Prevalence of type 2 diabetes mellitus in Iran and its relationship with gender, urbanisation, education, marital status and occupation

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ABSTRACT

Introduction: We investigated the prevalence of type 2 diabetes mellitus and its relationship between gender, urbanisation, education, marital status and occupation in the Iranian population.

Methods: A total of 3,778 men and women aged between 15 and 64 years were recruited by using a cluster-stratified sampling method from Khorasan province, northeast Iran. Using an interviewer-administrated questionnaire, demographical data including gender, urbanisation, education, marital status and occupation data was collected. Anthropometrical and biochemical measurements were taken for each subject. Associations of type 2 diabetes mellitus and other variables were tested for significance.

Results: The prevalence of diabetes mellitus (defined as fasting blood sugar equal to or more than 126 mg/dL) was 5.5 percent, and the prevalence in men and women was 5.1 percent and 5.8 percent, respectively, with a significantly higher prevalence among urban dwellers (seven percent) compared to that of the rural subgroup (three percent, p-value is less than 0.001). Diabetes mellitus was found to be most prevalent among the older age group (age more than 60 years, 10.9 percent), those who were retired (14.4 percent), and illiterate (6.1 percent, p-value is less than 0.001). Marital status was not significantly related to diabetes mellitus (p-value equals 0.09).

Conclusion: The prevalence of diabetes mellitus is related to some sociodemographical factors within the Iranian population. Thus the preventive strategies should be based on the affective factors. The urbanisation of the population with the migration of people from rural to urban areas may account in part for the increasing prevalence of type 2 diabetes mellitus in Iran.

Keywords: diabetes mellitus, sociodeomographics, type 2 diabetes mellitus, urbanisation

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INTRODUCTION

Type 2 diabetes mellitus (DM), is a disease with a rising prevalence worldwide.(1-3) It is currently estimated that 190 million people around the world suffer from DM, with over 330 million predicted to have the condition by 2025, and 366 million by the year 2030. It is predicted that the developing countries will contribute 77.6% of the total number of diabetic patients in the world by the year 2030.(4,5) This metabolic disease is one of the most common endocrine disorders affecting almost 6% of the world's population.(6) The prevalence of type 2 DM ranges from 1.2% to 14.6% in Asia, 4.6% to 40% in the Middle East, and 1.3% to 14.5 % in Iran.(4,7)

This rapidly-growing prevalence among developing countries is attributed to the effects of urbanisation.(8,9) A marked difference in the risk profile of DM was associated with years of education and occupation of the people. Also, there is an association between occupation status and DM.(10-12) Meanwhile, there is a relationship between the prevalence of DM and the single/married people in some societies.(10) Although the prevalence of cardiovascular risk factors, such as obesity and DM, are higher in men compared to women in developed countries, an inverse association between gender and prevalence of DM has been predicted in developing societies.(13-16) Evidence on risk factors for DM among the Iranian population is limited at present.(4,7) This cross-sectional study was carried out to assess the prevalence of DM and to investigate its association with gender, urbanisation, education, marital status and occupation in a large group of the Iranian population.

METHODS

As a part of a national survey of non-communicable diseases, using a multistage sampling method, 3,778 subjects (1,923 women and 1,855 men, aged 15–64 years) were recruited from greater Khorasan province, northeast Iran, with a population of around 6.2 million (about 10% of the Iranian total population).(17) Greater Khorasan province includes three political and geographical regions: Northern, Razavi and Southern Khorasan. Each region as a strata of study sample has

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Table I. Anthropometrical, biochemical and blood pressure measurements in the Iranian adult population.

