Predictive model for diabetes mellitus occurrence in Iran's southeastern region: a study based on American diabetes association guidelines

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ABSTRACT

To control diabetes in a society, risk assessment tools are used to predict disease risk. We aimed to assess the value of different risk factors for diabetes mellitus in a remarkable community in the city of Kerman, one of the vast areas in the southeast of Iran, with the final goal of designing a predictive model for diabetes in this region. This study was a cross-sectional study with the aim of investigating the predictive value of risk factors indicating the presence of diabetes in the population of Kerman City based on the guidelines of the American Diabetes Association (ADA) risk assessment tool. The information of 4000 people participating in the comprehensive screening plan for cardiovascular risk factors in Kerman City was extracted by reviewing the relevant data registry. According to the ADA guideline, 32.5% of participants were at risk for diabetes mellitus. The hazard ratio of diabetes mellitus in the subgroup with the ADA final score ≥5 as compared to those with a lower final score was 1.9. Advanced age, history of gestational diabetes, family history of diabetes mellitus, history of hypertension, low physical activity, and higher body mass index were the main determinants of diabetes mellitus. According to ADA guidelines and the diabetes mellitus risk assessment tool, 32.5% of the population residents in Kerman City are potentially at risk for diabetes mellitus that can be successfully predicted aide by the ADA risk assessment tool.

Introduction

According to recent epidemiological assessments, it is now expected an increasing trend of the prevalence of diabetes mellitus in the whole word with a 69% increase in the number of adults with diabetes in developing countries and a 20% increase in developed countries is predicted by 2030.[1,2] According to the latest available statistics, about 171 million people in the

world suffer from this disease and it is estimated that this figure will reach 300 million people by 2025.[3,4] Considering fatal or debilitating complications of diabetes mellitus mainly due to lack of access to necessary drugs and improper control, the World Health Organization has considered two main goals regarding the control of diabetes in the comprehensive program for the prevention and control of non-communicable diseases including stopping the increase in the rate of diabetes and obesity and 100% access of the population to appropriate drugs and necessary technologies for the treatment of diabetes as a common non-communicable disease.[5,6] Along with the implementation of preventive programs and appropriate control of the pathological process of the disease, the identification of risk and predisposing factors of the disease and its exacerbation are considered part of the national health programs in almost all societies of the world. Therefore, identifying the risk factors predicting the course of the disease is very important and vital. The American Diabetes Association (ADA) has stated that having a genetic background along with inappropriate eating habits and the lack of enough physical activity (for at least 150 minutes per week) are the major factors for occurring pre-diabetes status followed by overt diabetes.[7] In the meantime, finding an equation or model to determine the effect of baseline risk factors related to the occurrence and severity of diabetes mellitus is very important.

So far, many studies have been conducted to predict the incidence of diabetes and its intensity using existing statistical models,[8-10] but due to the multiplicity of risk factors and high variation of these factors in different communities and races, until now, comprehensive predictive model for diabetes and its risk has not been provided. In other words, considering the importance and individual and social burden of this disease, the need to identify people at risk for diabetes aided by such models is evident. The present study aimed to assess the value of different risk factors for diabetes mellitus in a remarkable community in the city of Kerman, one of the vast areas in the southeast of Iran with the final goal of designing a predictive model for diabetes in this region.

Materials and Methods

This study was a cross-sectional study with the aim of investigating the predictive value of risk factors indicating the presence of diabetes in the population of Kerman City based on the guidelines of the ADA as a model for predicting diabetes that was conducted on 4000 people aged 15 to 75 years resident in the urban population of southeast Iran in 2016. The information of these people participating in the comprehensive screening plan for cardiovascular risk factors in Kerman City was extracted by reviewing the relevant data registry. The study was approved by the ethics committee of Kerman University of Medical Sciences (with the ethical code of KA110/88). Informed consent was obtained from all participants. The sampling method of this study was a one-stage cluster. The primary sampling units were families who lived in Kerman for at least one year before the interview.

