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An increase in prevalence of diabetes mellitus in Jordan over 10 years

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Abstract

Objective: This study aimed to determine the prevalence of type 2 diabetes mellitus (DM) and impaired fasting glycemia (IFG), identify their associated factors, determine how the prevalence of type 2 DM has changed over 10 years, and assess the awareness and state of control of diabetes in Jordan. **Methods:** Data were analyzed from a cross-sectional study that included a random sample of 1121 Jordanians aged 25 years and above. A subject was deemed affected by DM if this diagnosis was known to the patient or if his or her condition complies with the American Diabetes Association definition. IFG was defined as a fasting serum glucose level of ≥6.1 mmol/l (110 mg/dl) but <7 mmol/l. HbA_{1c} >7.5% was defined as “unsatisfactory” metabolic control. **Results:** The age-standardized prevalence of diabetes and IFG was 17.1% and 7.8%, respectively, with no significant differences between women and men. Of the 195 diabetic subjects, 146 (74.9%) had been previously diagnosed. More than half (54%) of those previously diagnosed were found to be with unsatisfactory glycemic control. Compared to the 1994 survey, there was a significant increase in the prevalence of diabetes by 31.5%. Increase in age, increase in body mass index, and having a family history of diabetes were associated with increased odds of diabetes and IFG. While the level of education had no effect on IFG, higher level of education was associated with a decrease in the odds of having diabetes. **Conclusion:** The prevalence of type 2 diabetes and IFG is high in Jordan and is increasing. More than half of the patients with diabetes have unsatisfactory control. Therefore, they are likely to benefit from programs aimed at encouraging behaviors toward achieving optimum weight as well as physical activity behaviors. Physicians caring for patients with diabetes may need to adopt a more vigorous approach for diabetes control.

Keywords: Diabetes mellitus; Impaired fasting glycemia; Jordan

1. Introduction

Diabetes mellitus (DM) is a major risk factor for cardiovascular disease (Jaffe, Nag, Landsman, & Alexander, 2006). It predisposes to vascular, renal, ophthalmic, and neurological complications that impair the quality of life and presents a high burden to both individuals and society in terms of morbidity and economic costs (Engelgau et al., 2004). Diabetes has diverse geographical distribution and varies widely between populations (Harris et al., 1988), reflecting differences in both environmental influences and genetic susceptibility (Amos, McCarty, & Zimmet, 1997). Studies have reported an increasing prevalence of type 2 diabetes, with the most dramatic increase occurring in developing countries (Al-Lawati, Al Riyami, Mohammed, & Jousilahti, 2002; Al-Nuaim, 1997; Amos et al., 1997; El Mugamer, Ali Zayat, Hossain, & Pugh, 1995; Midthjell

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et al., 1984; Musaiger, 1992). It has been reported that patients with undiagnosed diabetes represent 25% to 66% of the overall diabetic population (Glumer, Jorgensen, & Borch-Johnsen, 2003; Wilks et al., 1999). Early recognition and treatment has a potential benefit of reducing the incidence of vascular complications of type 2 diabetes (UK Prospective Diabetes Study Group, 1998). Such complications were reported to be more common in patients with poor metabolic control and a longer course of diabetes (Foss, Paccola, de Souza, & Iazigi, 1989). Obesity and physical inactivity are well-established risk factors that contribute substantially for the increased incidence of diabetes (Zimmet, 1991). In developing countries, increasing life expectancy is an important factor for such increase (McCarty & Zimmet, 1994).

Earlier studies had applied former criteria for the diagnosis of DM (World Health Organization [WHO], 1985), which differ from the more recent criteria currently recommended by the WHO and the American Diabetes Association (ADA; Report of the Expert Committee, 1997; WHO, 1999). In the present study, we used the current ADA criteria to determine the prevalence of type 2 DM and impaired fasting glycemia (IFG), to identify their associated factors, and to determine how the prevalence of type 2 DM has changed in Jordan over 10 years. Furthermore, we assessed the awareness and state of control of diabetes among patients with known diabetes.

