Epidemiological Study of Diabetes and its Risk Factors in East Azerbaijan, Iran

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ABSTRACT

BACKGROUND: Prevalence of diabetes is increasing in Iran. While national statistics are available for diabetes in Iran, regional statistics are lacking. Therefore, we assessed the prevalence of diabetes and evaluated the relationship of diabetes with its risk factors in East Azerbaijan, Iran.

METHODS: A total of 990 men and women aged between 15 and 64 years were enrolled in the study using a cluster-stratified sampling method from East Azerbaijan province, northwest of Iran. Data were collected on demographic, nutritional, risk factors of diabetes and patients' physical characteristics using a structured questionnaire based on the stepwise guidelines of the World Health Organization in 2007. We calculated the age and gender specific prevalence of diabetes. A hierarchical logistic regression analysis was applied in two steps using the enter method to examine the associations between different risk factors and diabetes.

RESULTS: We estimated the crude prevalence of diabetes to be 10.6% (95% CI: 8.7-12.7). The peak prevalence of diabetes was reported among participants between 55 and 64 years. Residence in urban areas (OR: 2.2, 95% CI: 1.4-3.4), family history of diabetes mellitus (OR: 2.6, 95% CI: 1.63-4.66) and past history of hypertension (OR: 1.6, 95% CI: 1.2-3.1) were most strongly associated with diabetes mellitus ($p < 0.001$).

CONCLUSION: We found high prevalence of diabetes and impaired fasting glucose in the surveyed population. Residence in urban areas, family history of diabetes mellitus, hypertension and age were significantly associated with diabetes mellitus.

Keywords: Prevalence, Diabetes; Risk Factors

INTRODUCTION

Diabetes mellitus is one of the most common chronic diseases today in both developing and developed world. It is characterized by high levels of glucose in the blood as a result of too little insulin, resistance to insulin, or both [1]. Complications of diabetes affect the quality of life in the diabetic population. The number of people with diabetes in the world is expected to double between the years 2000 and 2030. The Middle East is expected to have the greatest increase in non-communicable diseases and their risk factors in the near future [2]. Diabetes is prevalent in elderly people in various parts of Iran [3]. According to the burden of disease in Iran (2003), 58% of disability-adjusted-life years (DALYs) were related to non-communicable diseases [4]. Based on the third Iranian national surveillance (SuRFNCD-2007), the prevalence of diabetes in Iran was 8.7% [2]. For effective prevention and management strategies, regional density of the disease needs to be taken into account. Currently, there are no regional statistics in Iran to inform the prevalence and risk factors of diabetes. Therefore, we aimed to assess the prevalence of diabetes and examine the associations between different risk factors and diabetes in East Azerbaijan, Iran.

METHODS AND MATERIALS

The target population included all residents, 15-64 years old living in rural and urban areas of East Azerbaijan. Ethical approval was obtained from the Center for Disease Control (CDC) of

Iran. All participants gave verbal informed consent, after being explained the study objectives and procedures. The participants were included in clusters of 10 males and 10 females living in neighboring households. Each cluster had 20 subjects. Every subject in each cluster was selected randomly based on the postal addresses and sampling was done based on a predetermined schedule [2].

Subjects were visited at home by interviewers from health center staff of East Azerbaijan. We used a structured questionnaire that inquired on demographic and ecological characteristics of participants, nutritional situation, risk factors of diabetes such as high blood pressure and diabetes history, and patient physical characteristics based on the guidelines of the WHO in 2007 [5].

First, data on all socio-demographic, lifestyle, and health were collected [2, 5]. This was followed by anthropometric measurements taken by trained healthcare staff of Tabriz University of Medical Science. Height and weight was measured using portable electronic weighing scale and portable measuring inflexible bars. Waist circumference (WC) was measured at the midpoint between the lower part of the lowest rib and the highest point of the hip on the midaxillary line and measured blood pressure with a calibrated sphygmomanometer. The average of three measurements, with intervals of 5 minutes, was considered for analysis [2, 5]. Finally, blood samples were collected for biochemical data. For every participant, 10ml of blood was drawn by a medical staff in sitting position, collected in 4 tubes, and centrifuged immediately for fasting plasma glucose (FPG), total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), and triglycerides (TG). Cold chain was maintained effectively while transferring these samples to the Central Reference Laboratory in our province.