Overall, 250 regions were identified as the center of the cluster by using the postal code query in the electronic post office. Qualified people were invited to complete the informed consent and participate in the research, and nearly 95% of them showed interest in participating in the research. During several stages of the interview, the participants provided the researchers with the necessary information in terms of demographics, medical history, and mental state (anxiety and depression) while visiting the Kerman Clinical Research Center. Also, fasting blood samples (after 12-14 hours of fasting) were taken from the participants to measure serum lipids and glucose levels. All participants were asked about their smoking status, drug use, and physical activity. Anthropometric indicators including height (measured by a meter with a minimum measuring power of 0.1 cm in a standing position without shoes) and weight (in light clothes but without shoes by a standard calibration scale, Secam, model 707, Germany, with an accuracy of 100 grams) were also measured. Body mass index (BMI) was measured by multiplying the weight by the square of the height. People with a BMI between 25 and 29.9 were considered overweight and people with a BMI of 30 and more were considered obese. People were diagnosed with diabetes mellitus with fasting blood sugar ≥126 mg/dl at the time of participating in the study or under treatment with anti-hyperglycemic medications, while those with fasting blood sugar 100 to 125 mg/dl were considered pre-diabetes mellitus state. To determine the glycemic control status of known diabetic patients, each diabetic patient was examined using serum hemoglobin A1C level. Uncontrolled diabetes was defined based on the old definition as hemoglobin A1C >7% or >53 mmol/mol Hba1c >53 mmol/mol.

The required information for adjusting the prognostic model included age, gender, family history of diabetes, history of raised blood pressure, BMI, history of gestational diabetes, and physical activity level. This information was scored in the diabetes prediction model of the ADA, which is presented in the form of the Diabetes risk test table, and according to the final score obtained; the risk of diabetes in people was predicted. The ADA diabetes risk test scoring includes seven questions (total score of 0-11) regarding age, gender, gestational diabetes mellitus, family history of diabetes, high blood pressure, physical activity, and

obesity (based on BMI via a weight-height chart). Total diabetes risk score ranged between 0 and 11 and the higher score represents a higher risk of diabetes. In this regard, cut point 5 or higher shows a high risk for diabetes mellitus, and cut point 4 shows a high risk for prediabetes.[11] In the present study, these risk factors were examined in the subjects studied, and finally the predictive value of this model for prediction of diabetes was assessed in a sample of the population of Kerman City.

Statistical analysis

The results were presented as mean ± standard deviation for quantitative variables and were summarized by absolute frequencies and percentages for categorical variables. The normality of data was analyzed using the Kolmogorov-Smirnoff test. The value of baseline parameters for predicting diabetes mellitus was assessed based on the multivariable logistic regression analysis. For the statistical analysis, the statistical SPSS software version 23.0 for Windows (IBM, Armonk, New York) was used. P values of 0.05 or less were considered statistically significant.

Results

The likelihood of diabetes mellitus according to the baseline parameters is summarized in Table 1. In this regard and of baseline characteristics, advanced age [hazard ratio (HR)=1.94, P=0.036], history of gestational diabetes (HR=1.25, P=0.020), family history of diabetes mellitus (HR=1.12, P=0.036), history of hypertension (HR=4.23, P=0.001), low physical activity (HR=1.24, P=0.044) and higher body mass index (HR=1.91, P=0.041) were the main determinants of diabetes mellitus. According to the ADA guideline, 32.5% of participants had a final diabetes risk score of 5. In this context, the odd ratio and hazard

Table 1. The value of each baseline variable to predict diabetes mellitus.