2. Materials and methods

2.1. Study population and data collection

A survey was conducted in the town of Sarih in Jordan. This town with about 3328 households and 19,227 residents (Department of Statistics 2002-Jordan) was selected because of the presence of a large comprehensive health center in which to perform the study, because of its proximity to the study team, and because this town showed the highest response rate in the 2002 Behavioral Risk Factor Survey (Shehab, Belbeisi, & Walke, 2003). This survey did not show evidence to conclude that this town is different from other towns in the country in the prevalence of self-reported diabetes. Minimum sample size needed was calculated assuming a 13% prevalence of diabetes among people aged 25 years or more (Ajlouni, Jaddou, & Batieha, 1998). The calculated sample size with a precision of $\pm 2\%$ and confidence level of 95% was 1086 subjects. A systematic sample of households (every sixth house) after a random start was selected. One week before the survey, a two-member team (a male and a female) visited the selected households, explained the purpose of the study, and invited all residents aged 25 years and above who were present at the time of the study to visit the health center at a given day after an overnight fast. Subjects on regular medications were asked not to take their medications early at that day and to bring all their medications with them to the survey site. To encourage participation and to secure subjects' cooperation, the study team contacted community and religious leaders, local clubs, schools, and the municipality. The study team offered free transportation to and from the health center upon request and worked every day of the week to encourage employed people to participate.

Participants visited the health center early in the morning (7:30–10:00 a.m.) with a minimum fasting time of 8 h. A pilot-tested structured questionnaire prepared specifically for the study was administered by trained interviewers to collect information on sociodemographic factors as well as information on DM, hypertension, hyperlipidemia, smoking habits, and potential risk factors.

2.2. Measurements and laboratory analysis

Anthropometric measurements including weight, height, and hip and waist circumferences were measured with the subjects wearing light clothing and no shoes. Waist circumference was measured, to the nearest centimeter, at the narrowest point between the umbilicus and the rib cage, and hip circumference was measured at the widest part of the body below the waist; a nonstretchable tailor's measuring tape was used for both measurements (Deen, 2004). Body mass index (BMI) was calculated as the ratio of weight (kilograms) to the square of height (meters). Two readings of systolic blood pressure (SBP) and diastolic blood pressure (DBP) were taken from the left arm with the subject seated and the arm at heart level, after at least 5 min of rest, using a standardized mercury sphygmomanometer. The mean of the two readings was taken as the individual's blood pressure.

For laboratory analysis and all biochemical measurements, two sets of fasting blood samples were drawn from a cannula inserted into the antecubital vein into sodium fluoride potassium oxalate tubes for glucose and lithium heparin vacuum tubes for lipids. Samples were centrifuged within 1 h at the survey site, and plasma was transferred into separate labeled tubes and transferred immediately in cold boxes filled with ice to the central laboratory of the Jordan University Hospital. All biochemical measurements were carried out by the same team of laboratory technicians using the same method throughout the study period.

Fasting plasma glucose (FPG), cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and triglyceride (TG) were measured by the glucose oxidase method, using a Cobas Analyzer (Roche). Glycosylated hemoglobin (HbA_{1c}) was analyzed using the high-performance liquid chromatography method (Bio-Rad).

2.3. Definition of variables

Participants were assessed for previously diagnosed diabetes by asking the question "Have you ever been told by a doctor or health professional that you have diabetes?" Those who answered "yes" to this question, excluding gestational DM, were defined as having previously diagnosed diabetes. Age at diagnosis for those patients was determined by asking the question "How old were you when a health professional first told you that you had diabetes?" A subject was deemed affected by DM if this diagnosis was known to the patient or if his or her condition complies with the ADA definition [fasting serum glucose was 7 mmol/l (126 mg/dl) or more]. IFG was defined as a fasting serum glucose level of ≥6.1 mmol/l (110 mg/dl) but <7 mmol/l (Report of the Expert Committee, 1997). HbA_{1c} >7.5% was defined as "unsatisfactory" metabolic control (Farnkvist & Lundman, 2003). A family history of DM was self-reported by participants and defined as positive if at least one first- or second-degree relative had DM. Obesity was defined as having a BMI ≥30, as defined by the WHO (1995). Other metabolic abnormalities were defined according to ATP III criteria for the metabolic syndrome (Expert Panel on Detection, 2001) as follows:

