Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy
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ORIGINAL RESEARCH

Frequency of diabetes, impaired fasting glucose, and glucose intolerance in high-risk groups identified by a FINDRISC survey in Puebla City, Mexico

This article was published in the following Dove Press journal:
Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy
17 November 2012
Number of times this article has been viewed

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Background: As a first step in the prevention of diabetes, the International Diabetes Federation recommends identification of persons at risk using the Finnish type 2 Diabetes Risk Assessment (FINDRISC) survey. The frequency of diabetes mellitus, impaired fasting glucose, and glucose intolerance in high-risk groups identified by FINDRISC is unknown in our country. The aim of this study was to determine the frequency of diabetes mellitus, impaired fasting glucose, and glucose intolerance in higher-risk groups using a FINDRISC survey in an urban population.

Methods: We used a television program to invite interested adults to fill out a survey at a television station. An oral glucose tolerance test was performed in all persons with a FINDRISC score $\geq$ 15 points (high-risk and very high-risk groups). Patients were classified as normal (fasting glucose $<$ 100 mg/dL and 2-hour glucose $<$ 140 mg/dL), or having impaired fasting glucose (fasting glucose 100–125 mg/dL and 2-hour glucose $<$ 140 mg/dL), glucose intolerance (fasting glucose $<$ 126 mg/dL and 2-hour glucose 140–199 mg/dL), and diabetes mellitus (fasting glucose $\geq$ 126 mg/dL or 2-hour glucose $\geq$ 200 mg/dL). We describe the frequency of each diagnostic category in this selected population according to gender and age.

Results: A total of 186 patients had a score $\geq$ 15. The frequencies of diabetes mellitus, impaired fasting glucose, glucose intolerance, and normal glucose levels were 28.6%, 25.9%, 29.2%, and 16.2%, respectively. We found a higher frequency of diabetes mellitus and impaired fasting glucose in men than in women (33% versus 27% and 40% versus 21%, respectively) and more glucose intolerance in women than in men (34% versus 16%, $P < 0.05$). Patients with diabetes mellitus (52.55 $\pm$ 9.2 years) were older than those with impaired fasting glucose (46.19 $\pm$ 8.89 years), glucose intolerance (46.15 $\pm$ 10.9 years), and normal levels (41.9 $\pm$ 10.45 years, $P < 0.05$). We found a higher frequency of diabetes mellitus in those aged over 50 years than in younger subjects (46.15% versus 15.88%, respectively).

Conclusion: The FINDRISC survey is a very useful tool for identifying individuals at high risk of developing diabetes and prediabetic states, especially in those older than 50 years.

Keywords: diabetes prevention, diabetes survey, diabetes risk, diabetes Puebla, FINDRISC Mexico

Introduction

Diabetes is a serious public health problem in Mexico. A recent national health survey showed that 14.4% of the total adult population has diabetes, and, not surprisingly, half of patients affected are not aware of their diabetic condition.[1] High mortality and the chronic complications frequently associated with diabetes are challenging for national health care systems (both public and private) because they consume a large amount

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of resources and diminish the quality of life and life expectancy in patients affected by the disease.[2,3]

Control of glucose levels has been traditionally regarded as the best strategy to prevent or delay the later complications of diabetes. However, results from different long-term well designed trials have been modest in terms of prevention of microvascular and macrovascular complications.[4]

Prevention and/or early diagnosis of diabetes have now emerged as more promising strategies to reduce both the prevalence of the disease and development of its complications. To accomplish these objectives, two approaches have been advocated, ie, pharmacologic treatment and lifestyle intervention. Both are easy to implement on a large-scale in the general population, and are relatively inexpensive and available to everyone.[5,6]

The International Diabetes Federation has proposed identification of persons at risk of diabetes using instruments such as surveys as a first step in prevention and/or early diagnosis of diabetes, and then performing a blood test to determine glucose tolerance in those identified as being at risk of diabetes.

The Finnish type 2 Diabetes Risk Assessment (FINDRISC) survey developed in 2001 has been widely used and validated in different countries and epidemiologic studies as an instrument to identify patients at risk of developing diabetes and prediabetic states.[7] The aim of this study was to evaluate the prevalence of diabetes, impaired fasting glucose, and glucose intolerance in an urban population from Puebla City, Mexico, identified as high-risk or very high-risk by FINDRISC.

