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Original article

Diabetes mellitus risk screening of parents of private school students in the city of Jundiaí, São Paulo, Brazil☆

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ABSTRACT

Objective: To screen the risk of developing diabetes mellitus type 2 (DM2) in adult individuals.
Methods: Several risk factors for DM2 (sedentary lifestyle, previous coronary artery disease, hyperglycemia-inducing medications, body mass index [BMI], blood pressure, serum triglyceride, and HDL-cholesterol levels) were assessed in 314 adults as a function of gender and age group.
Results: 73.2% of the population had two or more concurrent risk factors and 26.8% had less than two factors. The occurrence of risk factors for DM2 development was observed even in young adults, and the risk factors are likely associated with aging. Differences in risk factors and incidence were observed between men and women in the same age group.
Conclusion: Regardless the age studied, the most prevalent risk factors associated with DM2 were: BMI, sedentary lifestyle, and reduced serum HDL-cholesterol, which are modifiable, thus increasing the importance of preventive measures. Discrepancies found in prevalent risk factors in men and women also suggest that sociocultural differences influence the risk of developing DM.

Rastreamento do risco de desenvolvimento de *diabetes mellitus* em pais de estudantes de uma escola privada na cidade de Jundiaí, São Paulo

Palavras-chave:
Diabetes mellitus

RESUMO

Objetivo: Este trabalho objetivou rastrear em indivíduos adultos o risco de vir a desenvolver *diabetes mellitus* (DM) tipo 2.

☆Study conducted at Centro Universitário Padre Anchieta, Unianchieta, Jundiaí, São Paulo, SP, Brazil

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Rastreamento de risco
Prevenção do diabetes
Fatores de risco para *diabetes mellitus*

Métodos: Diversos fatores de risco para DM (sedentarismo, doença coronariana prévia, uso de medicação hiperglicemiante, índice de massa corporal (IMC), pressão arterial, níveis séricos de triglicerídeos e colesterol HDL-col) foram avaliados em 314 adultos, em função do sexo e faixa etária.
Resultados: 73,2% da população somou dois ou mais fatores de risco simultaneamente, e 26,8% apresentaram menos de dois fatores. Observou-se a ocorrência de fatores de risco para o desenvolvimento da DM mesmo entre adultos jovens, e a ocorrência dos mesmos tende a estra associada com o avanço da idade. Foram observadas diferenças nos fatores e incidência de risco entre homens e mulheres na mesma faixa etária.
Conclusão: Independentemente da idade estudada, os fatores de risco associados a DM de maior prevalência foram: IMC, sedentarismo e diminuição do HDL-colesterol, os quais podem ser modificáveis, reforçando a importância de medidas preventivas. Divergências encontradas entre os fatores de risco prevalentes em homens e mulheres sugerem também que diferenças socioculturais influenciam o risco de desenvolvimento da DM.

Introduction

During the last century, the epidemiological picture showed a reversal of disease pattern, moving from high prevalence of transmissible diseases towards non-transmissible conditions, such as cancers, cardiovascular diseases (CVD), and diabetes mellitus (DM), especially from the 1960s onwards.[1,2] This fact is suggested to result from the increased life expectancy associated with changes in smoking, inactivity, high blood pressure (HBP), DM, hyperlipidemias, overweight and obesity, high-calorie and high-protein diets, and other factors that cannot be changed, such as gender, race, and heredity.[3,4]

DM is mainly divided into two types: type 1, also termed juvenile diabetes or insulin-dependent diabetes, an autoimmune disease affecting approximately 10% of the diabetic population, in which the body itself destroys the insulin-producing pancreatic β cells and type 2, affecting approximately 90% of the diabetic population and impairing insulin action and production. Diabetes mellitus type 2 (DM2) is directly associated with bad lifestyles.[5]

DM is a global pandemic,[6,7] and 300 million people are estimated to have the disease in the next 20 years.[5] In Brazil, after a DM screening campaign in 2001, it was found that 50% of the diagnosed population were unaware they had the disease.[8] DM is the sixth leading cause for hospitalizations, and contributes to other intervening causes, such as ischemic heart disease, heart failure, strokes, and HBP.[9]

Early in its course, DM2 is asymptomatic and, although life expectancy has raised compared to the scenario decades ago, the disease reduces the quality of life by causing serious comorbidities, such as peripheral nerve diseases, kidney diseases, extremity amputations (DM is the major cause for nontraumatic amputations), retinopathies (it is the main cause for visual loss in the 16-64 age group), and poses a high risk for CVD. For every ten people with diabetes, eight will die as a result of a cardiovascular event.[10] This condition costs the public treasury millions in medications, hospitalizations, and early retirement.[5]

There are two populations at risk of progressing to DM2, and they can be considered pre-diabetic: individuals with abnormal fasting glucose, and those having abnormalities in the second hour of the oral glucose tolerance test.[11] The best way to identify pre-diabetes is by the blood glucose test. Pre-diabetes can be defined when fasting blood glucose (at least eight-hour fasting) is between 100 and 125 mg/dL and/or blood glucose in the second hour of the oral glucose overload test is between 140 and 199 mg/dL;[12] this portion of the population can also be classified as glucose-intolerant.

