

## ASSESSMENT OF RISK OF DEVELOPING TYPE 2 DIABETES MELLITUS IN A UNIVERSITY POPULATION

### *Avaliação do risco de desenvolver Diabetes Mellitus tipo 2 em população universitária*

### *Evaluación del riesgo de desarrollo de Diabetes Mellitus del tipo 2 en la población universitaria*

Original Article

#### ABSTRACT

**Objective:** To determine the prevalence of risk factors for developing type 2 Diabetes Mellitus (T2DM) in a university population. **Methods:** Observational, cross-sectional study, carried out between 2013 and 2014, in a university of Parnaíba, Piauí State, with individuals aged over 18 years, who study or work in *campus*. Of the total *campus* population provision (4,310 individuals), participated in the survey 74% (111) of teachers (G1), 77.68% (94) of the administrative staff (G2), and 32.10% (1,299) of the students, totalling 1,504 individuals who answered the questionnaire “Are you at risk for type 2 diabetes?”, translated into Portuguese, in a written, individual, and anonymous form, with responses obtained through self-administration. The risk of developing T2DM was calculated for each group, as well as the association between the group and the T2DM risk, using the chi-square test ( $p < 0.05$ ), and the relative risk of T2DM development, considering the scores obtained in the group. **Results:** The sample included 34.89% (1504) of the total sample n. T2DM risk was presented by 16.21% (18) of the individuals in G1, 13.82% (13) of G2, and 1.23% (16) of G3. For hypertension, the incidence of 17.1% (19) in G1, 12.8% (12) in G2, and 5.9% (77) in G3 was found. In G1, G2 and G3, 59.5% (66), 38.3% (36), and 41.26% (536), respectively, were not physically active. The risk of developing T2DM was higher in G1 and G2, and significantly different from G3. **Conclusion:** The prevalence of risk of developing type 2 diabetes was found at 16.21% in the teachers group, 13.82% in the administrative staff group, and 1.23% in the students group, with obesity and physical inactivity evidenced as the most common risk factors.

**Descriptors:** Risk Factors; Diabetes Mellitus, Type 2; Universities; Questionnaires.

#### RESUMO

**Objetivo:** Verificar a prevalência dos fatores de risco para desenvolver Diabetes Mellitus tipo 2 (DM2) em uma população universitária. **Métodos:** Estudo observacional, transversal, realizado entre 2013 e 2014 em uma universidade de Parnaíba-PI, com indivíduos maiores de 18 anos que estudam ou trabalham no *campus*. Do total populacional disposto no *campus* (4.310 pessoas), participaram da pesquisa 74% (111) dos docentes (G1), 77,68% (94) dos técnicos administrativos (G2) e 32,10% (1.299) dos discentes, totalizando 1.504 indivíduos que responderam ao questionário “Are you at risk for type 2 diabetes?”, traduzido para a língua portuguesa, de forma impressa, individual e anônima, com as respostas obtidas através de autopreenchimento. Calculou-se o risco de desenvolver DM2 para cada grupo, a associação entre o grupo e o risco de DM2 com teste do Qui-Quadrado ( $p < 0,05$ ) e o risco relativo (RR) para desenvolvimento de DM2 considerando os escores obtidos no grupo. **Resultados:** A amostra contemplou 34,89% (1504) do n amostral. O risco de DM2 foi apresentado por 16,21% (18) dos indivíduos do G1, 13,82% (13) do G2 e 1,23% (16) do G3. Quanto à hipertensão, verificou-se a incidência de 17,1% (19) no G1, 12,8% (12) no G2 e 5,9% (77) no G3. Nos G1, G2 e G3, 59,5% (66), 38,3% (36) e 41,26% (536), respectivamente, não eram fisicamente ativos. O risco de desenvolver DM2 foi elevado no G1 e no G2, significativamente diferente do G3. **Conclusão:** Encontrou-se a prevalência do

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risco de desenvolver Diabetes Mellitus tipo 2 (DM2) de 16,21% no grupo de docentes, 13,82% no grupo de técnicos administrativos e 1,23% no grupo de discentes, destacando-se a obesidade e a inatividade física como fatores de risco mais comuns.