- Abdominal obesity: waist circumference >102 cm (40 in.) in men and >88 cm (35 in.) in women.
- High blood pressure: SBP ≥130 mmHg and/or DBP ≥85 mmHg or on treatment for hypertension.
- Hypertriglyceridemia: serum TG level ≥150 mg/dl (1.69 mmol/l).
- Low HDL cholesterol: serum HDL cholesterol <40 mg/dl (1.04 mmol/l) in men and <50 mg/dl (1.29 mmol/l) in women.

Participants, with regard to their smoking habit, were categorized as (a) nonsmokers, if they had never smoked; (b) smokers, if they regularly smoke at least one cigarette daily; or (c) past smokers if they had quit smoking. Education was categorized as follows: illiteracy, 1–11 years of formal schooling, and >11 years of formal schooling.

2.4. Statistical analysis

Age-specific prevalence rates of diabetes were obtained. To facilitate comparison with other populations, we further derived a directly adjusted rate using the world population as a standard population (King & Rewers, 1993). The rate of unsatisfactory glycemic control was calculated as the number of diabetics with HbA_{1c} >7.5% divided by the number of diabetics aware of their diabetes status. One-way ANOVA was used to test the significance of differences in means of quantitative demographic, anthropometric, and metabolic characteristics between subjects with no diabetes, those with IFG, and those with DM. If significant differences were observed, post hoc pairwise comparisons were conducted using Bonferroni test. The chi-square test was used to compare the three groups with respect to categorical variables. Factors associated with diabetes and IFG were analyzed in a polychotomous logistic regression model using a three-class categorization of glucose level [diabetes, IFG, and normal glucose level (NG)] as a dependent variable. Data were entered and analyzed using the Statistical Package for Social Sciences software, version 11.5. P<.05 was considered statistically significant.

3. Results

3.1. Demographic, anthropometric, and metabolic characteristics of the participants

A total of 1121 participants (394 men and 727 women), aged 25 years and above, were included in this study. Their age ranged from 25 to 85 years with a mean of 46.2. About 52% of the subjects had less than high school education. Fifty-four percent (54%) were married and 43% were single. Their characteristics according to plasma glucose level are depicted in Table 1. The mean age at diagnosis of type 2 DM was 50.0±11.2 years with no gender differences (P=.633).

Table 1
The demographic, anthropometric, and metabolic characteristics of 1121 adults aged ≥25 years old in Jordan according to their plasma glucose level

	NG (n=835)	IFG (n=91)	DM (n=195)	IFG vs. NG	DM vs. NG	DM vs. IFG
Age (years)	43.4±12.7	51.7±12.6	55.5±10.6	<.0001	<.0001	.048
Years of education	10.1±5.2	7.9±6.2	6.3±5.6	.001	<.0001	.047
Weight (kg)	77.5±14.1	85.6±15.4	81.6±14.0	<.0001	.001	.086
Height (cm)	161.4±9.2	161.5±9.1	159.5±9.7	1.000	.034	.278
BMI (kg/m^2)	29.8±5.4	32.8±5.5	32.2±5.8	<.0001	<.0001	1.000
Waist circumference (cm)	94.2±13.7	104.4±13.1	103.2±11.9	<.0001	<.0001	1.000
Hip circumference (cm)	115.0±12.1	122.5±10.8	118.7±12.2	<.0001	<.0001	.040
FPG (mg/dl)	89.8±8.4	116.5±4.7	191.8±68.3	<.0001	<.0001	<.0001
SBP (mmHg)	121.0±16.4	132.9±19.5	134.7±20.9	<.0001	<.0001	1.000
DBP (mmHg)	79.0±11.4	84.8±11.2	82.9±12.2	<.0001	<.0001	.568
TG (mg/dl)	150.1±92.0	185.8±110.4	215.0±131.2	.004	<.0001	.071
Cholesterol (mg/dl)	199.4±41.4	202.8±40.6	215.8±45.0	1.000	<.0001	.046
LDL (mg/dl)	123.3±35.8	125.4±36.8	132.6±37.2	1.000	.003	.343
HDL (mg/dl)	44.8±12.2	40.2±9.7	42.0±10.2	.001	.008	.688

IFG: FPG=100–125 mg/dl (5.6–6.9 mmol/l); DM: FPG=126 mg/dl (7.0 mmol/l).

