patients. Obesity measured by waist to hip ratio ( $> 0.95$  in men and  $> 0.80$  in women) was found in 71.3% patients. Obesity measured by waist circumference was significantly associated with sex and nationality. Almost a third of the patients were within acceptable range for glycated hemoglobin HbA1c values (HbA1c  $< 8\%$ ), while the rest (67%) were in need of additional intervention to improve their glycemic control (HbA1c  $\geq 8\%$ ). These findings were highest among expatriates (men 43.2% and women 26.4%) as compared to Kuwaitis.

High levels of total cholesterol, triglycerides, and low-density lipoprotein LDL-cholesterol were found in 48%, 27%, and 72% patients respectively. High-density lipoprotein HDL-cholesterol levels were found to be abnormal in 60% and 31% among females and males respectively. The metabolic syndrome in diabetic subjects was found to be 33.9% according to ATP III criteria. In relation to age groups, it was 4.7%, 55.3%, and 40% in the age group 20 -39, 40-59, and  $\geq 60$  years respectively. The prevalence is increasing with age groups significantly. It was found to be 10.7%, 2.7%, 10.2%, and 9.8% among Kuwaiti women, Kuwaiti men, expatriate women, and expatriate men respectively. It was significantly associated with age among Kuwaiti women.

**Conclusion:** Regardless of ethnicity, patient education programs need to be implemented effectively to aid the achievement of glycemic control. As is well known, this can help prevent or delay the onset of diabetes related complications. The prevalence of the metabolic syndrome among diabetic subjects is similar to that in developed countries.

**KEYWORDS:** diabetes mellitus, hyperlipidemia, hypertension, ischemic heart disease, obesity, the metabolic syndrome

**INTRODUCTION**

Type 2 diabetes mellitus is a major clinical and public health problem in Kuwait<sup>[1]</sup>. The reported overall prevalence of Type 2 diabetes in 1998 was found to be 14.8% in Kuwait. The latter study reported that diabetes was more prevalent in the

age groups of 20-39 and 40-59 years<sup>[1]</sup>.

The majority of Type 2 diabetic patients are overweight and the prevalence of diabetes is increasing in parallel with that of obesity<sup>[2]</sup>. Both hypertension and diabetes are common conditions and the prevalence of hypertension is higher in

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diabetic subjects than in those without diabetes<sup>[3]</sup>. Both high cholesterol and high triglyceride levels are common in diabetes mellitus<sup>[4,6]</sup>. Furthermore, low HDL levels are often found in patients with Type 2 diabetes<sup>[5,7,8]</sup>. All of these factors predispose diabetic patients to increased risks of atherosclerosis and premature death from cardiovascular diseases.

The association of abdominal obesity, diabetes, hypertension, and atherogenic dyslipidemia constitute the metabolic syndrome<sup>[9,10]</sup>. Obesity has been shown to be a major health problem and is associated with wide range of co-morbid conditions including diabetes mellitus, coronary heart disease, gall bladder disease, hypertension, osteoarthritis, and cancer<sup>[11]</sup>. Obesity and physical inactivity was documented more in diabetic Kuwaiti adults<sup>[12]</sup>. Certain dietary, socioeconomic, and behavioral factors were found to be associated with obesity among Kuwaiti adults<sup>[13]</sup>. Studies in Kuwait and other Gulf States indicate that obesity is prevalent and may be increasing<sup>[11]</sup>. One third of adult Kuwaitis were found to be obese (BMI 30). It was found that BMI, cholesterol and glucose values increase with age<sup>[11]</sup>. The highest ratio of excess body fat distribution was observed in obese women with known diabetes mellitus<sup>[14]</sup>. Obesity was markedly associated with Type 2 diabetes<sup>[1]</sup>. There was a strong association of diabetes and a positive family history of diabetes in the same study. Hypertension was also strongly associated with diabetes<sup>[1]</sup>.