**Descritores:** Fatores de Risco; Diabetes Mellitus Tipo 2; Universidades; Questionários.

## RESUMEN

**Objetivo:** Verificar la prevalencia de los factores de riesgo para el desarrollo de la Diabetes Mellitus tipo 2 (DM2) en una población universitaria. **Métodos:** Estudio observacional y transversal realizado entre 2013 y 2014 en una universidad de Parnaíba-PI con individuos mayores de 18 años que estudian o trabajan en el campus. Del total poblacional del campus (4.310 personas), participaron de la investigación el 74% (111) de los docentes (G1), el 77,68% (94) de los técnicos administrativos (G2) y el 32,10% (1.299) de los discentes en un total de 1.504 individuos que contestaron el cuestionario "Are you at risk for type 2 diabetes?", que fue traducido para el idioma portugués, de forma impresa, individual y anónima con las respuestas obtenidas a través de auto aplicación. Se calculó el riesgo de desarrollo de la DM2 en cada grupo, la asociación del grupo y el riesgo de DM2 con la prueba de Chi-cuadrado ( $p < 0,05$ ) y el riesgo relativo (RR) para el desarrollo de la DM2 considerando las puntuaciones obtenidas en el grupo. **Resultados:** La muestra incluyó el 34,89% (1504) del cálculo total de la muestra. El riesgo de la DM2 se dió en el 16,21% (18) de los individuos del G1, el 13,82% (13) del G2 y el 1,23% (16) del G3. Sobre la hipertensión, se verificó la incidencia del 17,1% (19) en el G1, el 12,8% (12) en el G2 y el 5,9% (77) en el G3. En el G1, G2 y G3, el 59,5% (66), el 38,3% (36) y el 41,26% (536), respectivamente, no eran físicamente activos. El riesgo del desarrollo de la DM2 fue elevado en el G1 y el G2, significativamente distinto del G3. **Conclusión:** Se encontró una prevalencia del riesgo de desarrollo de la Diabetes Mellitus tipo 2 (DM2) del 16,21% en el grupo de docentes, del 13,82% en el grupo de técnicos administrativos y del 1,23% en el grupo de discentes destacándose la obesidad y la inactividad física como factores de riesgo más comunes.

**Descritores:** Factores de Riesgo; Diabetes Mellitus Tipo 2; Universidades; Cuestionarios.

## INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disease of multiple etiology, characterized by hyperglycemia, with modification in insulin secretion, insulin action, or both<sup>(1)</sup>. It can be classified into two categories: type 1 DM (T1DM), accounting for only 5-10% of people with diabetes and associated with insulin deficiency due to autoimmune destruction of pancreatic B-cells; and type 2 DM (T2DM), representing 90-95% of people with diabetes and resulting

of a complex pathophysiological process that culminates in insulin resistance<sup>(1,2)</sup>.

T2DM is a major problem of global public health. The International Diabetes Federation indicates that the number of people with diabetes will increase from 285 million in 2010 to 438 million in 2030, with over 70% of cases happening in developing countries. Among these, China, India, Russia, Brazil, Pakistan, Indonesia, and Bangladesh. In these countries, almost 80% of deaths are related to diabetes<sup>(3)</sup>. In 2012 the estimated prevalence in Brazil was 10.3%<sup>(4)</sup>.

T2DM is one of the main chronic diseases affecting modern man. Among its contributing factors, stand out: family history of T2DM, urbanization, lifestyle, poor diet, physical inactivity, alcohol consumption, and high blood pressure. Age, sex, and high capillary glycemia are additional factors<sup>(5)</sup>.

During the last decade, obesity has been considered a major factor for the onset of metabolic diseases such as DM<sup>(6)</sup>. Obesity rates are growing at an alarming way, causing health officials to encourage programs that contribute to the reduction in body mass index (BMI) among the population<sup>(7)</sup>. One of the strategies suggested with this aim are the physical activity programs because, in addition to favouring a decrease in the risk of DM, they also improve the cardiovascular capacity of those who practice, thus reducing the risk of heart disease, so common in people with DM<sup>(8)</sup>.

