Epidemiological factors for abnormal glucose levels in undergraduate students from the south of Tamaulipas, Mexico

Factores epidemiológicos de los niveles anormales de glucosa en estudiantes de pregrado del sur de Tamaulipas, México

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Abstract

Introduction: Type 2 diabetes mellitus (DM2) is an epidemic that requires actions in all areas of the health field to reduce its counterproductive effects. Mexico has a prevalence of diabetes of 10 %. The objective of this study was to estimate the prevalence of DM2 in adolescents and young people in the southern region of the State of Tamaulipas.

Methods: Adolescents and undergraduate students residing in southern Tamaulipas were included. Informed consent was obtained, and a risk factor questionnaire was applied. Subsequently, glycemia profiles and anthropometric data were obtained and the information was categorized.

Results: A total of 307 adolescents and young adults participated, we found a low prevalence of diabetes with 2 %, but cases of prediabetes (18 %) well above the national average. Alcohol consumption and smoking had a high prevalence, 14 % of the participants presented obesity in classes II and III.

Conclusions: A low percentage of DM2 was found, but prediabetes is well above the national average. This study serves as a background for the evaluation of health policies as well as the management of new guidelines to combat diseases such as DM2.

Resumen

Introducción: La diabetes mellitus tipo 2 (DM2) es una epidemia que exige acciones en todas las áreas del campo de la salud con el fin de reducir sus efectos contraproducentes. México presenta una prevalencia de diabetes del 10%. El objetivo de este estudio fue estimar la prevalencia de DM2 en adolescentes y jóvenes de la región sur del Estado de Tamaulipas.

Métodos: Se incluyeron adolescentes y estudiantes de pregrado que residían en el sur de Tamaulipas. Se obtuvo el consentimiento informado y se aplicó un cuestionario de factores de riesgo. Posteriormente se obtuvieron perfiles de glucemia y datos antropométricos y se categorizó la información.

Resultados: Participaron 307 adolescentes y adultos jóvenes, encontramos una baja prevalencia de diabetes con 2 %, pero casos de prediabetes (18 %) muy por encima del promedio nacional. El consumo de alcohol y el tabaquismo tuvieron una alta prevalencia, 14 % de los participantes presentó obesidad en clases II y III.

Conclusiones: Se encontró un bajo porcentaje de DM2, pero la prediabetes está muy por encima del promedio nacional. Este estudio sirve de antecedente para la evaluación de políticas de salud así como la gestión de nuevas directrices para el combate a enfermedades como la DM2.

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Introduction

In recent data, the International Diabetes Federation (IDF) estimates that the prevalence of diabetes will increase from 531 million people worldwide in 2021 to 629 million by 2045., Epidemiological studies suggest that the environment in which people develop is a determining factor in the appearance of DM2, indicating that the best time to intervene in this disease is in its initial stages. Studies around the world establish DM2 in adolescents as an epidemic that represents an extreme phenotype that is difficult to cope with. In the UK, more than 7 % of the population has DM2, with children under 14 years of age being the main affected or the USA, which a decade ago registered up to 9.3 % prevalence of DM2, coupled with estimates projecting that for 2050 the prevalence will stand at 21 %. According to the American Diabetes Association (ADA), DM2 is described as a progressive loss of adequate β-cell insulin secretion, frequently as on the background of insulin resistance. Data from Encuesta Nacional de Salud y Nutrición (ENSANUT) positions Mexico above the world average for DM2 with a 10.6 % prevalence by 2020. The northern region of the country according to ENSANUT, reflects that 12.8 % of the population over 20 years of age is diabetic; however, scientific reports on the epidemiology of DM2 in teenagers and youths in the region are scarce. Findings on the nature of diabetes show clear differences between DM2 in adults *vs* DM2 in adolescents, which presents its own characteristics such as faster progression of impaired pancreatic beta cell function. Based on the above, there is a need to know what the real impact of DM2 is in adolescents, to compare how quickly comorbidities arise and how they affect the adolescent patient's standard of living and self-esteem. Therefore, the objective of this study was to estimate the prevalence of DM2 in undergraduate adolescents and youths from southern Tamaulipas through a questionnaire, anthropometric data and glucose tests.

Material and methods

Population study

A cross-sectional, observational and descriptive study was conducted through the application of the risk factor questionnaire used in the first level of care of Secretaría de Salud and screening by fasting serum glucose level with a digital glucometer. The study population were nursing interns aged 18-25 years old from Ciudad Mante, Tamaulipas, Mexico. Informed consent was obtained from the adolescents. This study was previously validated by the ethics committee of the *Jurisdiscción Sanitaria No. VI* of the same locality with number 2022/001. The questionnaire used consisted of a series of 30 dichotomous questions that the subjects answered according to their self-perception (previously validated by Secretaría de Salud). Supplementary material 1, collects the total number of reagents used.

