

## Risk factors for Type 2 Diabetes Mellitus in college students: association with sociodemographic variables<sup>1</sup>

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**Objective:** identify the modifiable risk factors for type 2 diabetes mellitus in college students and associate these factors with their sociodemographic variables. **Method:** cross-sectional study, involving 702 college students from Fortaleza-CE, Brazil. Sociodemographic, anthropometric, physical exercise data and blood pressure and fasting plasma glucose levels were collected. **Results:** the most prevalent risk factor was sedentariness, followed by overweight, central obesity, high fasting plasma glucose and arterial hypertension. A statistically significant association was found between overweight and sex ( $p=0.000$ ), age ( $p=0.004$ ) and marital status ( $p=0.012$ ), as well as between central obesity and age ( $p=0.018$ ) and marital status ( $p=0.007$ ) and between high fasting plasma glucose and sex ( $p=0.033$ ). **Conclusion:** distinct risk factors were present in the study population, particularly sedentariness and overweight.

**Descriptors:** Risk Factors; Diabetes Mellitus, Type 2; Students; Nursing; Health Promotion.

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## Introduction

Lifestyle changes among the peoples of all countries have contributed to the ascent of type 2 diabetes mellitus (DM2) cases in different age groups. In recent decades, the prevalence of DM2 has been increasing, which is characterized as a global epidemic and a public health problem<sup>(1)</sup>.

The risk of developing this disease increases among sedentary people, suffering from overweight, central obesity, arterial hypertension fasting plasma glucose  $\geq 100$ mg/dl, inappropriate eating habits, advanced age, and also with a family history of diabetes, which is considered a non-modifiable risk factor<sup>(2)</sup>.

Public health policies have recommended the early identification of the risk factors for DM2 and the combat of those that can be modified, with a view to the implementation of interventions that can slow down or impede the manifestation of the disease and reduce public health spending<sup>(2-3)</sup>.

Therefore, researchers in the theme have been developing studies that initially investigated the risk factors for DM2 in middle-aged adults, who used to be considered more vulnerable<sup>(4-5)</sup>. The outbreak of DM2 in children and adolescents, however, determined the search for risk factors in those population groups<sup>(6-7)</sup>.

In Fortaleza-CE, a city in the Brazilian Northeast, a group of nurses have been investigating the risk factors for DM2 in different population segments. Thus, factors were identified in health workers<sup>(8)</sup> and the prevalence of these factors in children and adolescents is already known<sup>(9-10)</sup>.

Although in a limited manner, the literature also shows studies that identify risk factors for DM2 in college students<sup>(11-12)</sup>. Therefore, it is of interest in this research to identify risk factors for DM2 in college students from Fortaleza-CE.

All phases of life are important to investigate the presence of conditions that can trigger future illnesses. When they enter university, however, students go through different lifestyle changes that can favor the appearance of one or more risk factors for DM2 and other chronic illnesses. In addition, these are people who are getting prepared to enter the job market in the near future.

Developing this research means, at the same time, identifying risk behaviors for the students' health and offering support for the planning and implementation of interventions that permit preventing or postponing the appearance of DM2. In addition, the contribution

to the establishment of indicators is highlighted in the elaboration of public policies.

The objective in this study was to identify modifiable risk factors for DM2 in college students from Fortaleza-CE, Brazil and associate them with sociodemographic variables.

## Methods

A cross-sectional study was undertaken at *Universidade Federal do Ceará* (UFC). The sample was calculated using a formula for infinite populations. A 50% prevalence rate was adopted to provide a maximum sample size, as well as a significance level of  $\alpha=0.05$  and an absolute sampling error of 4%. To mitigate possible losses, 10% was added to the sample size ( $N=702$  college students), distributed among the following knowledge areas of the institution: human sciences, exact sciences, agriculture sciences, health sciences, sciences and technology. Based on the population per knowledge area, the sample was stratified and 143, 116, 98, 106, 127 and 112 students were investigated, respectively.

In the human science area, the courses Pedagogy, Social Sciences and Languages were investigated: in exact sciences, Business Administration, Economics and Accountancy; in agriculture sciences, Zootechnics, Agronomy and Fishing Engineering; in health sciences, Nursing and Pharmacy; in sciences, Chemistry, Geography and Biological Sciences; and in technology, Electrical, Civil and Metallurgical Engineering.

The following inclusion criteria were established: college students properly enrolled in face-to-face, daytime undergraduate programs; living in Fortaleza-CE, Brazil and having a contact telephone and e-mail. The exclusion criteria were: being pregnant and indicating oneself as a diabetes mellitus patient.