Current guidelines have advocated the application of multivariate risk scores to predict the risk of T2DM in healthy subjects<sup>(9)</sup>. These risk scores are used to classify individuals precisely and guide preventive interventions. Data collection can be done by means of questionnaires, which are probably less expensive and more acceptable than the biochemical screening methods such as measuring blood glucose<sup>(10)</sup>.

The development of diabetes prevention programs for specific public should be drawn based on the characteristics of the population, so that, in this way, the objectives be achieved by modifying aspects presented as risk factors<sup>(11)</sup>. The use of questionnaires is also efficient for scoring a large number of people, given its convenience of application and response<sup>(12)</sup>.

There is a tendency to find young adults vulnerable to developing T2DM on college campuses. In the search for professional stability, they adhere to the sedentary lifestyle and overweight, influenced by advances in technology that minimize physical efforts in daily activities and by fast and practical food<sup>(13)</sup>.

Companies, in general, are discussing and adapting to receive more and more employees with T2DM because, in spite of all the research related to prevention and treatment, there is a diabetes epidemic occurring in the world (14).

The number of T2DM diagnoses increases annually, and many people may have the disease, although, due to non-appearance of symptoms or to their low intensity, patients neglect the need for exams and frequent evaluations. In addition, since DM has widely studied and well-known characteristics, methods for identification of the population at risk to develop T2DM are extremely important to try to develop targeted prevention policies<sup>(11)</sup>.

From this premise, the study aimed to determine the prevalence of risk factors for developing type 2 diabetes mellitus (T2DM) in a university population.

## METHODS

This was an observational cross-sectional study conducted between September 2013 and February 2014, on Campus Minister Reis Velloso of the Federal University of Piauí (UFPI), in Parnaíba, PI-Brazil.

The study sample consists of individuals aged over 18 years, who were then studying or working on the campus of Parnaíba and accepted to participate. Individuals with a clinical diagnosis of type 2 Diabetes Mellitus were excluded. Participants received explanations about the objectives and procedures of the survey and only received the questionnaire after signing the Informed Consent Form (ICF).

Currently, the university campus of Parnaíba comprises 11 courses: Business Administration, Biomedicine, Accounting, Economics, Fishing Engineering, Physiotherapy, Degree in Mathematics and Biology, Pedagogy, Psychology and Tourism, containing a total of 4,039 students, 150 professors, and 121 technicians.

The population was divided into three groups according to the activities held on campus: Group 1 - professors (G1), group 2 - administrative staff (G2), and group 3 - students (G3).

The necessary sample for the study was calculated through simple random sampling without replacement, considering a confidence level of 95% and margin of error of 5%, resulting in a minimum of 353 participants for the study.

Of the total population on the campus, participated in the survey 111 (74%) individuals of G1, 94 (77.68%) of G2, and 1,299 (32.10%) of G3, totalling 1,504 individuals. The percentage distribution of the sample was similar to the population distribution within the campus groups, and the sample eventually had 38% (n=111) of its subjects

belonging to G1, 6.25% (n=94) to G2, and 86.36% (1,299) to G3.

The questionnaire “Are you at risk for type 2 diabetes?”, adapted<sup>(15)</sup>, made available by the American Diabetes Society, was subjected to translation and cultural adaptation following suggestions<sup>(16,17)</sup> for validation and use in this research. The original version of the questionnaire (Figure 1) was independently translated into Portuguese, thus generating two versions. The translators (both physical therapists and professors) were instructed by the researchers to draw up a report on doubts and difficulties. A third translator, not belonging to the academic area, summarized the two translations, and compared with the original version of the questionnaire, creating another version in Portuguese.