A study done among patients in Mubarak and Farwania health areas in Kuwait reported that the prevalence was increasing with age 40 years and above with a female preponderance. Obesity is a characteristic feature of the population studied with a mean BMI  $31.8 \pm 6.3$  and  $28.5 \pm 5.1$  in women and men respectively. Positive family history of diabetes was found in 63% of the diabetic subject<sup>[15]</sup>. Another reported study in Hawalli health area showed that hypertension was present in 40%, hypercholesterolemia in 23%, obesity in 47%, and overweight in 42% diabetic subjects.<sup>[16]</sup>

Parental history of Type 2 diabetes, high diastolic blood pressure and serum triglycerides were found to be significant associated risk factors for the development of Type 2 diabetes<sup>[12]</sup>.

The term "metabolic syndrome" refers to an apparent clustering of several findings together in patients such as abdominal obesity, insulin resistance (elevated fasting glucose), hypertension, and dyslipidemia (elevated triglyceride and decreased HDL-cholesterol levels)<sup>[17,18]</sup>. In 2001, the National Cholesterol Education Program (NCEP) Adult Treatment Panel III report (ATP III) provided the first definition of the syndrome in its national guidelines<sup>[19]</sup>.

Currently, the ATP III guidelines are the most commonly used criteria, although other criteria, such as those of the World Health Organization, are also used.<sup>[20]</sup>

The metabolic syndrome as defined by ATP-III guidelines requires the presence of any three of the following abnormalities, namely, abdominal obesity (defined by waist circumference > 102 cm in men and 88 cm in women); dyslipidemia (defined by serum triglycerides >150 mg/dL (1.69 mmol/L); high-density lipoprotein (HDL) cholesterol level <40 mg/dL (1.04 mmol/L) in men and < 50mg/dL (1.29 mmol/L) in women; presence of blood pressure medication or BP > 130/85 mmHg; fasting blood glucose level > 110 mg/dL (6.1 mmol/L)<sup>[19]</sup>. Minimum criteria for the metabolic syndrome are met in most patients with Type 2 diabetes. Correct identification of the syndrome is important for an integrated approach to reduce the high costs and the associated disabilities<sup>[19]</sup>.

The ATP III highlights the importance of treating patients with the metabolic syndrome to prevent cardiovascular disease (CVD) because it increases the risk in individuals with and without diabetes<sup>[20-22]</sup>. National survey data suggest that the metabolic syndrome is very common, affecting about 24% of US adults between 20 - 70 years of age and older<sup>[23]</sup>. The syndrome is more common in older people and in Mexican Americans<sup>[23]</sup>. People with the syndrome are about twice as likely to develop CVD and over four times as likely to develop Type 2 diabetes compared with subjects who do not have the metabolic syndrome. While this syndrome may have a genetic basis, environmental factors are important modifiable risk factors for the condition<sup>[23]</sup>.

The interrelation between the physiologic abnormalities that constitute the metabolic syndrome was examined. The latter study concluded that the pattern of variables associated with the metabolic syndrome tended to be similar among different ethnic groups<sup>[24]</sup>. Results from the U.S. (Third National Health and Nutrition Examination Survey), showed that the age-adjusted prevalence was 23.9% using the ATP III definition and 25.1% using the WHO definition<sup>[25,21]</sup>. However, another study showed that the metabolic syndrome among diabetic patients (Type 2) was 81% and 78% by WHO proposal and the ATP III criteria respectively<sup>[22]</sup>.