Values	Normal	IFG	DM
No. subjects	3,478	94	206
Age (years)	43.29 ± 11.93	50.41 ± 10.60	50.78 ± 10.63
Height (cm)	161.61 ± 9.71	161.80 ± 9.73	161.06 ± 9.72
Weight (kg)	65.91 ± 13.60	70.65 ± 14.69[3]	72.18 ± 14.51[a3]
Waist (cm)	88.74 ± 14.33	95.30 ± 14.45[3]	98.55 ± 13.82[b3]
BMI (kg/m^2)	25.24 ± 4.84	27.01 ± 5.35[3]	27.88 ± 5.34[3]
SBP (mmHg)	125.05 ± 19.99	135.14 ± 25.55[3]	135.53 ± 21.64[3]
DBP (mmHg)	79.15 ± 13.42	82.99 ± 12.60[3]	87.08 ± 15.36[b3]
FBS (mg/dL)	83.07 ± 8.90	117.11 ± 4.5[3]	189.80 ± 53.95[c3]
TC (mg/dL)	188.01 ± 38.55	209.34 ± 47.86[3]	211.76 ± 44.65[a3]
TG (mg/dL)	131 (89–198)	199 (104–299)[3]	197 (136–302)[3]
HDL (mg/dL)	33.33 ± 13.83	30.02 ± 10.78[2]	28.22 ± 10.74[a3]
LDL (mg/dL)	125.80 ± 41.78	134.70 ± 46.80[3]	138.00 ± 41.88[b3]

Values are expressed as mean and standard deviation for normally distributed data, and median (interquartile range) for non-normally distributed data.
IFG: impaired fasting glucose; DM: diabetes mellitus; FBS: fasting blood sugar; TC: total cholesterol; TG: triglyceride; HDL: high density lipoprotein; LDL: low density lipoprotein; BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure.
One-way ANOVA and chi-square tests with Post hock (Tukey HSD) method used.
[1] $p < 0.05$; [2] $p < 0.01$; [3] $p < 0.001$ (between normal and other groups); [a] $p < 0.05$; [b] $p < 0.01$; [c] $p < 0.001$ (between IFG and DM)

three clusters for every urban and rural districts, which were selected randomly. Subjects were selected using the probabilities proportional to their district population, to produce the target sample size, with only one person being selected per household. Data on demographical and biochemical measures were completed for 3,778 persons and used for the analyses presented in this paper.

The research team included a physician, a nurse and a healthcare officer, who measured the subject's height, weight, waist and hip circumference and blood pressure, while asking them to answer questions listed in the questionnaire, to obtain the demographical data. Self-reported data on the educational level, occupation, marital status and age were collected using an interweaver-administered questionnaire. Subjects were classified into subgroups according to the years of formal education received; viz: illiterates (0 years), < 12 years, 12 years, and > 12 years.

Subjects were asked about their occupation, and were accordingly classified into the following categories: office or adminstrative worker, manual worker, housewife, student, unemployed and retired. All retirees previously held administrative or governmental jobs. Marital status was classified into married (in Iran, the only way for couples to live together is by marriage), single (those who had never been married), and others (divorced, widowed). Urban and rural areas were defined according to official government definitions.

Body weight was measured to the nearest 100 g by trained nurses using a calibrated counter-weight balance (Seca, Japan), placed on a hard, level surface; subjects wore light clothing and were asked to remove shoes, heavy outer garments, heavy jewellery, keys and loose change. Height to the nearest mm was also measured at the same time with a portable, telescopic stadiometer, while the participant's head was measured in the Frankfort plane. Body mass index (BMI) was calculated as kg/m^2. Blood pressure was measured twice at an interval of 15 minutes, using a mercury sphygmomanometer with a suitable cuff size for each subject, with subjects in a sitting position. The average of the two measurements of Korotkoff phase I was considered as systolic blood pressure (SBP), and the average of two values of phase IV was recorded for diastolic blood pressure (DBP). Hypertension in this study was defined as SBP ≥ 140 mmHg, and/or DBP ≥ 90 mmHg.