Several models can be used to screen the risk of developing DM they are characterized by identifying a set of risk-predictive factors in a certain population, which, combined, indicate the individual risk.[13] Although numerous risk factors associated with DM are mentioned in the literature, there is not a single pattern or model used in clinical practice.[13] Among the many risk factors for DM2, this study used the following: age, overweight, HBP, elevated triglycerides (TG), coronary artery disease, gestational diabetes mellitus (GDM), use of hyperglycemia-inducing medications, and fasting blood glucose, as proposed by the Brazilian Diabetes Society (2002).[12]

The importance of identifying individuals at risk for DM is associated with the possibility to reverse the risk position, since numerous factors are modifiable. Changes in lifestyle, mainly body weight reduction and physical activity implementation, are observed to reduce DM incidence and to prevent or retard its comorbidities.[5,13,14] In large studies conducted with pre-diabetic individuals, these measures reduced the new case rate by over 50% in a two- to five-year follow-up.[12,15,16] Thus, in this study aimed to screen the study population for the risk for developing DM, to identify the most prevalent risk factors for gender, and to evaluate the age influence on risk factors associated with DM development.

Methods

Study population

The subjects in this project were 314 adults (54.5% women and 45.5% men), parents of 6- to 10-year-old children, 1st to 5th grade students of a private elementary school in the

municipality of Jundiaí, SP, who had been selected for a cardiovascular risk prevention study.[17] When assessing risks by age, seven individuals whose age was not reported were excluded, thus reducing the sample size to 307.

Study tools

A structured questionnaire was used as study tool to obtain the following data: age, prior history of gestational DM, sedentary lifestyle, previous coronary artery disease, and hyperglycemia-inducing medications. In addition to completing the questionnaire, the following data were assessed for the clinical exam: body weight, height, and blood pressure. Blood was also sampled for the following biochemical tests: fasting blood glucose, TG levels, and HDL-cholesterol levels.

Data collection and parameter analysis

A previously trained multidisciplinary team consisting of university health care students, nurses, nutritionists, pharmacists, and physical educators collected data from the structured questionnaire, as well as data from clinical exams and venous blood samples.

The clinical examinations performed by the multidisciplinary team fulfilled the following parameters:

- Weight was determined by using a digital scale with 100-g accuracy; height was measured with a portable stadiometer with a 1-mm accuracy. From these data, BMI (body mass index) was determined, calculated by the weight (in kilograms) divided by the height squared (in meters).
- The abdominal circumference was measured by a fiberglass tape measure with a 1-millimeter accuracy, on the largest abdominal diameter.
- Blood pressure was assessed through a mercury sphygmomanometer, with the individual sitting with his/her right arm positioned at the heart level and using a cuff covering 2/3 of the arm length. The systolic blood pressure was considered at Koroktoff phaseI and diastolic blood pressure at Koroktoff phase V of.

Diabetes mellitus *risk factors*

The parameters below, cited by the Brazilian Diabetes Society (2002),[12] were considered as DM risk factors; the sedentary lifestyle parameter was based on the criteria proposed by Mendonça and Anjos.[17] The other parameters were evaluated as described by Fornari et al.[18]

- Age ≥ 45 years
- Overweight (BMI ≥ 25 kg/m^2)
- HDL-cholesterol (< 40 mg/dL in men and < 50 mg/dL in women)
- Elevated fasting blood glucose (> 100 mg/dL)
- Elevated TG (> 150 mg/dL)
- HBP (> 140 mm Hg)
- CVD
- Previous gestational DM (GDM)
- Use of hyperglycemia-inducing medications (corticosteroids, thiazide diuretics, etc.)
- Sedentary lifestyle (< 30 minutes a day, according to Mendonça and Anjos)[17]

Statistical analysis

Data descriptive analysis was performed by using relative frequencies of the variables studied. Either the chi-squared test or the Fisher's exact test were used to find the association between two qualitative variables when needed. The significance level adopted for statistical tests was 5%.