Patients with diabetes and patients with IFG were older and less educated compared to those with a normal glucose level. Average weight, BMI, waist circumference, hip circumference, FPG, SBP, DBP, and TG were significantly higher among patients with diabetes and patients with IFG compared to those with a normal glucose level. As expected, HDL was significantly higher in subjects with a normal glucose level. Cholesterol and LDL were significantly higher among patients with diabetes when compared to subjects with a normal glucose level. Compared to patients with IFG, patients with diabetes were older, less educated, had a smaller hip circumference, and a higher cholesterol level.

3.2. The prevalence of IFG and DM

Of the 1121 subjects tested, 835 (74.5%) were classified as individuals with a normal glucose level, 91 (8.1%) as having IFG, and 195 (17.4%) as having DM. The age-standardized prevalence of diabetes was 17.1% [95% confidence interval (CI): 15.0, 19.1]. The age-standardized prevalence of IFG was 7.8% (95% CI: 6.2, 9.4). There were no significant differences between women and men in prevalence of diabetes and IFG. Fig. 1 shows a significant increasing trend in the prevalence of DM and IFG for men and women according to age. However, the prevalence of IFG for men dropped from 18.6% in the 50- to 59-year age group to 10.7% in the ≥60-year age group. Prevalence of IFG and DM among people in Jordan by sociodemographic and other important variables is depicted in Table 2.

Table 2
Prevalence of IFG and DM among adults aged ≥25 years old in Jordan by selected variables

Variable	NG (n=835)	IFG (n=91)	DM (n=195)	IFG vs. NG	DM vs. NG
Gender				.437	.501
Male	287 (72.8)	35 (8.9)	72 (18.3)		
Female	548 (75.4)	56 (7.7)	123 (16.9)		
Age (years)				<.0001	<.0001
25–29	106 (98.1)	0 (0.0)	2 (1.9)		
30–39	261 (91.3)	16 (5.6)	9 (3.1)		
40–49	232 (74.8)	25 (8.1)	53 (17.1)		
50–59	118 (59.0)	23 (11.5)	59 (29.5)		
60+	118 (54.4)	27 (12.4)	72 (33.2)		
Years of education				<.0001	<.0001
Illiterate	100 (52.9)	25 (13.2)	64 (33.9)		
1–12 years	276 (69.5)	31 (7.8)	90 (22.7)		
>12 years	459 (85.8)	35 (6.5)	41 (7.7)		
Marital status				.777	.354
Married	706 (74.0)	78 (8.2)	170 (17.8)		
Not married	129 (77.2)	13 (7.8)	25 (15.0)		
Smoking				.022	.036
Current smoker	113 (79.0)	9 (6.3)	21 (14.7)		
Past smoker	49 (59.8)	12 (14.6)	21 (25.6)		
Nonsmoker	672 (75.2)	70 (7.8)	152 (17.0)		
BMI				<.0001	<.0001
Normal	167 (88.8)	7 (3.7)	14 (7.4)		
Overweight	272 (77.7)	19 (5.4)	59 (16.9)		
Obese	387 (67.4)	65 (11.3)	122 (21.3)		
Family history of diabetes				<.0001	<.0001
No	520 (81.9)	34 (5.4)	81 (12.8)		
Yes	315 (64.8)	57 (11.7)	114 (23.5)		

3.3. The change in the prevalence of diabetes over 10 years

Table 3 shows the change in the prevalence of diabetes, according to the ADA definition, between the two surveys that were conducted 10 years apart (1994 and 2004). In both surveys, the study population, data collection, measurements, and laboratory analysis were identical. Compared to the 1994 survey, there were changes in the distributions of age, education, BMI, and smoking status. The trend in the 2004 survey leans toward a lower proportion of younger people (25–29 years), a smaller proportion of illiterate individuals (16.9% vs. 36.5%), a smaller proportion of smokers, and a higher proportion of obese people (51.2% vs. 43.0%).