**ARE YOU AT RISK FOR TYPE 2 DIABETES?** American Diabetes Association

**Diabetes Risk test**

Write your score in the box

1 How old are you?  
Less than 40 years (0 points)  
40-49 years (1 points)  
50-59 years (2 points)  
60 years or older (3 points)

2 Are you a man or a woman?  
Man (1 point) Woman (0 points)

3 If you are a woman, have you ever been diagnosed with gestational diabetes?  
Yes (1 point) Não (0 points)

4 Do you have a mother father sister, or brother with diabetes?  
Yes (1 point) No (0 points)

5 Have you ever been diagnosed with high blood pressure?  
Sim (1 point) Não (0 points)

6 Are you physically active?  
Yes (1 point) No (0 points)

7 What is your weight status?  
(see chart at right)

Height	Weight (lbs.)		
1'10"	119-142	143-190	191+
4'11"	124-147	148-197	198+
5'0"	128-152	153-203	204+
5'1"	132-157	158-210	211+
5'2"	136-163	164-217	218+
5'3"	141-168	169-224	225+
5'4"	145-173	174-231	232+
5'5"	150-179	180-239	240+
5'6"	155-185	185-246	247+
5'7"	159-190	191-254	255+
5'8"	164-196	197-261	262+
5'9"	169-202	203-269	270+
5'10"	174-208	209-277	278+
5'11"	179-214	215-285	286+
6'0"	184-220	221-293	294+
6'1"	189-226	227-301	302+
6'2"	194-232	233-310	311+
6'3"	200-239	240-318	319+
6'4"	205-245	246-327	328+
	(1 point)	(2 points)	(3 points)

Add up your score

You weigh less than the amount in the left column n (0 points)

Adapted from Bang et al. Ann Intern Med 151: 775-783, 2009  
Original algorithm was validated without gestational diabetes as part of the model.

Figure 1 - Original questionnaire “Are you at risk for type 2 diabetes?” by the American Diabetes Society. (<http://www.diabetes.org/>)

That Portuguese version was then back-translated by two other independent translators, without any knowledge of the original version. The first translator had no knowledge of the medical field and was not informed about the study objectives. The second translator was physiotherapist, professor at an American university and knowledgeable about the concepts to be evaluated, but was not given

information on the study objective. After that, the English translation was reviewed by the researchers, the translators, and two physical therapists unrelated to this survey, in order to check for clarity, relevance, coherence, and meaning of the items by comparison with the original questionnaire. At last, all the reviewers approved the final version in Portuguese (Figure 2).

Based on the instructions of the questionnaire in its final form, the interviewee was considered at risk for developing T2DM when the sum of scores reached a total greater than or equal to five (5).

The questionnaires were applied individually, anonymously, being the responses obtained through self-report. They were made available in print to the participants, who were instructed to carefully read the instructions for filling and then respond according to their understanding.

The questionnaires were considered valid if in perfect conditions (no damage, drawings, or erasures) and filled only in the presence of the researchers. Erased or incomplete questionnaires were disregarded during data tabulation.

**VOCÊ TEM RISCO DE TER DIABETES TIPO 2?** Associação Americana de Diabetes

Teste de risco de diabetes

1 Quantos anos você tem?  
Menos de 40 anos (0 pontos)  
40-49 anos (1 ponto)  
50-59 anos (2 pontos)  
60 anos ou mais (3 pontos)

2 Você é homem ou mulher?  
Homem (1 ponto) Mulher (0 ponto)

3 Se você é mulher, você já foi diagnosticada com diabetes gestacional?  
Sim (1 ponto) Não (0 ponto)

4 Você tem uma mãe, pai, irmã ou irmão com diabetes?  
Sim (1 ponto) Não (0 ponto)

5 Você já foi diagnosticado com pressão arterial alta?  
Sim (1 ponto) Não (0 ponto)

6 Você é fisicamente ativo?  
Sim (1 ponto) Não (0 ponto)

7 Qual é o seu status de peso?  
(ver quadro à direita)

Altura	Peso (Kg)		
1,47	53,98-64,41	64,86-86,18	86,64+
1,50	56,25-66,68	67,13-89,36	89,91+
1,52	58,06-68,95	69,40-92,06	92,53+
1,55	59,87-71,21	71,67-95,25	96,71+
1,57	61,69-73,94	74,39-98,43	94,88+
1,60	63,96-76,20	76,66-101,6	102,06+
1,62	65,77-78,47	78,93-104,78	106,23+
1,65	68,04-81,19	81,65-108,41	108,86+
1,68	70,31-83,91	84,37-111,58	112,04+
1,70	72,12-86,18	86,64-115,21	115,67+
1,73	74,39-88,90	89,36-118,39	118,84+
1,75	76,66-91,63	92,08-122,02	122,47+
1,78	78,93-94,35	94,80-125,50	126,10+
1,80	81,19-97,07	97,52-129,27	129,73+
1,83	83,46-99,79	100,24-132,9	133,36+
1,86	85,73-102,51	102,97-136,53	136,98+
1,88	88,0-105,23	105,69-140,61	141,07+
1,90	90,72-108,41	108,86-144,24	144,70+
1,93	92,99-111,13	111,58-148,32	148,78+