Variable	Score	Frequency (%)	Odds ratio	Relative risk	P value
Gender, %			0.64	0.682	0.133
Male	1	1612 (40.3%)			
Female	0	2388 (59.7%)			
Age, %			1.74	1.945	0.036
<40 years	0	1134 (28.3%)			
40 to 49 years	1	936 (23.4%)			
50 to 59 years	2	968 (24.2%)			
>59 years	3	960 (24.1%)			
Gestational diabetes			1.41	1.25	0.020
Present	1	376 (15.7%)			
Absent	0	2012 (84.3%)			
Family history of diabetes			1.80	1.12	0.036
Present	1	1789 (44.8%)			
Absent	0	2211 (55.2%)			
History of hypertension			5.50	4.23	0.001
Present	1	792 (19.9%)			
Absent	0	3153 (80.1%)			
Physical activity			1.22	1.24	0.044
Present	1	1897 (48.0%)			
Absent	0	2048 (52.0%)			
Body mass index			1.40	1.91	0.041
<25	0	1281 (32.1%)			
25 to 30	1	1505 (37.7%)			
30 to 40	2	1159 (29.1%)			
>40	3	45 (1.1%)			

ratio of diabetes mellitus in the subgroup with a final score ≥5 as compared to those with lower final scores was 2.3 and 1.9 respectively indicating a significant difference (P=0.020).

Discussion

The prevalence of diabetes mellitus is now rising in both developing and developed societies because of improper and sedentary lifestyles, poor nutritional habits, and even psychosocial factors. According to the statistics released by the International Diabetes Federation, more than 460 million adults over 20 years suffer from diabetes that will be raised to more than 700 million by 2045.[12] According to this upward trend of the prevalence of diabetes in the whole world, determining the major correlates of this event in each country should be a major concern for healthcare systems. The first step to control this trend, designing and applying risk assessment tools based on both clinical and biochemical parameters can be very helpful in managing and predicting the risk of diabetes. In this regard and due to the significant differences in social, cultural, and even political characteristics in the societies, it seems that such predicting systems may be specified to each country and even in the different regions of the country. According to the findings of the present survey, a collection of baseline variables including high age, history of hypertension, history of gestational diabetes in women, family history of diabetes, low physical activity, and obesity are the main determinants increasing the risk for diabetes mellitus in the southeast region of Iran. According to our results, 32.5% of our population are at high risk of developing diabetes according to the ADA scoring tool. Similar results were reported in other nations based on this screening tool. As previously reported by Weber *et al*.,[13] diabetes is more likely to occur in people who are older, owing to concurrent increases in insulin resistance linked to obesity and inactivity. Some other studies also reported that men are more prone to develop diabetes than women,[14,15] where men under the age of 55 have a higher chance of developing heart disease and diabetes than women, and of course in our study, gender was not found as a main determinant for diabetes. Some others also revealed that women who were previously diagnosed with gestational diabetes during pregnancy have a higher chance of developing diabetes as well as cardiovascular diseases later in life compared to women who have normoglycemic pregnancy, with more than sevenfold increased risk of developing T2DM,[16,17] that was in line with our observation. Moreover, similar to our survey, a family history of diabetes is closely related to the development of diabetes,[18] and also being overweight or obese are the most significant diabetes predictors.[19] In addition, people with high blood pressure were discovered to have a 50% increased chance of developing diabetes mellitus.[20] Therefore, it seems that similar studies emphasize similar predictive indicators for the risk of diabetes, and therefore it is possible to achieve a global predictive system for the screening of diabetes mellitus. Of course, taking into account the differences in some indicators that can be considered in each society in a way that is unique to that society.

Although several scoring systems have been considered to predict the occurrence of diabetes in different societies, until now the system provided by ADA has been used with high reliability and validity in all societies. Based on some studies on the reliability and efficiency of this predictive system, this risk assessment tool could obtain high sensitivity, specificity, and predictive value to predict diabetes mellitus in different populations.[21,22] Of course, considering the lack of significant value of gender in predicting the occurrence of diabetes, it seems necessary to make reforms in this system to localize it.

Conclusions

It can be finally concluded that according to ADA guidelines and the diabetes mellitus risk assessment tool, 32.5% of the population resident in Kerman City, a great city in southeast Iran, are potentially at risk for diabetes mellitus. In this regard, the main determinants for predicting diabetes in our population are high age, history of hypertension, history of gestational diabetes in women, family history of diabetes, low physical activity, and obesity. Therefore, in order to provide a comprehensive and at the same time community-oriented predictive scoring system for diabetes mellitus screening in this society, it is recommended to use the aforementioned indicators so that the disease process declines.

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