Among different age groups the prevalence of the metabolic syndrome was increasing from 6.7% to 43.5% to 42% in 20-29, 60-69, and 70 years age groups respectively<sup>[21]</sup>. The same study showed that the prevalence was similar for men (24%) and women (23.4%) and that the metabolic syndrome had a higher prevalence among African American

women<sup>[21]</sup>. Another study assessed the prevalence and characteristics of the metabolic syndrome among different ethnic and age groups using the two definitions (ATP III or the WHO criteria). It concluded that the metabolic syndrome affects 20-30% of middle-aged adults in the U.S. by any criteria<sup>[26]</sup>

A recent study from Kuwait showed that the metabolic syndrome was found in 34% of hypertensive subjects, 55% being male and 45% female. Prevalence of the syndrome was 28.2% among 40- 55 year old and 41.9% in those above the age of 55 years<sup>[27]</sup>. A study from Oman showed that the prevalence of the metabolic syndrome was 21.0% and affected 19.5% men and 23% women. The same study showed that abdominal obesity was markedly higher in women (44.3%) than men (4.7%)<sup>[28]</sup>.

## SUBJECTS AND METHODS

Hawalli health center provides health care to a total population of 162,116 in Kuwait. One of its services is to deliver health care to diabetic patients. The target subjects were adults diagnosed as Type 2 diabetes mellitus patients. Data were collected during October and November 2002.

A questionnaire was designed to include personal data (age, sex, and nationality); family history of diabetes in first-degree relative; and social habits such as current smoking, exercise and dieting. Dieting was considered positive if the patient stated that he or she is following specialist dietary therapy, or the patient is restricting his or her caloric intake. Exercise was considered positive if the patient stated that he or she is exercising on regular basis or according to specialist advice. Past history of hypertension, ischemic heart disease (IHD) and hyperlipidemia was considered positive if there was documented evidence in the medical records.

Measurements of weight and height were recorded and body mass index was calculated as kg/m<sup>2</sup>. Also, measurements of waist and hip circumference (in centimeter) were taken and waist to hip ratio (WHR) was calculated. Biochemical measurement of glycated hemoglobin (HbA1c), total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol and triglycerides were done.

Criteria for abnormalities were as follows: A BMI  $\geq 30$  was considered as obesity. Patients were labeled as overweight if their BMI  $\geq 25$  and  $< 30$ . Obesity measured by waist circumference (WC) was recorded higher than normal if the WC was  $> 102$  cm in men and  $> 88$  cm in women. WHR was higher than normal if it was  $> 0.95$  in men and  $> 0.80$  in women. HbA1c  $\geq 7\%$  was considered as

**Table 1**

Distribution of Type 2 diabetic patients by age, sex, and nationality

	Men (n = 142) n (%)	Women (n = 114) n (%)	Total (n = 256) n (%)
<b>Kuwaiti</b>	28 (10.9)	53 (20.7)	81 (31.6)
20 - 39 years	3 (1.2)	5 (2)	8 (3.1)
40 - 59 years	16 (6.3)	25 (9.7)	41 (16)
60 + years	9 (3.5)	23 (9)	32 (12.5)
<b>Non Kuwaiti</b>	114 (44.5)	61 (23.8)	175 (68.4)
20 - 39 years	17 (6.6)	53 (20.7)	24 (9.4)
40 - 59 years	76 (29.7)	61 (23.8)	112 (43.8)
60 + years	21 (8.2)	18 (7.3)	39 (15.2)

optimal glycemic control. Normal, goal, and acceptable levels of HbA1c were considered as  $< 6\%$ ,  $6\%$  to  $< 7\%$ , and  $7\%$  to  $< 8\%$  respectively. If HbA1c was  $8\%$ , it was considered as unacceptable and additional action was recommended to improve glycemic control for such patients<sup>[9,19,29,30]</sup>.