Ethical issues

This project is the result of an INCOR-UNIANCHIETA partnership, and is part of a larger project whose initial proposal considered an educational program to prevent cardiovascular events.[18] The project was approved by the Ethics Committee on Human Research (CEPSH) of the Centro Universitário Padre Anchieta through the opinion number 002/2010.

Study limitations

The following study limitations have to be considered when interpreting the results:

- the population was initially selected for a cardiovascular disease prevention study[17] and, thus, individuals already diagnosed with diabetes, pregnant women, and patients having untreated hypothyroidism, patients having untreated hypopituitarism, nephrotic syndrome, chronic kidney failure, congenital biliary atresia, storage diseases, systemic lupus erythematosus, and acquired imunnodeficiency syndrome were excluded;
- by defining the 1st- to 5th-grade students' parents (children aged 6 to 10 years) of a private elementary school in the municipality of Jundiaí, SP, as the population sample, the following features were narrowed: socioeconomic status and age group, predominantly characterized by young adults, resulting in 84.4% of the study individuals aged younger than 45 years.

Results and discussion

Descripton of diabetes mellitus-associated risk factors

In a sample of 312 people, 205, (approximately 65.7%) had elevated BMI (CI: 60.1%, 71.0%). In a sample of 312 people, 194 (approximately 62.2%) had a sedentary lifestyle (CI: 56.5%, 67.6%). In a sample of 311 people, 128 (approximately 41.2%) had low HDL values (CI: 35.6%, 46.9%). In a sample of 312 people, 60 (approximately 19.2%) had elevated triglycerides

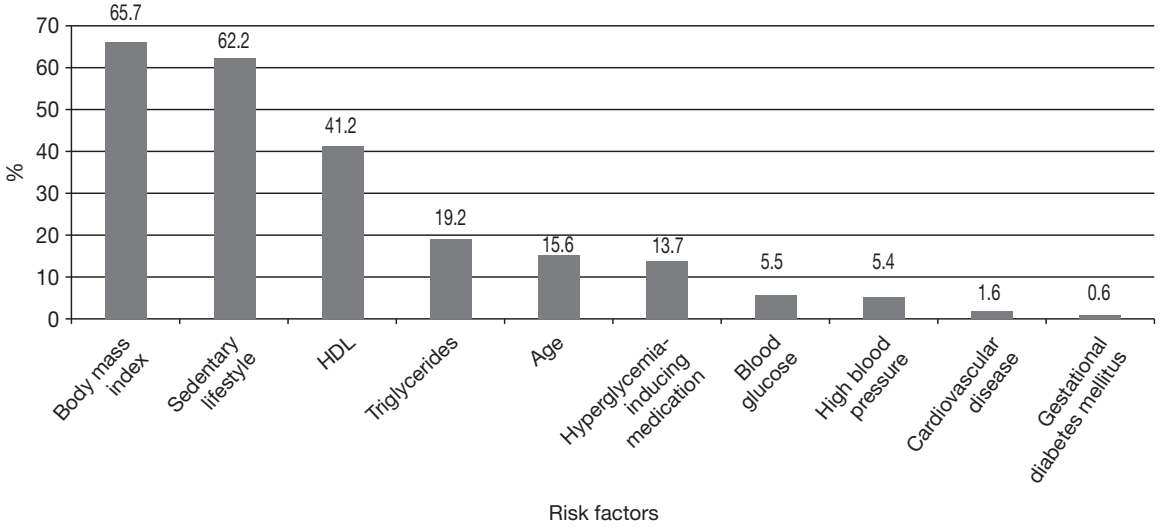

Fig. 1 – Diabetes mellitus-associated risk factors in 314 adult individuals, both men and women, parents of children from an elementary school in the city of Jundiaí, SP, Brazil, in 2010.

(CI: 15.0%, 24.0%). In a sample of 307 people, 48 (approximately 15.6%) presented age as a DM risk factor (CI: 11.8%, 20.2%). In a sample of 314 people, 43 (approximately 13.7%) were on hyperglycemia-inducing drugs (CI: 10.1%, 18,0%). In a sample of 291 people, 16 (approximately 5.5%), had elevated fasting blood glucose, that is, (CI: 3.2%, 8.8%). In a sample of 312 people, 17 (approximately 5.4%) had HBP (CI: 3.2%, 8.6%). In a sample of 312 people, five (approximately 1.6%) had cardiovascular disease (CI: 0.5%, 3,7%). In a sample of 170 study women, only one (approximately 0.6%), had a history of GDM (CI: 0.0%, 3.2%). Figure 1 shows risk factors contributing to DM development evaluated in the study population. Due to the lack of information, the sample varies according to the related parameter.