As Table 3 shows, there has been a significant increase in the prevalence of diabetes between the two surveys using the same cutoff points. Between 1994 and 2004, the age-

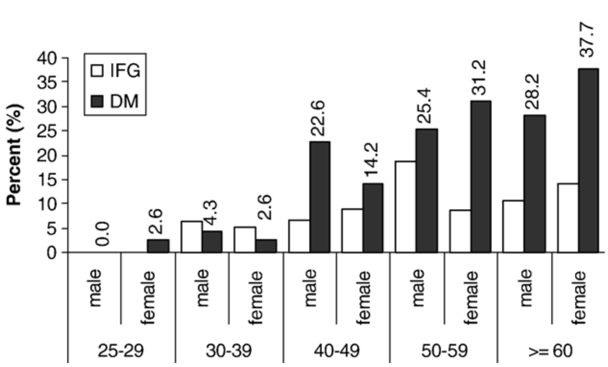

Fig. 1. Age- and sex-specific prevalence of IFG and type 2 DM among adults aged ≥25 years old in Jordan.

Table 3
The change in the prevalence of type 2 DM in Jordan between 1994 and 2004

	1994		2004	
	N	n (%)	N	n (%)
Age group (years)				
25–29	113	1 (0.9)	108	2 (1.9)
30–39	161	5 (3.1)	286	9 (3.1)
40–49	155	23 (14.8)	310	53 (17.1)
50–59	138	32 (23.2)	200	59 (29.5)
≥60	131	29 (22.1)	217	72 (33.2)
Gender				
Male	226	32 (14.2)	394	73 (18.3)
Female	472	58 (12.3)	727	123 (16.9)
Overall crude prevalence, OR (95% CI)	12.9 (10.5, 15.6)		17.4 (15.2, 19.7)	
Age-adjusted prevalence, OR (95% CI)	13.0 (10.6, 15.4)		17.1 (15.0, 19.1)	

standardized prevalence of diabetes increased from 13.0% to 17.1%. The increase in the prevalence of diabetes between the two cohorts was statistically significant [standardized prevalence ratio=1.32 (1.11, 1.64)]. The rate of increase was greatest for those who are 60 years or older.

3.4. Awareness of diabetes and glycemic control

Of the 195 diabetic subjects, 146 (74.9%) had been previously diagnosed and 49 (25.1%) were detected by the study. The proportions of previously known and newly diagnosed cases of diabetes by age group and sex are presented in Fig. 2. Except for the 40- to 49-year age group, women were more likely to be previously diagnosed with diabetes than men. The majority of diabetic men younger than 50 years were previously diagnosed.

Of the 146 previously diagnosed patients, 22 (15.1%) owned a glucometer and 27 (18.5%) owned a sphygmomanometer. The median frequency of testing glucose level using glucometer was 3 per month. About two thirds of diabetics visited the internist in the last month for follow-up.

A total of 79 (54%) previously diagnosed patients were found to be under unsatisfactory glycemic control (HbA_{1c} >7.5%). A large percentage of those previously diagnosed had received treatment (88.3%), of whom 58.9% were under unsatisfactory glycemic control. Fig. 3 shows the glycemic control among patients with diagnosed type 2 diabetes mellitus according to age and gender.

3.5. Factors associated with IFG and DM

Table 4 shows multivariate analysis of factors associated with IFG and DM. Increase in age and BMI and having a family history of diabetes were significantly associated with increased odds of diabetes and IFG. The level of education had no effect on IFG. However, a higher level of education was associated with a decrease in the odds of having diabetes. Compared to those who completed ≥12 years of education, those that fall in the illiterate category and those with 1–11 years of education were 3.03 and 2.56 times more likely to have diabetes, respectively. Differences in the odds of DM between women and men were not statistically significant [OR=1.53 (95% CI: 0.97, 2.41); P=.065]. On the contrary, men were 1.84 times (95% CI: 1.04, 3.27; P=.036) more likely to have IFG compared to women after adjusting for other important variables.