Diabetes Mellitus (DM) was defined as either having a diagnosis of DM or receiving a prescription for anti-diabetic drugs. New diabetes was considered, if fasting plasma glucose (FPG) level was ≥ 126 mg/dl. Impaired fasting glucose (IFG) was defined by FPG levels ≥ 100 mg/dl (5.6 mmol/l) but <126 mg/dl (7.0 mmol/l). Federation (IDF) criteria define DM as WC ≥ 80 cm in females and ≥ 94 cm in males. Dyslipidemia was defined according to the criteria by the National Cholesterol Education Program-Third Adult Treatment Panel as total cholesterol levels ≥ 200 mg/dl, TG ≥150 mg/dl and high density lipoprotein (HDL) < 40mg/dl in males and HDL <50 mg/dl in females [6].

Statistical analysis: Data were analyzed using the Statistical Package for Social Science software (SPSS Version 16.0). Student's t test and non-parametric Mann-Whitney were used to ascertain the significance of differences of mean values between two continuous variables. At first we used univariate analysis for differences in proportions of categorical variables between two groups.

A hierarchical logistic regression analysis was applied in two steps using the Enter method. Variables found to be associated with diabetes in the univariate analysis were included in multiple logistic regression models [7]. The p-values for entry and removal variables in the stepwise logistic regression model were 0.05 and 0.1, respectively. For logistic regression analysis this study employed an odds ratio (OR) and 95% confidence intervals. A p-value of <0.05 was considered to be significant.

RESULTS

The total number of participants in the study was 990 of which 496 were women and 593 subjects were from urban areas. Finally, 683 subjects had FPG determined, of which 105 subjects had diabetes. Characteristics of the survey population in East Azerbaijan are shown in Table 1.

The mean weight in men was significantly different compared to women (mean difference: 6.48 ± 1.03), ($p \leq 0.009$). In contrast, women had statistically higher BMI than men (mean difference: 2.04 ± 1.18) ($p \leq 0.001$). Mean FPG in women was also greater than men (mean difference: 1 ± 5.62) ($p \leq 0.001$). According to study findings, there were not statistical differences in height, SBP, DBP, total cholesterol, HDL and smoking between women and men (Table 1).

We estimated crude prevalence of diabetes as 10.61% (95% CI: 8.72-12.79); in women 9.67% (95% CI: 7.22-12.72); and in men 11.54% (95% CI: 8.82-14.84) (Figure 1). Crude prevalence of diabetes was 12.65% (95% CI: 10.02- 15.76) in urban areas and 7.56% (95% CI: 5.19- 10.65) in rural areas. Unknown or newly discovered diabetes cases were found to have prevalence of 3.13% (95% CI: 2.16-4.39).

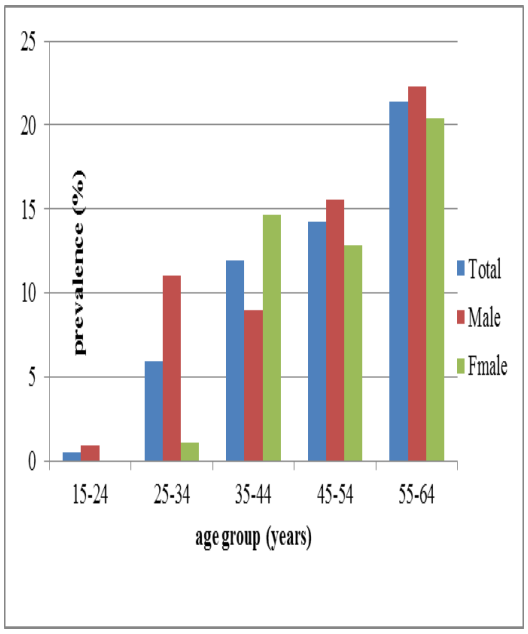
The overall prevalence of IFG was 16.16% (95% CI: 13-18); in women 16.73% (95% CI: 13-20) and in men 15.59% (95% CI: 12-19). Prevalence of IFG was 15.68% (95% CI: 12-19) in urban area and 16.88% (95% CI: 13- 21) in rural areas.