The following values of  $< 5.2$  mmol/L,  $2.6$  mmol/L and  $< 1.7$  mmol/L were considered normal for total serum cholesterol, LDL-cholesterol and triglycerides respectively. HDL-cholesterol was considered abnormal if it was  $< 1.1$  mmol/L and  $< 1.3$  mmol/L for men and women respectively<sup>[5,9,19,30]</sup>. The metabolic syndrome was defined using ATP III criteria ( $> 3$  of the following abnormalities): waist circumference greater than  $102$  cm in men and  $88$ cm in women; serum triglycerides at least  $150$  mg/dL ( $1.69$  mmol/L); high-density lipoprotein cholesterol level of less than  $40$  mg/dL ( $1.04$  mmol/L) in men and  $50$  mg/dL ( $1.29$  mmol/L) in women; blood pressure of at least  $130/85$  mm Hg; or serum glucose level of at least  $110$  mg/dL ( $6.1$  mmol/L)<sup>[19]</sup>.

Data collected was then data analyzed by SPSS, using chi-square test to test for significance of association between different variable. A p-value  $< 0.05$  was considered to be significant.

## RESULTS

### Personal Characteristics of Type 2 Diabetic Patients

Table 1 shows the distribution of patients by sex, nationality and age. Of the 256 diabetic patients, 114 (44.5%) were women and 142 (55.5%) were men; 81 (31.6%) were Kuwaiti and 175 (68.4%) were expatriates. Among Kuwaiti patients, the average age ( $\pm$  SD) was  $50.7 \pm 10.9$  years in men (range 36 - 71 years) and  $55.0 \pm 10.4$  years in women (range 33 - 73 years); the median age was 48 years in men and 57 years in women. Among expatriate patients, the mean age was  $50.3 \pm 10.7$  years in men (range 23 - 84 years) and  $52.5 \pm 11.1$  years in women (range 29

**Table 2**

Prevalence of pre-existing conditions by nationality and gender

	Kuwaiti		Non-Kuwaiti		p-value
	Men n (%)	Women n (%)	Men n (%)	Women n (%)	
Family					
h/o D.M.	19 (67.9)	43 (81.1)	48 (42.1)	32 (52.5)	0.000
Smoking	10 (35.7)	4 (7.5)	44 (38.6)	2 (3.3)	0.000
Dieting	11 (39.3)	37 (68.8)	61 (53.5)	44 (72.1)	0.005
Exercise	7 (25)	7 (13.2)	25 (21.9)	10 (16.4)	0.441
Obesity					
(BMI $\geq 30$ )	10 (35.7)	37 (71.2)	31 (27.2)	36 (59)	0.000
Obesity					
WC > normal	12 (44.4)	48 (96)	47 (41.2)	49 (87.5)	0.000
Obesity					
WHR > normal	3 (60)	28 (82.4)	45 (64.3)	36 (73.5)	0.295
Hypertension	14 (50)	30 (56.6)	45 (39.5)	30 (49.2)	0.191
IHD	3 (10.7)	14 (26.4)	5 (4.4)	11 (18)	0.001
Hyperlipidemia	11 (39.3)	32 (61.5)	42 (36.8)	31 (50.8)	0.019

- 84 years); the median age was 49 years in men and 53 years in women. Of the 175 expatriate patients in the study, about 70.1% were of Arab ethnicity (from Egypt, Syria, Jordan, Saudi Arabia, Lebanon, Palestine, Iraq, and Oman) and 29.1% were from South and Southeast Asia (Iran, Pakistan, India, Bangladesh, Philippines, and Sri Lanka).

The mean age of patients was found to be 51.7 years ( $\pm 10.8$  years) with a range of age 23 - 84 years.

The mean duration of diabetes was found to be 6.1 years ( $\pm 5.5$  years) with a range of duration 0 - 22 years.

### Prevalence of Pre-existing Conditions and Smoking

Other personal characteristics and co-existing medical conditions for the study population are shown in Table 2. Smoking was recorded in 23.4% (60/256), dieting in 59.8% (153/256), exercise in 19.1% (49/256), and family history of diabetes in first degree relative in 55.5% (142/256) of the patients.