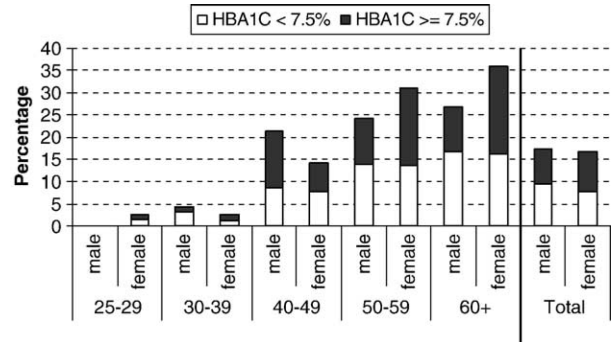

Fig. 3. Glycemic control among patients with type 2 DM in Jordan.

3.6. IFG, DM, and other components of metabolic syndrome

Abdominal obesity, hypertriglyceridemia, low HDL cholesterol, and high blood pressure were significantly and markedly more prevalent among patients with diabetes and patients with IFG compared to those with a normal glucose level (Table 5). Only hypertriglyceridemia was significantly higher among patients with diabetes compared to patients with IFG. Low HDL cholesterol was the most common abnormality in the study population (59.9% in subjects with a normal glucose level, 72.5% in patients with diabetes, and 71.3% in patients with IFG). Among those with diabetes, 13.8% had one additional component of metabolic syndrome, 21.0% had two additional components, 29.7% had three additional components, and 32.8% had four additional components. The

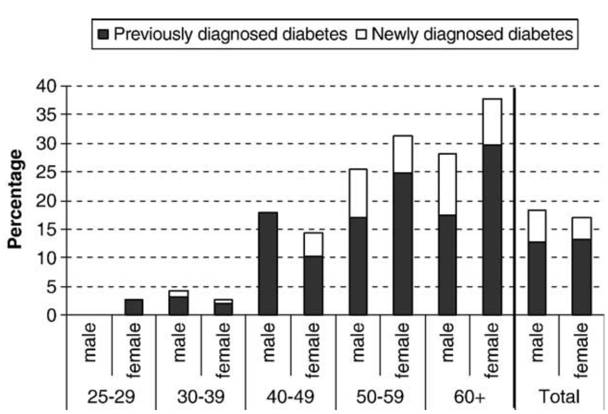

Fig. 2. Age- and sex-specific proportions of previously and newly diagnosed type 2 diabetes among adults aged ≥25 years old in Jordan.

Table 4
Multivariate analysis of factors associated with IFG and DM among adults aged ≥25 years old in Jordan

	IFG vs. no diabetes		DM vs. no diabetes	
Variable	OR (95% CI)	P value	OR (95% CI)	P value
Age	1.04 (1.02, 1.07)	<.0001	1.06 (1.05, 1.08)	<.0001
BMI	1.09 (1.05, 1.14)	<.0001	1.06 (1.02, 1.09)	.002
Family history of diabetes (yes vs. no)	3.86 (2.38, 3.86)	<.0001	3.09 (2.69, 5.68)	<.0001
Years of education (vs. ≥12 years)				
Illiterate	1.82 (0.81, 4.08)	.144	3.03 (1.60, 5.74)	.001
1–11	1.13 (0.64, 1.98)	.680	2.56 (1.63, 4.01)	<.0001
Gender (male vs. female)	1.84 (1.04, 3.27)	.036	1.53 (0.97, 2.41)	.065

Table 5
The relative frequencies of individual components of metabolic syndrome among adults aged ≥25 years old in Jordan categorized by their plasma glucose level