The results showed that the prevalence of impaired fasting glucose in overweight and obese

Table 1: General characteristics of survey in East Azerbaijan

Parameter	Sex		p-value
	Men	Women	
	means (SD)	means (SD)	
Age (year)	39.78 (±14.44)	39.38 (±13.81)	0.048
Height (cm)	171.48 (±7.43)	157.42 (±7.064)	0.107
Weight (kg)	74.65 (±13.52)	68.17 (±14.55)	0.009
BMI (kg/m^2)	25.47 (±4.36)	27.51 (±5.54)	0.001
Waist (cm)	89.12 (±13.30)	89.11 (±14.58)	0.001
SBP (mmHg)	127.32 (±16.5)	122.09 (±19.66)	0.227
DBP (mmHg)	79.49 (±11.12)	81.12 (±12.33)	0.482
FPG (mg/dl)	104 (±39.45)	105 (±45.07)	0.000
Total Cholesterol (mg/dl)	178(±46.686)	194 (±63.94)	0.013
HDL (mg/dl)	34 (±8.85)	38(±9.84)	0.703
TG (mg)	197(±115.53)	192 (±122.23)	0.033

Figure 1: Prevalence of diabetes specified by age-groups and sex



subjects were 17.27% (95% CI: 13-22), 24.89% (95% CI: 19-31), respectively. Prevalence of IFG in centrally obese men and women was 21.76% (95% CI: 15-29) and 27.78% (95% CI: 28.4-36.3), respectively. Univariate analysis indicated significant association between presence of diabetes and residence in urban area ($p \leq 0.001$), 35-44 year age group ($p < 0.001$), 45-54 year age group ($p \leq 0.011$), 55-64 year age group ($p \leq 0.056$), history of hypertension ($p \leq 0.006$) and family history of diabetes ($p < 0.000$). Central obesity had significant association in women with diabetes ($p \leq 0.011$) (Table 2).

In multiple logistic regression, age, residence in urban areas, family history of diabetes mellitus (adjusted odd ratio (AOR): 2.71, 95% CI: 1.64 - 4.48; $p \leq 0.001$), place of residence (AOR: 2.06, 95% CI: 1.27 - 3.34; $p = 0.003$) and current smoking (AOR: 2.10, 95% CI: 1.16 - 3.80; $p = 0.015$) had the high significant association and independently related with diabetes mellitus (Table 2).

DISCUSSION

Our study found high prevalence of DM and IFG in East Azerbaijan than other studies from the countryside. According to the present study, crude prevalence of diabetes in East Azerbaijan was estimated at 10.61% (95% CI: 8.72-12.79). In contrast, national survey of risk factors for non-communicable diseases of Iran in 2005 reported that the prevalence of diabetes was 7.7% (95% CI: 7.5–7.9) [8]. In another national survey done in 2007, the prevalence of DM in Iran was estimated at 8.7% (95% CI = 7.4–10.2). Older age groups, females, and urban dwellers had high prevalence of diabetes. The prevalence of IFG was 9.2% among non-diabetic subjects [2]. In greater Khorasan province, northeast Iran, the prevalence of diabetes mellitus (defined as fasting blood sugar ≥ 126 mg/dl) was 5.5%, 5.1% in men and 5.8% in women. Prevalence was significantly higher among urban dwellers (7%) compared to the rural subgroup (3%, $p < 0.001$). Diabetes mellitus was most prevalent among the older age group (age more than 60 years, 10.9 %), especially among those who were retired (14.4 %) [9]. This difference in prevalence rate of DM between our study findings and other studies result could be related to regional and ethnic differences such as diet and life style and other risk factors between East Azerbaijan and other regions.

We found that men had higher prevalence of DM than women, but women had higher prevalence of IFG than men which is in contrast to national survey. However, we found that the peak prevalence of diabetes was among participants aged 55-64 years which is consistent with the national survey in Iran (2007) [8].