Materials and methods

As part of a diabetes prevention campaign in Puebla City, Mexico, through a local morning television show (TV Azteca) during the second half of January 2009, an open invitation was offered to all adult members of the audience without a diagnosis of diabetes to attend the television station and participate in a FINDRISC survey. Trained nurses implemented the survey, performed the necessary measurements of height, weight, and waist circumference, and calculated body mass index. All patients who obtained a score ≥ 15 points (high-risk and very high-risk according to FINDRISC) were sent to a reference laboratory where an oral glucose tolerance test was performed (according to the protocol of the World Health Organization and the American Diabetes Association) after at least 8 hours of fasting, 75 g of anhydrous glucose in 300 mL of water was administered orally, taking two blood samples to determine fasting glucose levels and at 2 hours after the oral load.

Patients were divided according to American Diabetes Association criteria in the following diagnostic categories: normal (fasting glucose < 100 mg/dL and 2-hour glucose < 140 mg/dL), impaired fasting glucose (fasting glucose 100–125 mg/dL and 2-hour glucose < 140 mg/dL), glucose intolerance (fasting glucose < 126 mg/dL and 2-hour glucose 140–199 mg/dL), and diabetes mellitus (fasting glucose ≥ 126 mg/dL or 2-hour glucose ≥ 200 mg/dL).

FINDRISC is a questionnaire consisting of eight questions, each one with a score, and predicts the likelihood of developing diabetes in the next 10 years. The eight variables included in the survey that are clearly correlated with the risk of diabetes are age, body mass index, waist circumference, current antihypertensive medication, frequency of fruit and vegetable consumption, physical activity, personal history of high blood glucose, and family history of diabetes. Variables are scored according to the risk that they may confer, resulting in a range of 0–21 total points, divided into five risk categories, ie, low (<7 points) slightly elevated (7–11 points), moderate (11–14 points), high (15–20 points), and very high (>20). All patients identified in our study as having high or very high scores were sent for an oral glucose tolerance test, and given a sealed envelope with their laboratory results, along with a letter with the diagnosis and recommendations, according to their glucose levels.

The study protocol was approved and registered with the ethics committee of the Universidad Popular Autonoma del Estado de Puebla, Mexico. All patients who scored ≥15 on FINDRISC signed an informed consent form in which they agreed to participate in this protocol. All international guidelines for good clinical practice were followed throughout the study.

Statistical analysis

Data are presented as percentages for categorical variables, and as the mean and standard deviation for the constant variables. For comparison between groups, we used *t*-test and Chi-square statistics as needed. The data were processed using SPSS version 13 (SPSS Inc, Chicago, IL).

Results

In total, 640 individuals attended the television station, 75.7% of whom were women. Of these, 185 (28.9%) individuals had a FINDRISC score ≥ 15 points. The average age of the total group was 47.1 ± 10.4 years (women 46.9 ± 10.3 years, males 48 ± 10.7 years, $P = 0.5$). Eighty-four percent of individuals with a FINDRISC score ≥ 15 already had some abnormality in their glucose tolerance and only 16% of individuals had a normal oral glucose tolerance test. The frequency of

diabetes mellitus, glucose intolerance, and impaired fasting glucose was 28.6%, 29.2%, and 25.9%, respectively. We found statistically significant differences in the frequency of diabetes mellitus, glucose intolerance, and impaired fasting glucose between men and women (Table 1).

Mean fasting glucose level in the total group was 115.95 ± 29.38 mg/dL and 2 hours after a glucose load was 158 ± 58.11 mg/dL. These means were very similar when dividing the group into women (fasting glucose 115 ± 32 mg/dL and 159 ± 54 mg/dL 2 hours after an oral glucose load) and men (fasting 117.69 ± 17 mg/dL and 154 ± 68 mg/dL, respectively) with no statistically significant differences.

The age of the individuals diagnosed with diabetes mellitus (52.55 ± 9.2 years) was higher than that of those with glucose intolerance (46.15 ± 10.9 years), impaired fasting glucose (46.19 ± 8.89 years), and normal glucose levels (41.9 ± 10.45 years, $P < 0.05$). The frequency of diabetes mellitus was also higher in those older than 50 years than in younger individuals (46.15% versus 15.88%, respectively, $P < 0.05$). Mean values for fasting glucose and 2 hours after a glucose load are shown in Table 2 according to diagnostic category.