The risk factors with higher incidence were BMI (65.7%) and sedentary lifestyle (62.2%). These data are comparable to other data found in the literature in studies related to identifying DM risk factors: Ortiz e Zanetti[19] showed that 70% of individuals studied reported sedentary lifestyle and 51.5% had a BMI higher than 25 kg/m^2; Souza et al.,[20] when studying individuals already diagnosed with diabetes, observed the highest DM prevalence is due to overweight; and Martinez and Latorre[21] found that sedentary lifestyle is the most prevalent DM risk factor (63.3%), followed by elevated BMI (42.7%). Several studies have demonstrated overweight is one of the most important risk factors associated with DM2 development,[13,22,23] increasing the role of adipose tissue in the establishment of insulin resistance.

Figure 2 shows the distribution of DM risk factors associated with the study population. The sum of individuals having an association of two or more risk factors corresponds to 73.2% of the total; the remaining 26.8% correspond to no risk factors or only one DM-associated risk factor.

According to Franco, prevention can act on three fronts: by avoiding the disease onset, by early diagnosis, and by treating DM to prevent comorbidity onset.[24] It is recommended that

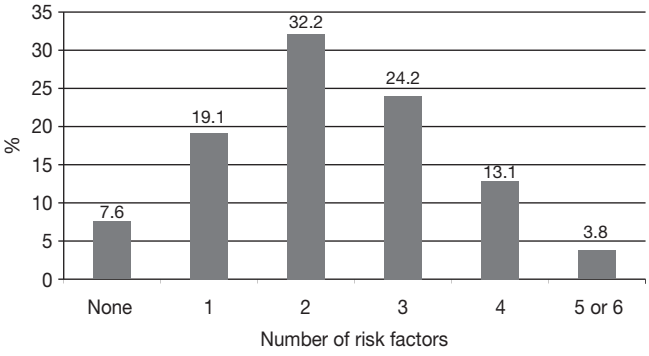

Fig. 2 – Association of diabetes mellitus risk factors in 314 adult individuals, both men and women, parents of children from an elementary school in the city of Jundiaí, SP, Brazil, in 2010.

screening should be performed every three to five years in people aged ≥ 45 years, and yearly in those having two or more factors consistent with DM onset.[12] Therefore, 73.2% of the study population is indicated to undergo yearly DM screening, since they have two or more risk factors simultaneously, and 26.8% every three to five years since they have less than two associated factors.

Gender influence on diabetes mellitus-associated risk factors

Interestingly, sociocultural features may contribute to different behaviors in females and males, implying which DM risk factors are favored. Table 1 shows the study risk factor prevalences separated by gender, as well as the test significance level (p-value).

Table 1 – Diabetes mellitus-associated risk factors in women (171) and men (143), parents of children from a school in the city of Jundiaí, SP, Brazil, in 2010.

Risk factor	Women, %	Men, %	p-value
BMI	53.5	80.3	< 0.001*
Sedentary lifestyle	65.9	57.7	0.140
HDL-cholesterol	35.5	47.9	0.027*
TG	8.3	32.2	< 0.001*
Age	8.9	23.7	< 0.001*
Hyperglycemia-inducing medications	18.1	8.4	0.012*
HBP	3.5	7.7	0.102
Blood glucose	1.9	9.8	0.003*
Coronary artery disease	1.2	2.1	0.662
GDM	0.6	0	–

BMI, body mass index; GDM, gestational diabetes mellitus; HBP, high blood pressure; HDL, high density lipoprotein; TG, triglycerides.

In the male study population (n = 143), risk factors in descending order of prevalence were: elevated BMI, sedentary lifestyle, low HDL-cholesterol, elevated TG, age, blood glucose, hyperglycemia-inducing medications, and HBP. In the female study population (n = 171), the most prevalent risk factors were: sedentary lifestyle, elevated BMI, low HDL-cholesterol, and hyperglycemia-inducing medications.

Although BMI is a highly prevalent risk factor, this parameter is higher in the male population than in the female population. These data differ from those found in literature, according to the Family Budget Survey (Pesquisa de Orçamento Familiar – POF) 2008-2009, conducted by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística – IBGE),[25] in which 50.1% of Brazilian men and 48% of women were overweight. Another relevant finding in comparing the risk factor prevalence between men and women is elevated TG, which, in the male population, is 74.2% as high as in the female population; HBP is 54.2% higher in men, and low HDL is 27.9% lower in men. These data might have been mostly influenced by the higher prevalence of overweight presented by the male study population. On the other hand, the female study population was shown to be more susceptible to other risk factors, such as the use of hyperglycemia-inducing medications (contraceptives) and sedentary lifestyle.