	NG (n=835)	IFG (n=91)	DM (n=195)
Abdominal obesity	373 (44.7)	63 (69.2)	131 (67.2)
High blood pressure	254 (30.4)	57 (62.6)	117 (60.0)
Hypertriglyceridemia	314 (37.6)	46 (50.5)	129 (66.2)
Low HDL cholesterol	500 (59.9)	66 (72.5)	139 (71.3)
Number of additional metabolic abnormalities			
0	119 (14.3)	4 (4.4)	5 (2.6)
1	215 (25.7)	9 (9.9)	27 (13.8)
2	247 (29.6)	25 (27.5)	41 (21.0)
3	173 (20.7)	28 (30.8)	58 (29.7)
4	81 (9.7)	25 (27.5)	64 (32.8)

Abdominal obesity: waist circumference >102 cm (40 in.) in men and >88 cm (35 in.) in women. Hypertriglyceridemia: serum TG level ≥150 mg/dl (1.69 mmol/l). Low HDL cholesterol: serum HDL cholesterol <40 mg/dl (1.04 mmol/l) in men and <50 mg/dl (1.29 mmol/l) in women. High blood pressure: SBP ≥130 mmHg and/or DBP ≥85 mmHg.

corresponding figures for those with IFG were 9.9%, 27.5%, 30.8%, and 27.5%, respectively.

4. Discussion

The total number of respondents included in this study was 1121, and the response rate was 94.0%. Work outside the town was the main reason for nonparticipation.

Epidemiological studies in different populations around the world have demonstrated a marked variation in the prevalence of DM, IFG, and rate of awareness and control of diabetes among different countries and among ethnic groups in one country (King & Rewers, 1993). This variation may be partly due to the use of different criteria for diagnosis, different age groups studied, and different cutoff points used.

Epidemiological studies that reported standardized rates are rare. Therefore, comparison of our data with previous reports is troublesome. Highest prevalence (35%) has been found in Pima Indians in Arizona, USA (Olefsky & Kruszynska, 2001). High rates were also reported among people of developing countries and in lower socioeconomic groups of more developed countries. The WHO and ADA have recently revised the criteria for diagnosing diabetes (Report of the Expert Committee, 1997; WHO, 1999). Age- and sex-specific prevalence of diabetes, according to the current WHO and ADA criteria, are not widely available. The age-standardized prevalence of diabetes according to ADA criteria in the current study was 17.1% and the age-standardized prevalence of IFG was 7.8%. Compared to age-standardized rates of diabetes, defined by the current ADA criteria, that were reported in some recent studies, the rate in Jordan was higher than that reported in India (Sadikot et al., 1997), Spain (Masia et al., 2004), the adult population of China (Gu et al., 2003), and the rural population of Bangladesh (Sayeed et al., 2003). The age-standardized prevalence of IFG was also higher than that reported in a number of studies (Gu et al., 2003; Masia et al., 2004; Sadikot et al., 1997) but lower than that reported among the rural population of Bangladesh (Sayeed et al., 2003). In agreement with studies that reported an increasing prevalence of type 2 diabetes in some Gulf countries including Saudi Arabia (Al-Nuaim, 1997), Bahrain (Musaiger, 1992), United Arab Emirates (El Mugamer et al., 1995), and Oman (Al-Lawati et al., 2002), the age-standardized prevalence of diabetes in Jordan increased from 13.0% to 17.1% over a period of 10 years.

The variation of prevalence between areas can be understood as reflective of the demographic and genetic variations in the population (Berger, Stenstrom, & Sundkvist, 1999), as well as differences in resource allocation and priorities concerning screening for diabetes. A higher prevalence can also reflect other factors such as adoption of a sedentary lifestyle, characterized by changes in dietary habits, reduction in physical activity, and the resulting obesity. However, high prevalence of diabetes does not necessarily indicate high incidence because high prevalence may reflect better case ascertainment and prolonged survival of diabetic patients as suggested by the findings of others (Berger et al., 1999; Stovring, Andersen, Beck-Nielsen, Green, & Vach, 2003).