Discussion

This study evaluates for the first time in a Latino population the performance of FINDRISC in identifying individuals at high risk of diabetes who need a confirmatory blood test and, if necessary, intervention to prevent or treat diabetes.

Our results support the use of this survey in the general population, mainly because it helps to identify rapidly those individuals at risk for development of diabetes and those who already have it. Use of FINDRISC also avoids widespread expenditure on blood tests in the prevention and early diagnosis of diabetes.

Table 1 Frequency of diagnostic categories according to gender

Diagnosis	Women (%)	Men (%)	Total (%)
Normal	25 (18%)	5 (11%)	30 (16%)
Impaired fasting glucose	30 (21%)	18* (40%)	48 (26%)
Glucose intolerance	47* (34%)	7 (16%)	54 (29%)
Diabetes	38 (27%)	15* (33%)	53 (29%)
Total	140 (100%)	45 (100%)	185 (100%)

Note: *$P < 0.05$.

Table 2 Mean fasting and two-hour glucose divided by diagnostic category

Diagnosis	Fasting glucose, mean ± SD (95% CI)	Two-hour glucose, mean ± SD (95% CI)
Normal	93.63 ± 3.7 mg/dL (92.2–95.01)	110.83 ± 19.5 mg/dL (103.5–118.1)
Impaired fasting glucose	109.83 ± 7.75 mg/dL (107.5–112.0)	115.19 ± 22.71 mg/dL (108.5–121.7)
Glucose intolerance	108.63 ± 7.33 mg/dL (106.6–110.6)	164.1 ± 18.96 mg/dL (158.9–169.2)
Diabetes mellitus	130.9 ± 15.9 mg/dL (126.3–135.5)	223.48 ± 63.1 mg/dL (205.1–241.82)

Abbreviations: CI, confidence interval; SD, standard deviation.

One of the interesting findings of our study is the usefulness of a cut-off value of ≥15 using FINDRISC, which corresponds to high-risk and very high-risk groups. In these groups, we found a high percentage of individuals in a prediabetic state, diabetics who were unaware of their condition, and, importantly, some individuals with glucose levels considered as serious and uncontrolled glycemia.

The very high prevalence of diabetes identified by FINDRISC in this group of apparently healthy individuals supports use of this survey as a first step in identifying individuals who need a confirmatory blood test. Another important consideration is that 20.5% of the population having a FINDRISC score ≥ 15 points had a fasting glucose level > 126 mg/dL. This number is far higher than the 14.42% reported recently by ENSANUT (National Survey on Health and Nutrition) as the national prevalence of diabetes in Mexico.[1]

Our results endorse the use of FINDRISC as a simple tool, not only for identification of patients who may already have impaired glucose tolerance (prediabetes or diabetes), but also, as has been recently published, for identification of those at high risk for developing diabetes and those with insulin resistance. One aspect of our study that could be controversial is the arbitrary cut-off level chosen to identify patients at risk in our population, given that recent publications cite a FINDRISC score of 12 points (moderate-risk) as the most representative for identification of patients at risk for diabetes. We think that our cut-off (15 points) may increase the specificity of the survey, thereby decreasing the number of false-positive cases.[8,9]

The population described in this study cannot be considered "normal", in that they were selected because of their high FINDRISC score. Further, the individuals who attended to participate in this survey were also likely to have had some degree of personal risk, such as a close relative with a history of diabetes or a personal suspicion that they

were already diabetic, which may have contributed to some degree of selection bias.

As expected, given that age is one of the variables that accrues points on FINDRISC, the survey is especially useful for detecting patients over 50 years who are at increased risk of diabetes. It is also this age group that has a significant increase in the prevalence of diabetes, as found in other epidemiologic studies in our country.[1] Even in this age group, FINDRISC detected a greater number of individuals compared with ENSANUT (46.1% versus 31.1%, respectively).[1]

One of the limitations of this study is that we do not have any more information on the patients beyond their age, gender, and glucose levels on oral glucose tolerance testing. This is because the intention of the campaign was to detect the largest number of people with diabetes and prediabetes, and not the demographic characteristics of individuals at high risk or very high risk identified by the survey. Our results show that the survey is a very useful tool, and easy to use in the population at large to identify individuals at risk for diabetes and in the prediabetic stages.

Disclosure

The authors report no conflicts of interest in this work.

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