The evaluation of the sum of risks according to the gender shows that while 34.5% of the women had less than two risk factors, only 17.5% of men lie in this category. Thus, 82.5% of the men in this study had an association of two to five DM-associated risk factors, a value above that shown by women. This information is in line with the report by Martinez and Latorre,[21] who found that men had a higher chance to present DM influenced by high BMI and sedentary lifestyle.

Gender imbalances are reflected in laws, policies, and social practices, as well as in people's identities, attitudes, and behaviors, which alter patterns of suffering, illness, and death patterns.[26] Although women have shown to be more sedentary than men in this study population, culturally women often assume more responsible attitudes and are more careful regarding their health than men,[27] possibly warranting a lower association of risk factors in the present study's female group. Although the results are related to a specific social class (see considerations in the topic Study Limitations), some behaviors defined by gender, including better health care and more frequent demand for health services by women, are so strongly rooted that they pervade across social classes,[28,29] and perhaps these results can reflect other segments of society.

Age influence on diabetes mellitus-associates risk factors

Although a predominantly young adult population was studied, with 84.4% of individuals younger than 45 years, the results allowed clear discrimination of the age influence on increased risk to develop DM. When risk factors contributing to DM development in accordance with population age are evaluated, the following result profile is obtained, in descending order of prevalence, for the population under 45 years (84.4%): BMI ≥ 25 kg/m^2 (65.6%), sedentary lifestyle (63.7%), low HDL (40.1%), elevated TG (18.2%), use of hyperglycemia-inducing agents (12.7%), HBP (5.8%), blood glucose (3.3%), coronary artery disease (1.5%), and gestational diabetes (0.6%). In the group aged 45 years or older (15.6%), data obtained per risk factor were: BMI ≥ 25 kg/m^2 (66.7%), sedentary lifestyle (58.3%), low HDL (46.8%), elevated TG (23.4%), hyperglycemia-inducing agents (20.8%), and high blood glucose (18.2%), and none had coronary artery disease.

It is noteworthy that, regardless of age, the most prevalent DM risk factors were elevated BMI, sedentary lifestyle, and decreased HDL-cholesterol. As demonstrated,[18] chronic disease prevention can be reached through educational measures aiming to change habits directly influencing these factors.

Evaluating the sum of risks with age allows for the observation that, after 45 years of age, a relevant increase in the sum of risk factors occurs: the association of four risk factors rises from 10.0% to 31.3%, the association of five risk factors rises from 1.5% to 10.4%, and the previously not found association of six risk factors reaches 6.3%. The relationship between aging and higher DM prevalence is widely described in literature: Goldenberg et al.[30] indicate DM is more prevalent among older people; the Multicentric Study on Diabetes Prevalence in Brazil[31] describes a 6.4-fold higher diabetes incidence in the population aged 60 to 69 years compared with the 30 to 59 years

age group; according to Collins et al.,[13] age is found as the most widely used risk factor in stratifying DM risk. As age is not a modifiable parameter, the present data confirm the importance that individuals older than 45 years increase care to control the modifiable risk factors, as they tend to be found in association, and DM has a higher incidence in this age group.

Interestingly, many of the risk factors assessed in this study, such as overweight, dyslipidemias, HBP, and sedentary lifestyle, are considered risk factors for other non-transmissible chronic diseases, such as cardiovascular diseases.[18,32] The present results show that, regardless of age, the most prevalent DM risk factors were elevated BMI, sedentary lifestyle, and decreased HDL-cholesterol, all of which are modifiable risk factors. Thus, their identification and intervention can contribute not only to a decrease of DM in this population, but also to a decrease in other comorbidities and mortality in this population. As demonstrated,[18] chronic disease prevention can be reached through educational measures aiming to change habits directly influencing these factors.

Conclusion

Even after considering that the aforementioned particularities of this study limit result correlation, so the results cannot be directly correlated with the adult population of the city of Jundiaí, they reflect relevant aspects that might lead to studies with greater coverage. The results found reveal a high occurrence of DM risk factors, most of which are modifiable. Thus, prevention actions, as well as periodic DM screening, are important in this particular population. Another relevant feature is the difference in risk factors shown in males and females. In the study population, men had more risk factors than women, and therefore are more susceptible to DM development. The results demonstrate a great occurrence of DM risk factors among young adults, which stresses the importance of this study as an indicator that DM2 prophylactic action should target young adults, even considering that this condition is typically shown in older ages.

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Conflict of interest

All authors declare to have no conflict of interest.

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