In this study, we determined the influence of potential

Table 2: Multiple Logistic Regression Analysis for association between selected risk factors and having diabetes mellitus

Parameters	No	Diabetes yes (+)				
		No (%)	Un-adjusted		Adjusted	
			OR (95% CI)	p-value	OR (95% CI)	p-value
Gender						
Women	496	48 (9.67)	1	0.230		
Men	494	57 (11.54)	0.77(.51-1.18)			
Residence						
Urban	593	75 (12.65)	2.21(1.40-3.47)	0.001	2.06 (1.27 – 3.34)	0.003
Rural*	397	30 (7.56)	1			
Age						
<25*	207	1 (0.48)	1	0.001		
25-34	188	11 (5.85)	3.30 (0.41-26.65)	0.262	3.54 (0.39 - 31.73)	0.259
35 – 44	209	25 (11.96)	4.38(2.15-8.94)	<.0.001	1.88 (0.21 - 16.80)	0.571
45- 54	204	29 (14.22)	2.05 (1.17-3.58)	0.011	1.49 (0.17 - 13.22)	0.723
54-65	182	39 (21.43)	1.70 (0.92-2.91)	0.054	.71 (0.08 - 6.66)	0.767
SBP hypertension						
yes	21	3 (14.28)	1.104(.31-3.88)	0.878	0.95 (0.22 - 4.02)	0.943
No*	969	102 (10.53)	1			
DBP hypertension						
yes	66	8 (12.12)	0.95(0.44-2.84)	0.906	0.62 (0.26 - 1.51)	0.291
No*	924	97 (10.50)	1			
Raised Total Cholesterol						
>200 (mg/dl)						
yes	205	36 (17.56)	1.37 (.87-2.13)	0.169		
No*	476	64 (13.44)	1			
>250(mg/dl)						
Yes	67	9 (13.43)	1.12 (.53-2.33)	0.769		
no	614	91 (14.82)	1			
Obesity						
19<BMI<25*	414	22 (5.31)	1			
25<BMI<30	330	47 (14.24)	2.13(1.20-3.78)	0.001	1.81 (1.01 - 3.24)	0.048
BMI>30	233	35 (15.02)	0.99 (.61-1.60)	0.961	1.62 (0.85 - 3.10)	0.147
Family History of Diabetes mellitus						
Yes	160	34 (21.25)	2.666(1.67-4.26)	<.0.001	2.71 (1.64 - 4.48)	<.0.001
No*	830	71 (8.55)	1			
Past History of HTN						
Yes	150	30 (20.00)	1.935(1.20-3.11)	0.006	1.52 (0.88 - 2.65)	0.138
No*	840	75 (8.93)	1			
Past History of DM						
Yes	31	31 (100)	--			
No	775	57 (7.35)	--			
Current Smoker						
Yes	160	22 (13.75)	1.60(.95-2.72)	0.076	2.10 (1.16 - 3.80)	0.015
No*	830	83 (10.00)	1			

The Hosmerl –Lemeshow goodness-of-fit test: χ^2= 8.640, df = 8, sig = 0.374.

* Reference category

risk factors on diabetes. Logistic regression analysis showed that higher age, triglycerides, family history of diabetes, being current smoker, and residences in urban areas were associated with increased risk of diabetes.

In the region, similar survey in Turkey reported significant association between diabetes and age (1 year), waist hip ratio, familial diabetes, mild and severe hypertension in men and women [10]. According to Pakistan national survey, significant association between diabetes and family history of DM was present [11]. Study in Isfahan found that older age, higher WC, dyslipidemia and systolic BP significantly associated with diabetes. Age, WC and HDL significantly increased the risk of IFG [12].

Survey in Qatar found that central obesity, hypertension, triglyceride, HDL, metabolic syndrome and heart diseases were significantly higher in diabetic adult Qatari population, compared to non-diabetic subjects. Logistic regression analysis found that smoking habits and family history of DM had significant association with DM. In addition, age, physical activity, meals per day and BMI were associated with DM significantly [13].

Our study has several strengths and limitations. The strengths included broader age groups. Each participant was between 15 and 64 years and results may be applicable to general population of East Azerbaijan. The findings of our study illustrated for the first time, the prevalence of diabetes and IFG in this particular region of Iran. Our major limitation is relatively small sample size of our survey. Another limitation in our survey was that we did not carry out glucose tolerance test and our findings relied on one time fasting plasma glucose test.

CONCLUSION

Our finding that the prevalence of DM was higher in urban areas has important implications. Urbanization is on the rise in East Azerbaijan and thus the prevalence of DM may continue to increase in this population. Programs that target modifiable risk factors for the development of DM should be implemented.

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