Adaptado de Bing et al. Ann Intern Med 151:775-783,2009  
Algoritmo original foi validado sem diabetes gestacional como parte do modelo

Figure 2 - Brazilian final version of "Are you at risk for type 2 diabetes?" Teresina, PI, 2013-2014.

Data collection took place in accordance with the evaluated group. The researchers visited the students and professors, made a presentation and gave clarifications on the research and its procedures and. Following that, each subject received the ICF and soon after the questionnaire, having no time limit to register the answers.

Members of G2 were invited to participate in the study in their workplaces inside the campus, considering their allocation at the occasion. They received guidance and filled the questionnaires identically to the other groups surveyed.

Having been filled, the questionnaires were immediately delivered to the researchers and stored in folders, which were identified only by the group studied. At the end of the collection period, the risk for T2DM was calculated for each individual.

The representativeness of subjects at risk of developing T2DM in their group was calculated, being expressed in frequency of appearance and percentage. To verify the association between the group and the risk for T2DM, the chi-square test was used, adopting a significance level of  $p < 0.05$ . Subsequently, each question was individually analysed to identify which factors would stand out in increased risk for T2DM in this population. The relative risk (RR) for development of T2DM was calculated, considering the scores obtained in the sample groups. Sample calculations and statistical analysis were performed with use of BioEstat 5.0 software.

The study was approved by the Ethics Committee for Research Involving Human Beings of the Federal University of Piauí (Opinion No. 676,235), and all procedures were performed in accordance with Resolution 466/12 of the National Health Council.

## RESULTS

The study sample included 1,504 participants, representing 34.89% of the total sample size (4,310) on the UFPI Campus Minister Reis Velloso. Specifically, the questionnaire was applied to 74% (111) of the group of professors, 77.68% (94) of the administrative staff group and 32.1% (1,299) of the students group.

Eighteen individuals of G1 (16.21%), 13 of G2 (13.82%), and 16 of G3 (1.23%) presented risk for T2DM (Figure 3). The chi-square test showed an association between the analysed groups and the risk for T2DM ( $p < 0.0001$ ).

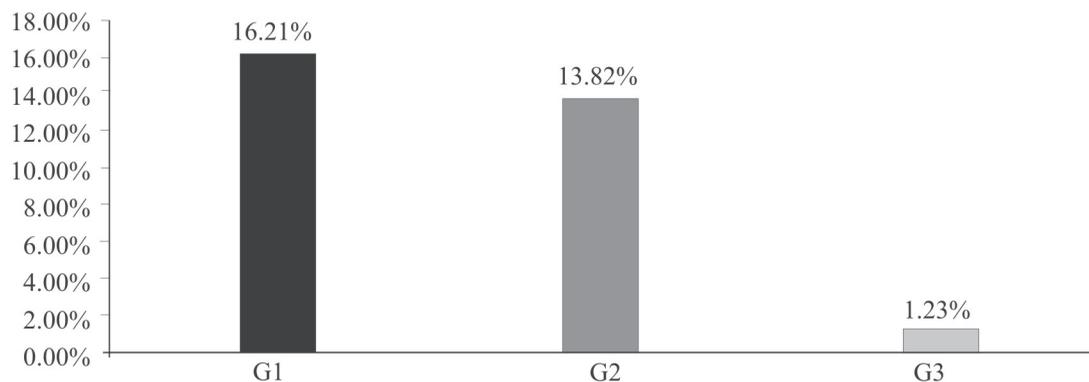


Figure 3 - Risk of developing type 2 diabetes mellitus for G1 (professors), G2 (administrative staff), and G3 (students). Parnaíba, PI, 2013-2014.