Blood samples were obtained in the early morning after an overnight fast at the subject's home, using heparinised tubes and assayed for serum glucose, total cholesterol, low density lipoprotein cholesterol and high density lipoprotein cholesterol using standard techniques with Cobas auto-analyser system (ABX Diagnostics, Montpellier, France). According to the American Diabetic Association criteria, a fasting blood sugar (FBS) < 110 mg/dL was considered as normal, values between 110 and 126 mg/dL, and those > 126 mg/dL were considered as impaired fasting glucose (IFG) and DM, respectively.[18]

Statistical analysis was done using the Statistical Package for Social Sciences version 11.5 (SPSS Inc, Chicago, IL, USA), with descriptive statistics (mean ± standard deviation, median, and interquartile range) being determined for all variables. *t*-test and chi-square test were used to compare groups. The chi-square test was used for statistical analysis of qualitative data, such

Table II. Distribution of diabetes mellitus prevalence in different gender and age groups.

Age groups (years)	No. normal (%)	No. IFG (%)	No. DM (%)
< 20			
Male	19 (90.5)	0 (0)	2 (9.5)[3]
Female	20 (95.2)	0 (0)	1 (4.8)
Total	39 (92.9)	0 (0)	3 (7.1)
20–29			
Male	243 (98.00)	3 (1.2)	2 (0.8)[2]
Female	254 (98.4)	1 (0.4)	3 (1.2)
Total	497 (98.2)	4 (0.8)	5 (1)
30–39			
Male	418 (95.4)	9 (2.1)	11 (2.5)[3]
Female	444 (97.8)	4 (0.9)	6 (1.3)
Total	868 (96.6)	13 (1.5)	17 (1.9)
40–49			
Male	460 (93.1)	9 (1.8)	25 (5.1)[1]
Female	459 (92)	10 (2)	30 (6)
Total	919 (92.55)	19 (1.9)	55 (5.55)
50–59			
Male	342 (89.1)	16 (4.2)	26 (6.8)[3]
Female	382 (86.2)	17 (3.8)	44 (9.9)
Total	724 (87.65)	33 (4)	70 (8.35)
≥ 60			
Male	223 (84.2)	14 (5.2)	28 (10.6)
Female	201 (84.1)	11 (4.6)	27 (11.3)
Total	424 (84.05)	25 (4.95)	55 (10.9)
Total			
Male	1,710 (92.2)	51 (2.7)	94 (5.1)
Female	1,767 (91.9)	43 (2.2)	112 (5.8)
Total	3,477 (92.1)	94 (2.5)	206 (5.5)

IFG: impaired fasting glucose; DM: diabetes mellitus
Chi-square test was used to compare, [1] $p < 0.05$; [2] $p < 0.01$; [3] $p < 0.001$, between genders in diabetics.

as distribution of DM by age groups, urban or rural area, occupation, education and marital status. Logistic and binary regression analysis were separately used to examine the associations between DM and biochemical/anthropometrical measurements, gender, urbanisation, education, marital status and occupation. Odds-ratios (OR) for the prevalence of DM were calculated as the antilogarithm of the logistic regression coefficient for each of the categories. All ORs were adjusted for confounding factors, including age and gender.

RESULTS

The sample consisted of a total of 3,778 subjects (1,923 women and 1,855 men) with a mean age of 39.34 ± 14.45 years. Basic characteristics of subjects are presented in Table I. In general, the prevalence of DM was 5.5% (Table I). Although it was slightly more prevalent in females than in males (5.8% vs. 5.1%), the difference did not reach significance ($p = 0.36$, Table II). The prevalence of IFG (defined as FBS between 110 and 126 mg/dL) was 2.5% (Table I). DM was the most prevalent in older age groups (the seventh decade of life), in both in men (10.6%) and women (11.3%) (Table II). There was also a significant difference between males and females in the younger groups of the population (Table II). DM was also more prevalent in urban than in rural areas (7% vs. 3%).

There was no association between education and DM, as the prevalence of DM was not significantly different among subjects with various education levels ($p = 0.09$). Significant differences were observed in people with different occupations ($p < 0.001$). Our results also indicated that the prevalence of DM is highest in retirees at 14.4% ($p < 0.001$), followed by the unemployed and housewives, with prevalences of 10.3% and 5.9%, respectively ($p < 0.001$) (Table III). Although there are no significant differences in the prevalence of DM among married, single, widowed or divorced subjects, the differences are slightly more noticeable in widowed or divorced subjects ($p = 0.069$).