Methodology

After completing the questionnaire, a digital glucometer (Accu Chek-Active®) was used to measure fasting glucose; first, the subject's index finger was squeezed to stimulate blood flow, the finger was pricked with a lancet, and the second drop of capillary blood was collected, which was deposited on the strip/equipment to read the analyte. Abnormal glucose levels were identified based on the diagnosis criteria of diabetes established by the ADA. Briefly, after the first capillary glucose intake and within the following 48 hours a second capi-

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llary intake was determined: diabetes when the presence of fasting glucose was above 126 mg/dL; prediabetes with the presence of values of 100-125 mg/dL; and non-diabetic subjects with fasting glucose values below 99 mg/mL. Those identified with abnormal glucose values were advised for further follow-up clinical evaluations by trained physicians at "Jurisdiscción Sanitaria No. VI". Anthropometric measurements were taken using a stadiometer (Bame-425®) to measure; weight, height, and waist diameter sizes of each of the participants. The BMI measurements were cataloged according to the statutes of the World Health Organization (WHO). Participants were categorized according to their BMI as follows: underweight (<18.5 kg/m²), normal weight (18.5 to 24.9 kg/m²), overweight (25 to 29.9 kg/m²), obesity I (30 to 34.9 kg/m²), obesity II (35 to 39.9 kg/m²) and obesity III (≥ 40 kg/m²). Blood pressure was evaluated in the subjects using a digital sphygmomanometer (Paramed-Aneroid®), holding the inflatable cuff according to the diameter of the left biceps of each patient. Blood pressure reading was determined in millimeters of mercury (mm Hg, systolic pressure and diastolic pressure). The classification of hypertension in the patients studied was conducted according to the American Heart Association (AHA) clinical practice guidelines; blood pressure values were determined twice during a 48-hour period. Patients were classified as normal (less than 120/80 mm Hg); elevated (systolic between 120-129 and diastolic less than 80); stage 1 (systolic between 130-139 or diastolic between 80-89); or stage 2 (systolic at least 140 or diastolic at least 90 mm Hg).[12,13]

Statistical analysis

The calculation of the proportions was determined with the formula: prevalence= positive cases or above the cut-off threshold/total cases of the study. The statistical package IBM SPSS Statistics for Windows version 24 (IBM Corp., Armonk, NY, USA) was used for the calculation of descriptive statistics (frequencies, proportions, tendencies, and dispersion). A Kolmogorov-Smirnov normality test was performed for continuous data (age, glucose levels), if non-normality was identified, the Wilcoxon test was applied; otherwise, independent t- test was used. Finally, the values obtained for the parameters of glycemia, BMI, exercise per day and hypertension were classified according to established ranges yet (eg. glycemia = normal, prediabetes and diabetes). Dichotomous variables (sex, drugs, alcohol) were analyzed by cross-tabulation and Chi-square test, a value of $p \leq 0.05$ was considered significant.

Results

This study was conducted from September to December in 2022 and included the participation of 307 Mexican adolescents living in the south of the state of Tamaulipas. 95.8 % of the respondents were teenagers and young adults living in the southern municipalities of Tamaulipas (El Mante, Antiguo Morelos, Nuevo Morelos, González, Llera, Ocampo y Xicoténcatl) and only 4.2 % (n = 13) considered themselves foreigners, as they originated from other states such as Nuevo león, San Luis Potosí y Sonora.
Table 1 summarizes the main findings obtained in this work. According to our data, smoking habit of was associated to male subjects (p= <0.01) with 46 % (n= 36) and 19 % (n= 43) in females. Alcohol intake in this study was associated to males with (p= 0.02), 66 % (n= 52) and females had 52 % (n= 120). No significant differences were found between groups for sex and drug, but we found a strong association between the use of drugs and alcohol (p= <0.01). The prevalence of DM2 in university adolescents was only 2 %. However, the prevalence for prediabetes was found

to be 18%. A marked tendency for the presence of DM2 in the siblings of the subjects evaluated was also found compared to the presence of DM2 in the parents and relatives of the same subjects. BMI revealed that almost half of the surveyed (44 %) were overweight and 14 % had obesity in classes II and III. Blood pressure levels showed abnormal values but were not associated to sex and age (see table 1).