The following sociodemographic variables were considered: sex (male and female); age (16-58 years); ethnic origin (white, mulatto, black, Asian); marital status (married/fixed partner, single, widowed, separated/divorced); professional situation (studies only, studies and works); course term (term the student is taking); novice (taking the first half of the program); veteran (taking the second half of the program); economic class (A1, A2, B1, B2, C, D, E according to the Brazilian Economic Classification Criteria of the *Associação Brasileira de Empresas e Pesquisas*) and whom the student lives with (parents, family members, friends, partner/companion, alone)<sup>(13)</sup>.

The following outcome variables were selected: sedentariness (students who exercise less than 30 minutes and less than three times per week<sup>(14)</sup>); excess weight (overweight with BMI between 25.0 and 29.9kg/m<sup>2</sup> and obese with BMI over 30kg/m<sup>2</sup>, according to World Health Organization recommendations<sup>(14)</sup>); central obesity: abdominal circumference (AC) over 102cm in men and over 88cm in women<sup>(14)</sup>); arterial hypertension (systolic blood pressure levels of 140mmHg or higher and diastolic BP levels of 90mm/Hg or higher; besides levels of 140mm/Hg or higher, indicating isolated systolic hypertension<sup>(15)</sup>); high fasting plasma glucose (100mg/dl or higher)<sup>(3)</sup>.

To collect the data, the field researchers received a 30-hour training: two Ph.D. students, two M.Sc. students and two scientific initiation grantees, in order to guarantee the reliability of the data. The data were collected between September and November 2010 and between February and June 2011, in private rooms at the university.

The college students were recruited in the classrooms after receiving clarifications about the research objectives and methods. The students who agreed signed the Free and Informed Consent Form and answered the questionnaire about the sociodemographic data and physical exercise practice. In addition, a day and time were scheduled to measure the weight, height, blood pressure (BP), abdominal circumference, as well as to collect the fasting plasma blood. On the day before the appointment, the researchers contacted the students to remind them about the need to fast.

Portable scales were used to measure the weight and an inelastic metric tape attached to the wall for the height. The students were oriented to remove their shoes and remain standing still, with their hands resting on their thighs and their head adjusted to the Frankfurt plane. The abdominal circumference (AC) was measured using a non-elastic metric tape placed on the skin at the midpoint between the final rib and the upper end of the iliac crest at the end of the expiration movement<sup>(14)</sup>. The blood pressure was verified according to the Brazilian guidelines elaborated for that purpose<sup>(15)</sup>. The blood collection as done by a specialized and previously hired laboratory, complying with orders to preserve the samples and the subjects' safety. All students were informed of the results by e-mail and participants who presented at least one risk factor for DM2 received the recommendation to visit a health service.

The collected data were organized in a Microsoft Excel worksheet, using triple data entry and further

validation, in order to control for possible errors in the transfer of the information. Central trend measures were calculated for the continuous variables. To analyze the associations among variables, the non-parametric Chi-square ( $\chi^2$ ) test and the likelihood ratio were employed. The data were processed in the statistical software *Statistical Package for the Social Sciences* (SPSS) version 18.0. The project received approval from the Ethics Committee for Research Involving Human Beings at *Universidade Federal do Ceará* under protocol 208/10.

## Results

Among the 702 college students, 62.7% were women; 53.3% in the age group between 20 and 24 years (21.5 SD=1.57); 49.3% mulatto; 92.3% single; 69.1% were taking the first to fifth course term; 71.2% lived with their parents and 65.2% did not work. The economic classes B and C were predominant (39.5%), respectively, with a monthly family income of U\$ 1,705 (SD=200). This variable showed an asymmetric distribution to the right (Kolmogorov Smirnov with  $p < 0.001$ ) (Table 1).

Table 2 shows that the most prevalent risk factor for DM 2 was sedentariness, followed by overweight, central obesity, high fasting plasma glucose and arterial hypertension.

As regards the investigated risk factors for DM2 and the sociodemographic variables, it was verified that sedentariness levels were higher in women (77.6%), in the age range from 20 to 24 years (71.3%), novices (71.9%), single (71.2%) and in socioeconomic class C (74.4%). A statistically significant association was found with sex only though ( $p < 0.001$ ).

Overweight was predominant among men (32.1%), in the age range between 25 and 58 years (34.1%), married (29.3%), veterans (24.4%) and in economic classes D and E (22.9%). Obesity was more frequent among men (7.6%), in the age range between 25 and 58 years (10.6%), married (14.6%), veterans (7%) and in economic class A (10.8%). Obesity increased with age, while overweight was practically similar in the age groups between 18 and 19 and between 20 and 24 years. Hence, overweight prevailed among men, married and in the age range between 25 and 58 years. A statistically significant association was found between overweight and sex ( $p = 0.000$ ), age ( $p = 0.004$ ) and marital status ( $p = 0.012$ ), respectively.