For the investigation of the most effective factor on DM, factors such as age, gender, region, marital status, educational level and occupation, blood pressure, anthropometrical and biochemical (except FBS) measurements, were considered for multivariate analysis by binary and forward logistic regression. Urbanisation had the highest odds-ratio (OR) (2.73), ($p < 0.001$, 95% confidence interval [CI] 1.89–3.92). Moreover, ageing had a considerable association with DM, with OR of 1.052 ($p < 0.001$, 95% CI 1.029–1.074). With respect to anthropometrical and biochemical measurements, two factors, waist circumference and triglyceride, have significant influence on DM, with respective ORs of 1.031 (95% CI 1.012–1.052) and 1.002 (95% CI 1.000–1.004) ($p < 0.001$). There was no significant association between DM and gender, marital status, education level, occupation and other biochemical and anthropometrical variables.

DISCUSSION

The present population-based study examined the associations between gender, urbanisation, education, marital status, occupation, and the prevalence of DM in the greater Khorasan province of northeast Iran, which is a representative sample for whole population of this country, for the first time.[17] According to the present study, although the prevalence of DM is higher in females than males, there is no significant difference. It may be because women in Iran generally spend most of their time at home and engage in less physical activities. In some studies conducted in developed countries, there is an inverse relationship between prevalence of DM and gender.[19] However, data from other studies in the Middle East and developing societies agree with our data.[20,21] Illiteracy has an association with DM in this study, which is consistent with other studies.[8,22,23] Also, limited literacy is associated with a decreased knowledge of one's medical condition.[24,25] These individuals have no access

Table III. Socioeconomic factors among normal, impaired fasting glucose and diabetic adults aged between 15 and 64 years in the Iranian population.

	No. normal (%)	No. IFG (%)	No. DM (%)
Gender			
Male	1,710 (92.2)	51 (2.7)	94 (5.1)
Female	1,767 (91.9)	43 (2.2)	112 (5.8)
Region			
Urban	2,092 (90)	69 (3)	163 (7)*
Rural	1,386 (95.3)	25 (1.7)	43 (3)
Marital status			
Married	3,073 (92.1)	83 (2.5)	180 (5.4)
Single	255 (94.4)	3 (1.1)	12 (4.4)
Widowed/ divorced	150 (87.2)	8 (4.7)	14 (8.1)*
Educational level (years)			
Illiterate (0)	969 (90.4)	38 (3.5)	65 (6.1)
< 12	1,809 (92.6)	36 (1.8)	108 (5.6)
12	423 (93.2)	12 (2.6)	19 (4.2)
> 12	277 (92.6)	8 (2.7)	14 (4.7)
Occupation			
Administrative officer	291 (93.6)	10 (3.2)	10 (3.2)
Manual worker	1,385 (93.6)	33 (2.2)	61 (4.1)
Housewife	1,511 (91.6)	41 (2.5)	98 (5.9)
Student	38 (97.4)	1 (2.6)	0 (0)
Retired	137 (82)	6 (3.6)	24 (14.4)*
Unemployed or others	110 (87.3)	94 (2.4)	13 (10.3)

Chi-square test was used. * p < 0.001 between the marked group and other diabetic-related subgroups
IFG: impaired fasting glucose; DM: diabetes mellitus

to knowledge for self care for the prevention or treatment of DM and other diseases, nor can they afford the medical treatment.[26,27]

In this study, there is also a significant difference in the prevalence of DM between widows/divorcees and the other marital status subgroups. Some findings suggest that single, divorced and widowed statuses constitute potentially adverse health effects.[28,29] Marriage may buffer against stress and thereby reduce the activation of the neuroendocrine system, which may lead to a reduction in the progression of atherosclerosis and other pathological processes.[28] There is no data on the marriage pathophysiology and reduction of cardiovascular diseases rates in Iran. With regard to occupation, there is a significant difference in the prevalence of DM between retirees and other related categories. The retirees are in the last decades of life, and ageing has a significant role in increasing cardiovascular risk factors. On the other hand, some studies indicate that the prevalence of cardiovascular risk factors, including DM, are higher in people with low income.[30] As the pension for retirees is low in Iran,[17] this may account for the higher risk of DM and cardiovascular diseases in this subgroup of the Iranian population.