Discussion

The prevalence of smoking habit was found above the national reports for adolescents which is 1.9 % and 7.4 %, respectively according to the ENSANUT 2020. A similar study conducted in Spain reported percentages of up to 16 % of adolescent smokers, without specifying on gender details. On the other hand, González-Bautista, based on ENSANUT 100K, reports similar prevalence of smokers in the Mexican population; but allowing to find a marked difference between smokers up to 14 years old (1 %), with respect to those between 15-19 years old (11 %). In our case, the bulk of the population was between 21-22 years old and although, the smoking habit is indistinct between both genders, this study showed presence in male subjects. Alcohol intake was also above the national average. According to the *Encuesta Nacional de Consumo de Drogas, Alcohol y Tabaco* (ECONDAT), Mexico has a prevalence of up to 43 % of alcohol consumption in adolescents between 12 and 17 years of age. Puig-Lagunes reported a prevalence of alcohol consumption in high school students of up to 58 %, in a study conducted in Veracruz. In this work, it was found that the presence of DM2 has a low prevalence compared to the national average. A similar work reported 614 students from Zacatecas, with a ~3 % increase in glucose compared to the normal limit and Fernández-Carrasco interpreted the minimal risk of developing diabetes in Mexican university students using a questionnaire as a measurement instrument. Our data shows that the presence of prediabetes in our region is alarming, as it almost doubles the prevalence of the national average reported for DM2. The prevalence of type 2 diabetes in adolescents and young adults is increasing dramatically;- although there is a delay in health promotion in our region, this study shows that the teenagers and young adult population has habits that promote individual well-being, such as outdoor exercise and a decrease in the use of harmful substances. However, the "pre-diabetes" factor should receive special attention, since if concrete policies are not applied in the target population, it could negatively impact the economic and social aspects of similar groups in the next decade. Metabolic syndrome, overweight, obesity, dyslipidemia and a sedentary lifestyle are comorbidities that favor the appearance of DM2. In this study, all respondents stated that they exercised at least once a week. However, more than half of the surveyed were overweight and obese. The appearance and development of arterial hypertension is a problem with a profound impact in Mexico, especially when patients have unhealthy eating habits and the presence of hyperglycemia and obesity. In our study, almost half of the population had abnormal blood pressure levels, and 9% of the total number of respondents were classified as having classes 2 and 3 of arterial hypertension. A study conducted in Michoacán reported prevalence of arterial hypertension of up to 32%, emphasizing that younger adults presented untreated hypertension. As we restricted the sampling to university teenagers and youths, we consider that we have left out of this study a fraction of adolescents who have not completed their education and who, therefore, could present other lifestyles and diets, this being the study's weakness. On the other hand, the strengths of our study lie in the fact that the results in our region show that diabetes prevention policies are useful and that, due to the number of samples, it allowed us to precisely know the levels of prevalence of DM2 in adolescents in the southern region of the state of Tamaulipas.

Conclusion

In this study, adolescents and young people evaluated by questionnaire, clinical and anthropometric tests found a low percentage of 2DM compared to the national average reported by the institutions in charge. We also found that the presence of prediabetes is well above the national average reported for Mexican adolescents and youth. Smoking and alcoholism habits, which are considered predisposing factors for diseases such as diabetes, cancer and obesity, were also found to be well above the national average. Our data suggests that the prevalence of diabetes is increasing, and the situation may become uncontrollable in the future. Finally, this study serves as background for the evaluation of health policies as well as the management of new guidelines to combat diseases such as 2DM.

Table 1

Characteristics found in adolecents and young people from southern Tamaulipas, classified by gender

Characteristics	Proportion	Male *n*= 78 (25.5%)	Female *n*= 229 (74.5%)
Age		20 ±3	20 ±3
Age (strat)		18 (13); 19-20 (25); 21-22 (18); >23 (22)	18 (30); 19-20 (72); 21-22 (100); >23 (27)
Drugs (Cannabis)		Yes = 7 (9%), Not = 71 (91%)	Yes = 11 (5%), Not = 218 (95%)
DM2 in siblings		Yes = 3 (4%), Not = 75 (96%)	Yes = 8 (3%), Not = 221 (97%)
DM2 parents/relatives		Yes = 59 (76%), Not = 19 (24%)	Yes = 167 (73%), Not = 62 (27%)
Comorbidities parents/relatives		Yes = 33 (42%), Not = 45 (58%)	Yes = 54 (24%), Not = 175 (76%)
Cancer family/relatives		Yes = 33 (42%), Not = 45 (58%)	Yes = 109 (48%), Not = 120 (52%)
Glicemic	Range		
	≤ 99	57 (73.1%)	187 (81.6%)
	100 - 126	20 (25.6%)	40 (17.4%)
	≥127	1 (1.2%)	2 (0.9%)
BMI			
	Underweight	1	10
	Normal	27	91
	Overweight	43	93
	Obesity I-III	7	35
Exercise per day			
	None	0	1
	Yes	78	228
Hypertension			
	Normal	59	109
	Elevated	14	98
	Stage 1 and 2	5	22

Source: own elaboration.

Conflict of interest

The authors declare no confict of interest.

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