Table 1 - Distribution of the number of college students according to the sociodemographic variables, Fortaleza, CE, Brazil, 2011

Variable	N	%	Mean±SD
Sex (N=702)			
Female	440	62.7	
Male	262	37.3	
Age range (N=696)			
16-19	237	34.1	21.5±4.5 years
20-24	374	53.7	
25-58	85	12.1	
Term (N=687)			
Novices	485	70.6	
Veterans	202	29.4	
Marital status (N=690)			
Married/Fixed partner	42	6.1	
Single	648	93.9	
Employment Situation			
Only studies	454	65.2	
Studies and works	242	54.8	
Economic class (N=698)			
			R\$ 3,211.7±R\$ 3,765.50
A	74	10.6	
B	277	39.7	
C	277	39.7	
D	70	10.0	
Lives with			
Parents	494	71.2	
Family members	118	17.0	
Friends	27	3.9	
Companions	35	5.0	
Alone	20	2.9	

Central obesity levels were similar among men and women (5.0% and 5.7%), respectively, and prevailed in the age range from 25 to 58 years (11.8%) and among married people or who lived with a fixed partner (14.6%). The statistically significant association between central obesity and age ( $p=0.018$ ) and marital status ( $p=0.007$ ) is highlighted.

Most cases of arterial hypertension were found in men (7.1%). A statistically significant association was found between arterial hypertension and sex ( $p<0.001$ ). In this respect, the percentages of men and women were close (15.7% and 10.2%), respectively. A statistically significant association was found between high fasting plasma glucose and sex ( $p=0.033$ ).

As regards the risk factors for DM2 and the knowledge areas, the prevalence levels of sedentariness were high in all areas. The lowest level (65.5%) was found in exact sciences and the highest (75.2%) in health, without a statistically significant difference between the proportions though ( $p=0.586$ ). Concerning the overweight, the area in which the highest percentages of students were identified were sciences (31.5%) and the lowest in health ( $p=0.014$ ). The prevalence of central obesity was equitably distributed among the areas ( $p=0.097$ ), ranging from 0% in health to 7.9% in sciences. The highest prevalence of hypertension was found in sciences (11.8%) and the lowest in health (2.8%) ( $p=0.080$ ). High fasting glucose revealed different proportions among the areas ( $p<0.0001$ ), ranging from 28.2% in technology to 6.6% in health.

Table 2 - Prevalence of risk factors for type 2 diabetes mellitus, Fortaleza, CE, Brazil, 2011

Variable	Sedentariness		Overweight (%)		Central obesity (%)		Arterial Hypertension (%)		High glucose (%)	
	%	p	%	p	%	p	%	p	%	p
Sex		<0.0001*		<0.0001*		0.045*		<0.0001*		0.033*
Female	77.6		18.9		4.1		0.9		10.2	
Male	59.0		39.7		7.6		18.3		15.7	
Age range		0.853		<0.0001*		0.024*		0.236		0.697
16-19	70.6		22.8		3.0		6.3		13.8	
20-24	71.3		24.6		5.3		7.0		11.9	
25-58	68.2		44.7		10.6		11.8		10.7	
Term		0.182		0.054		0.097		0.195		0.811
Novices	71.9		24.5		4.3		6.6		12.2	
Veterans	66.8		31.7		7.4		9.5		7.3	
Marital status		0.534		0.005*		0.001*		0.245		0.312
Married/Fixed partner	66.7		45.2		16.7		12.2		7.3	
Single	71.2		25.3		4.6		7.3		4.5	
Economic class		0.131		0.804		0.072		0.859		0.393
A	62.2		31.1		10.8		9.5		11.1	
B	68.2		26.0		3.2		7.2		14.5	

(continue...)

Table 2 - (continuation)

Variable	Sedentariness		Overweight (%)		Central obesity (%)		Arterial Hypertension (%)		High glucose (%)	
	%	p	%	p	%	p	%	p	%	p
C	74.4		26.0		6.1		7.6		10.0	
D	74.3		28.6		5.7		5.7		14.5	
Knowledge area		0.586		0.014		0.097		0.080		<0.0001
Agriculture	70.1		26.5		6.1		4.1		12.4	
Sciences	71.7		31.5		7.9		11.8		13.6	
Exacts	65.5		28.4		5.2		8.6		11.4	
Human	73.4		28.0		7.7		6.3		3.6	
Health	75.2		12.3		-		2.8		6.6	
Technology	67.3		31.3		4.5		9.8		28.2	

\*The proportions are different and statistically significant

Sedentariness was the most prevalent risk factor for DM2 (65.1%) among the students with only one risk factor ( $p < 0.0001$ ). For the students with two factors, the most prevalent risk factors were overweight (41.2%;  $p < 0.0001$ ), hypertension (53.8%;  $p = 0.003$ ) and glucose (49.4%;  $p < 0.0006$ ); among the

students with three factors, hypertension was the most prevalent (39.5%), but without statistical significance ( $p = 0.246$ ). Among the students with four risk factors, obesity was the most prevalent (18.4%), but without statistical significance.