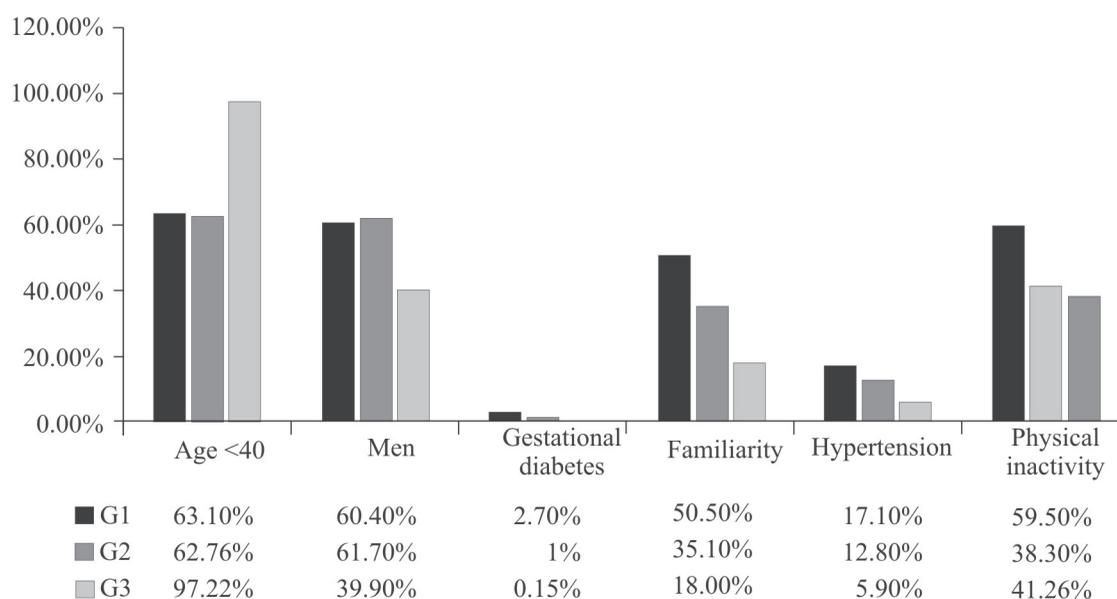


Figure 4 - Risk factors for developing type 2 diabetes mellitus for G1 (professors), G2 (administrative staff), and G3 (students). Parnaíba, PI, 2013-2014.

When separately compared, there was no association between G1 and G2 ( $p=0.6830$ ). The comparison between G1 and G3, and between G2 and G3, showed significant association with risk for T2DM ( $p < 0.0001$ ).

In the isolated analysis of each question, the percentages of risk factors were established by group. Concerning the subject's age, all groups were mostly composed by young adults, aged less than 40 years (G1 – 63.1% (69), G2 – 70.2% (66), and G3 – 97.22% (1,263)).

As for gender, the questionnaire used in the study scores 1 point for males. It was observed that 60.4% (67) of G1, 61.7% (58) of G2, and 39.9% (518) of G3 were men.

The incidence of gestational diabetes was found small among female participants of all groups (G1 – 2.7% (3), G2 – 1.1% (1), and G3 – 0.15% (2)).

As regards the risk factor related to familiarity, the frequency was 50.5% (56) in G1, 35.1% (33) in G2, and 18% (234) in G3.

Concerning the diagnosis of systemic arterial hypertension (SAH), it was possible to verify the incidence of 17.1% (19) in G1, 12.8% (12) in G2, and 5.9% (77) in G3.

When investigating the practice of physical activities among the participants, punctuating the physically inactive individual, the values reached 59.5% (66) in G1, 38.3% (36) in G2, and 41.26% (536) in G3 (Figure 4).

The weight status receives a score of 0 to 3, according to an increasing order of risk. In G1, 66.66% (74) received some score, 10.81% (12) with two points. In G2, 62.76% (59) of the participants scored in this item of the questionnaire, 14.89% (14) with 2 points, while in G3, 46.14% (599) of the participants scored but only 4.5% (58) with 2 points.