Obesity (BMI  $\geq 30$ ) was recorded in 44.7% (114/255) and overweight (25  $\leq$  BMI < 30) was recorded in 33.7% (86/ 255) of the patients. The mean BMI ( $\pm$  SD) found to be  $32.56 \pm 5.85$  kg/m<sup>2</sup> among women and  $27.83 \pm 4.84$  kg/m<sup>2</sup> among men. Additionally, obesity was determined by waist circumference (WC) and waist to hip ratio (WHR). WC was recorded higher than normal (> 102 cm in men and > 88 cm in women) in 63.2% (156/247); WHR was higher than normal (> 0.95 in men and > 0.80 in women) in 71.3% (112/157). In relation to sex and nationality, obesity by WC was found in 92.5% (98/156), 41.1% (58/156), 77.9% (60/156) and 56.5% (96/156) among women, men, Kuwaiti, and expatriates respectively. Obesity by WC was significantly associated with sex (p-value 0.000)

**Table 3**

Selected biochemical characteristics and glycemic control in diabetic patients

	n	(%)
HbA1c		
Normal	10	(4.5)
Goal	29	(13.1)
Acceptable	35	(15.8)
Unacceptable	148	(66.7)
Total	222	(86.7)
Total Cholesterol		
Normal	123	(52.3)
High	112	(47.7)
Total	235	(91.8)
Triglycerides		
Normal	172	(72.9)
High	64	(27.1)
Total	236	(92.2)
HDLCholesterol - in women		
Normal	41	(39.8)
Abnormal	62	(60.2)
Total	103	(90.4)
HDLCholesterol - in men		
Normal	90	(68.7)
Abnormal	41	(31.3)
Total	131	(92.3)
LDLCholesterol		
Normal	67	(28.6)
High	167	(71.4)
Total	234	(91.4)

and nationality (p-value 0.001). Obesity by WHR was found among women 77.1% (64/112), among men 64.9% (48/112), among Kuwaitis 79.5% (31/112), and among expatriates 68.6% (81/112). Past history of hypertension was recorded in 46.5% (119/ 256), ischemic heart disease (IHD) in 12.9% (33/ 256), and hyperlipidemia in 45.5% (116/ 255) of the patients.

Table 2 shows the prevalence of these factors by nationality and sex. Among men, smoking was the most prevalent personal characteristic (38.6 % in expatriates and 35.7% in Kuwaitis) with highly significant p- value < 0.000. Among women the most prevalent personal characteristics were the presence of family history of diabetes in first degree relative and dieting. Presence of family history of diabetes in first-degree relative was 81.1% in Kuwaitis and 52.5% in expatriate women. Dieting was 68.8% in Kuwaitis and 72.1% in expatriate women. Also, among women the most prevalent co-existing conditions were obesity (both by BMI and WC), hyperlipidemia, hypertension and ischemic heart disease (IHD). Obesity by BMI was 71.3% in Kuwaitis and 59% in expatriate women, while obesity by WC was 96% in Kuwaitis and

**Table 4**

Distribution of diabetic patients with unacceptable level of HbA1c in relation to nationality and gender

	Kuwaiti (n = 71)		Non-Kuwaiti (n = 151)		Total
	Men n (%)	Women n (%)	Men n (%)	Women n (%)	
Number of patients	18	27	64	39	148
percentage of those with unacceptable level of HbA1c	(12.2)	(18.2)	(43.2)	(26.4)	
percentage with nationality and gender grouping	(69.2)	(60)	(64.6)	(75)	
Total	26	45	99	52	222

87.5% in expatriate women. Hyperlipidemia was 61.5% in Kuwaitis and 50.8% in expatriate women. Hypertension was 56.6% in Kuwaitis and 49.2% in expatriate women. Ischemic heart disease (IHD) was 26.4% in Kuwaitis and 18% in expatriate women. It may also be noted that obesity by BMI and WC was two folds more significantly prevalent in women as compared to men. IHD was three to four folds more prevalent in women as compared to men. Hypertension existed in equal proportion among men and women.