Table 3 - Distribution of risk factors according to the number of factors, Fortaleza, CE, Brazil, 2011

Risk factor	Number of factors								p
	1		2		3		4		
	N	%	N	%	N	%	N	%	
Sedentariness	321	65.1	113	22.9	49	9.9	10	2.0	<0.0001
Overweight	48	25.7	77	41.2	52	27.8	10	5.3	<0.0001
Central obesity	4	10.5	12	31.6	15	39.5	7	18.4	0.246
Hypertension	5	9.6	28	53.8	15	28.8	4	7.7	0.003
Glucose	13	15.3	42	49.4	24	28.2	6	7.1	<0.0006

## Discussion

The most prevalent risk factor for DM2 was sedentariness, which was also predominant among the investigated women, confirming the results of Brazilian and international studies involving college students<sup>(11,16)</sup>. On the other hand, data from the Brazilian Ministry of Health indicate similar percentages of lack of physical exercise among male and female adults<sup>(17)</sup>.

Although the problems deriving from the lack of physical exercise have been widely disseminated in the global media nowadays, and the cult of the body is predominant, resistance against exercising still permeates daily life in Brazil. The main justifications for this conduct are lack of time, motivation or tiredness, related to the workday<sup>(17)</sup>.

College students in general, independently of the course they are affiliated with, are involved in intense classes throughout the program, often combined with

extracurricular training or even work. Nevertheless, a substantial part of the sample only studied, which can permit the planning of exercise times.

Excess weight, including overweight and obesity, also stood out in this study, in accordance with studies on the theme<sup>(12)</sup>. In addition, it was predominant among men, exemplifying studies undertaken in Brazil as well as on other continents, indicating that, independently of the country, the daily habits that lead to the appearance of this risk factor for DM2 are similar<sup>(12,18)</sup>.

Overweight and obesity involve a complex network of triggering factors, such as sedentariness, inappropriate eating habits, cultural and environmental issues, which may justify results of studies that indicated the predominance of excess weight in women<sup>(19)</sup>.

Excess weight showed statistically significant associations with age and marital status. Most college students were young adults, confirming the

early appearance of overweight and obesity in this development phase and increasing with age.

The relation between excess weight and the marital status was confirmed in other studies, but has not been sufficiently clarified yet, revealing a knowledge gap<sup>(20-21)</sup>.

The levels detected for central obesity, blood pressure and glucose were similar to other publications reviewed<sup>(22-25)</sup>. The predominance of adiposity among women and of high blood pressure and glucose among men is also similar to other studies involving college students<sup>(22-25)</sup>.

The statistically significant association found between risk factors for DM2 and knowledge areas cannot be discussed due to the lack of literature, leaving this relation so far unknown and representing a challenge for future studies.

Hence, in the future, beyond the quantitative data, it is important to discover the nuances related to the gender and age range of this social group, which prevent them from following an appropriate diet and practicing physical exercise regularly. Issues like an unfavorable academic infrastructure for a healthy diet or a lack of areas for physical exercise, the time spent on digital technologies or the cult of practicality and speed in the preparation of meals. All of these can represent reflections to clarify the continuing high percentages of sedentariness and overweight in such a young and knowledgeable part of society.

Investigating modifiable risk factors for DM2 independently of the target population implies the performance of procedures that are mainly inherent in Nursing practice. In that context, a tool like anthropometrics is highlighted, which should increasingly be used in the nursing consultations. Its advantages include low cost, easy application and availability of material at all health services.

## Conclusion

The data found in this study indicated that the most prevalent risk factor was sedentariness, followed by overweight, central obesity, high fasting plasma glucose and arterial hypertension. A statistically significant association was found between excess weight and sex ( $p=0.000$ ), age ( $p=0.004$ ) and marital status ( $p=0.012$ ); between central obesity and age ( $p=0.018$ ) and marital status ( $p=0.007$ ); between high fasting plasma glucose and sex ( $p=0.033$ ).

Although the sample was representative from a statistical viewpoint, the investigation did not

consider students from all courses, nor eating habits and family antecedents. The participants' voices were not heard either, so as to understand their *modus vivendi*, which includes the motives that make them adopt inappropriate health behaviors. This important aspect would complement the data needed to elaborate public policies for the students at the investigated institution. Therefore, other qualitative or intervention studies are suggested focused on college students, so as to clarify important issues for the strengthening of regular physical exercise, a healthy diet and, consequently, the prevent of type 2 diabetes.

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