The multivariate analysis in the present study indicates that the prevalence of DM may also be related to urbanisation in Iran. These findings are consistent with previous studies in neighbouring countries.[8,31] Moreover, some studies have shown a higher prevalence of DM in urban areas, compared to rural parts in other developing societies.[22,32] A possible explanation for the higher prevalence of DM in Iran could be due to the increasing cardiovascular risk factors in the urban area, due to the changes caused by the third epidemiological transition, including increased fat and caloric intake and decreased activity, for Middle Eastern countries.[33]

In the past 25 years, Iran experienced rapid socioeconomic developments that were associated with a sharp rise in a sedentary lifestyle, such as increased usage of televisions and computers, car ownership, an increase in the consumption of a high fat caloric-dense food and refined sugar. Furthermore, the increase in the population growth rates of up to 3.8% between 1975 and 1985 caused some social difficulties, such as unemployment, that resulted in a migration from rural to municipal regions.[17] In addition, some periodic droughts in these areas during this time adversely affected the agricultural industry, thus causing a exodus of the rural population to the towns and cities.

Because of the lack of available information on the economic conditions such as household income, lifestyle factors such as diet and physical activity, household expenditure, and other socioeconomic factors, it was not possible to examine whether these variables contribute to the relationship between urbanisation and DM. The results also showed that increasing of waist circumference has a significant association with DM. These findings are consistent with previous studies.[34-37] Approximately more than 30% of the adult Iranian population are overweight and 20% of them are obese.[35] Central adiposity has been associated with elevated glycosylated haemoglobin levels, glucose intolerance and DM.[38] Abdominal fat distribution is also associated with DM, independent of overall adiposity.[39,40] Moreover, there is a significant association between excessive triglycerides and DM. This finding is more prevalent in urban dwellers.[40,41] In DM with hyperinsulinism, very low density lipoproteins and triglycerides are elevated because of insulin stimulation of triglyceride hepatic production.[42,43] The prevalence of DM also increases with age, as seen in the present study, which is consistent with other results.[44,45]

This study is limited by the cross-sectional nature of the data, which does not provide any indication of the direction of effect or causality. This limitation also prevents any measure of temporal changes in prevalence of DM and factors associated with DM. Longitudinal studies would complement the present study to determine causality and directional effect of the factors. In addition, we have no history of the diagnosed diabetic patients and only the blood test was used to diagnose DM, and this did not differentiate between type 1 and type 2 DM. As the proportion of individuals (7.1%) with DM in the lowest age group is likely to be suffering from type 1 DM, and as the risk factors associated with the two types of DM are different, the significance of the other factors in the model may therefore be underestimated.

This study highlights the increasing prevalence of DM in the urbanised areas of Iran. Public health policies should be directed towards this area with a focus on primary prevention by lifestyle interventions. As the relatively young Iranian population ages in the future, there will likely be an escalation in the prevalence of DM and other chronic diseases. Therefore, it is important to continually monitor the coronary risk factors in Iran, as well as to direct effective public health interventions towards the high risk groups, such as housewives and young girls that will be housewives in the future. Although in this study, there is no information regarding migration, other collected data has shown that in the three last decades, the trend of migration from rural to urban areas is sharply rising. The Iranian government should concentrate particularly on this issue, by capitalising and creating more adaptable and accessible jobs, and by somehow improving the standard of living in the rural areas, which in the long term will help reverse the trend of migration.

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