#### Glycemic Control and Biochemical Characteristics of Type 2 Diabetic Patients

Table 3 shows selected biochemical characteristics of diabetic patients included in this study. Glycemic control measured by HbA1c was done in 222/ 256 (86%) of the studied patients. The mean HbA1c value ( $\pm$  SD) was found to be 9.1% ( $\pm$  2.1) with a range of 4.8% - 14.3%. Overall, 33.4% were within acceptable range of HbA1c values (HbA1c < 8%), while the rest (66.7%) were in need for additional action to improve their control (HbA1c  $\geq$  8%). Only 17.6% of 222 patients achieved goal glycemic control (HbA1c < 7%) and additional 15.8% were with an acceptable control (HbA1c < 8%). High levels of total cholesterol, triglycerides, and LDL- cholesterol were found in 47.7% (112/235), 27.1% (64/236), and 71.4% (167/234), respectively. HDL- cholesterol levels were found to be abnormal 60.2% (62/103) and 31.3% (41/131) among females and males respectively.

The 148 (66.7%) patients with unacceptable range of HbA1c values (HbA1c  $\geq$  8%) were further analyzed (Table 4). The majority (43.2% and 26.4%) were expatriate men (64/148) and women (39/148) respectively.

Table 4 also shows the same group of patients distributed in relation to nationality and sex. Among Kuwaitis, 45/71 (63.4%) were with unacceptable level of HbA1c values (HbA1c  $\geq$  8%). Men were 18/26 (69.2%) and women were 27/45

**Table 5**

Prevalence of the metabolic syndrome (according to ATP III) among diabetic patients (Type 2) distributed by nationality, gender and age groups

	Age Group (years) n (%)			Total n (%)	p - value
	20-39	40-59	60+		
All Subjects	4 (4.7)	47 (55.3)	34 (40)	85 (33.9)	0.001
Sex					
Women	2 (3.8)	27 (50.9)	24 (45)	53 (21.0)	0.002
Men	2 (6.3)	20 (62.5)	10 (31.3)	32 (12.5)	0.479
Nationality					
Kuwaiti	2 (5.9)	15 (44.1)	17 (50)	34 (13.5)	0.007
Expatriate	2 (3.9)	32 (62.7)	17 (33.3)	51 (20)	0.101
Kuwaiti					
Women	1 (3.7)	12 (44.4)	14 (51.9)	27 (10.7)	0.009
Men	1 (14.0)	3 (42.9)	3 (42.9)	7 (2.7)	0.632
Expatriate					
Women	1 (3.8)	15 (57.7)	10 (38.5)	26 (10.2)	0.230
Men	1 (4)	17 (68.0)	7 (28.0)	25 (9.8)	0.359

(60%) in this group. Similarly, among the expatriates, 103/151 (68.2%) were with unacceptable level of HbA1c values (HbA1c  $\geq$  8%). Out of them, men were 61.6% (64/99) while the women were 75% (39/52).

Table 5 shows that prevalence of the metabolic syndrome in diabetic subjects was 33.9% (85/251) according to ATP III criteria. Its distribution in relation to age groups was as follow. It was 4.7% (4/85), 55.3% (47/85), and 40% (34/85) in the age group 20-39 years, 40-59 years, and 60 years respectively. The prevalence is increasing with age groups significantly (p-value 0.001). Among both sex and nationality groups, the prevalence increased with age. Among women, it was found to be 3.8%, 50%, and 45.3% in the three age groups respectively. Among men, it was found to be 6.3%, 62.5%, and 31.3% in the three age groups respectively. Among Kuwaitis, it was found to be 5.9%, 44.1%, and 50% in the three age groups respectively. Among expatriates it was found to be 3.9%, 62.7%, and 33.3% in the three age groups respectively. The association of the metabolic syndrome was significant with age among women (p-value < 0.002) and Kuwaiti (p-value < 0.007) diabetic subjects.