About 75% of diabetics had been previously diagnosed, reflecting a high level of awareness of the disease in our population. This rate is higher than that reported from many developing countries (Abdelgadir, Elbagir, Eltom, & Berne, 2006; Andersson, Lundblad, & Svardsudd, 1993; McLarty et al., 1989) and some developed countries (Andersson, Svardsudd, & Tibblin, 1972; Wandell, Brorsson, & Aberg, 1998). A number of studies have reported that patients with undiagnosed diabetes represent 25% to 66% of the overall diabetic population (Glumer et al., 2003; Wilks et al., 1999). However, much lower figures of undiagnosed diabetes were reported from countries such as Sweden (1%; Abdelgadir et al., 2006) and the United States (4.3% and 6.3%; Harris et al., 1988).

The high rate of awareness in this town is understandable in light of the fact that the people in this town have good access to health care and, therefore, greater chances of being diagnosed. Also, the town is near Jordan University of Science and Technology where the students practice their community-based training and conduct their research.

Despite the high awareness of diabetes and like other studies (Andersson et al., 1972; Lundman & Engstrom, 1998), a high proportion of patients with previously diagnosed diabetes still has unsatisfactory metabolic control. In the present study, 54% of previously diagnosed patients were not satisfactorily controlled. Of the patients who received treatment, 58.9% were not controlled. This indicates that treatment was not effective or there is a lack of compliance with the treatment protocol. It is possible that patients rely much on medications and ignore the need to modify their eating habits and increase their physical activity. Another possibility lies in the conservative attitude of attending physicians who attempt to keep glycemic levels above that recommended for fear of hypoglycemia. Proper control of diabetes, however, may represent a high priority given that early recognition and control were shown to have a potential benefit in reducing the incidence and slowing down the progression of micro- and macrovascular complications. Therefore, a new strategy to improve the status of control of diabetes is needed.

Diabetes was significantly related to age, BMI, and family history of diabetes and was high among those with the least education. Diabetes in this population, therefore, is related to factors typically associated with the disease in the United States (Harris, 1991). Our study shows a clear relationship between age and diabetes. The prevalence is increased considerably in both sexes after the age of 40 years. Previous reports showed that prevalence of diabetes was inversely related to socioeconomic status (Choi & Shi, 2001; Connolly, Unwin, Sherriff, Bilous, & Kelly, 2000; Robbins, Vaccarino, Zhang, & Kasl, 2000). In our study, the odds of having diabetes decreased as education increased. This may be due to the fact that less educated people have a greater exposure to environmental risks such as poor diet, lack of exercise, and the resulting obesity.

Several prospective studies, mostly performed in elderly men or in populations with a high incidence of DM, have also observed that elevated blood pressure, elevated serum concentrations of total and LDL cholesterol and TG, as well as low HDL cholesterol levels predict the future occurrence of type 2 DM. However, because of the important role of insulin resistance in the pathogenesis of both DM and these cardiovascular risk factors, these components of the metabolic syndrome are strongly confounded with overweight and glucose intolerance. It is therefore not clear whether they are independent risk factors.

One limitation of this study is that several well-known factors that can affect diabetes, such as diet and physical activity, were not examined. Previous studies, which compared the WHO and ADA criteria, showed various degrees of concordance with respect to diagnosis of manifest DM and great discordance with respect to diagnosis of the prediabetic state (Harris, Eastman, Cowie, Flegal, & Eberhardt, 1997). Moreover, compared to impaired glucose tolerance (WHO), IFG (ADA) had a weaker association with cardiovascular morbidity and all-cause mortality (Barzilay et al., 1999). This suggests that the ADA criteria may underestimate the burden of glucose disorders (Davies, 1999). The considerably low sensitivity of IFG limits its use as a single test for identification of people at high risk of developing diabetes to whom preventive measures are indicated.

The present survey was conducted in a relatively well defined, stable, and accessible population. These characteristics facilitate future follow-up studies using the same sample. Such studies may provide useful information on the incidence of diabetes, the rate of progress from prediabetic to diabetic state, changes in diabetes control, and the prognosis of diabetic patients.

In conclusion, the prevalence of type 2 diabetes and IFG is high in Jordan. More than half of the patients with diabetes have unsatisfactory control. Therefore, they are likely to benefit from programs aimed at encouraging behaviors toward achieving optimum weight as well as physical activity behaviors. In addition, an integrated approach is needed for the prevention and treatment of DM.

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