Further analysis showed that the metabolic syndrome (according to ATP III criteria) was significantly associated with age groups among Kuwaiti women (p-value < 0.009). Among Kuwaiti women, it was found to be 3.7%, 44.4%, and 51.9% within the three age groups respectively. Among Kuwaiti men it was found to be 14.3%, 42.9%, and 42.9% in the three age groups respectively. Among expatriate women, it was found to be 3.8%, 57.7%, and 38.5% in the three age groups respectively.

Among expatriate men, it was found to be 4%, 68.0%, and 28% in the three age groups respectively.

## DISCUSSION

The results of this study confirmed that both obesity<sup>[1,10,11,15]</sup> and a positive family history<sup>[1,12,15]</sup> are important associated risk factors for Type 2 diabetes in Kuwait. It also showed that hypertension, hyperlipidemia and ischemic heart disease were more common among our diabetic female patients in comparison to diabetic male patients. Tight blood pressure control is recommended among the diabetic population<sup>[9]</sup>.

Obesity was strikingly high (44.7%), which is a reflection of the affluent lifestyle of Kuwaiti population. In particular, obesity was more prevalent among females (63.7%). This may be due to decreased physical activity. It has been suggested that these changes are probably due to the effects of rapid modernization, affluence, increased food consumption, and concomitant adoption of a sedentary lifestyle<sup>[12,31]</sup>.

Reported studies showed similar results to those in our study. In one study, it was reported that the prevalence of overweight and obesity among adult females in Kuwait was 52.5% and 42% respectively<sup>[32]</sup>. The numbers increased with age<sup>[32]</sup>. Another study reported that the prevalence of obesity among Kuwaitis was found to be higher than reported figures elsewhere in the world. It was found to be 70.2% and 36.4% for BMI > 25 and > 35 respectively<sup>[33]</sup>.

Another reported study among Hawalli Governorate residents in Kuwait found that the mean age of patients was 53 years ( $\pm$  13.9), with a mean duration of diabetes 7.8 years (range 2-28 years). A positive family history was reported in 63% of those patients. They found that the mean BMI was  $31.8 \pm 6.3$  kg/m<sup>2</sup> and  $28.5 \pm 6.3$  kg/m<sup>2</sup> in women and men respectively. High blood pressure was reported in 14.9%<sup>[34]</sup>.

A study about obesity among adults in South Asia (Taiwan) showed that women had a higher mean value of BMI than men. Overweight and obesity were prevalent in 27.3% and 3.2% male patients. Overweight and obesity was prevalent in 34.9% and 6.4% of women<sup>[35]</sup>.

It is mostly important that family practitioners be aware of the fact that the goal in the treatment of diabetes mellitus is the control of co-existing conditions and not merely the control of blood glucose<sup>[16]</sup>. Thus control of obesity should start early in the management of obese diabetics.

Immediate action should be taken to develop a public health intervention strategy to educate Kuwaiti men and increase their awareness of the causes of CHD, methods of reducing their risk for

CHD and heart attack, the leading cause of death in Kuwait<sup>[36]</sup>.

A striking finding was the large percentage of diabetic patients (66.7%) with an unacceptable level of glycated hemoglobin. It was higher among the expatriate group than in the Kuwaiti group of patients, especially among males. Nevertheless, this should alert the health authorities towards the important role of the diabetes educator and diabetes education programs.

Primary care physicians must recognize that the co-occurrence of risk factors for Type 2 diabetes and CHD represents an extremely adverse metabolic state warranting aggressive risk factor intervention.

## CONCLUSION

The results of this study confirmed that obesity, hypertension, and hyperlipidemia were more common among the diabetic population.

The strong association between hypertension and Type 2 diabetes may suggest a common approach to the prevention and control of these conditions. Association of diabetes with obesity should form the basis of immediate intervention programs to encourage exercise.

Research focusing on the genetics of Type 2 diabetes mellitus in the highly susceptible Kuwaiti population should be planned.

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