Only in G3 there was a 3-point status (0.07%, 1 participant), thus increasing the risk factor for T2DM in this group (Figure 5).

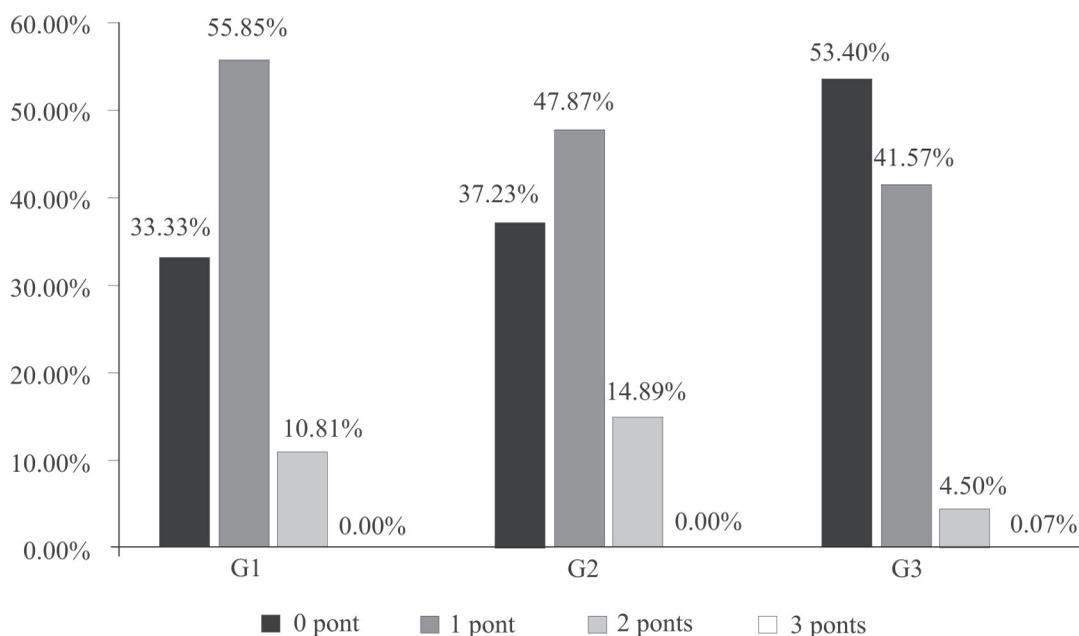


Figure 5 - Weight status for G1 (professors), G2 (administrative staff), and G3 (students). Parnaíba, PI, 2013-2014.

## DISCUSSION

Type 2 DM is part of the so-called noncommunicable diseases (NCDs), which produce an economic burden with high costs for health and social security systems, because of early mortality and disability, affecting society, families, and individuals with these diseases<sup>(18)</sup>. The young adult population is a major target of the Strategic Action Plan to Combat the NCDs in Brazil 2011-2022<sup>(19)</sup>. One of the axes of the said plan is the health promotion that values population-based actions; these may contribute to reducing the burden of NCDs and are cost-effective<sup>(20)</sup>.

Thus the investigation of potential factors that provide information about the risk of developing NCDs and, like in this study, the risk for DM, is critical to the planning of actions on education and promotion, aimed at the health of this population, with the members of universities, namely professors, technicians, and students, composing an important sample to be studied.

In recent years, the number of professors, students, and administrative staff in higher education is increasing in Brazil, with the recent expansion of Brazilian federal universities, the infrastructure restructuring, and adherence of all 54 federal institutions of higher education. This has given rise to the establishment of ten new federal universities

in all regions, and the creation and consolidation of 49 college campuses. Regarding the offering of vacancies, 77,279 jobs and 1,035 new face-to-face undergraduate courses were created between 2006 and 2010<sup>(21)</sup>.

It is observed that the customary frequenters of the university spend the day on the campus and thus perform their work and study activities, meals and sometimes, physical and cultural activities. The university environment thus become propitious to conduct studies in order to identify health risks in the population that attends the university for various reasons, such as transmitting information and content, gain knowledge, or give support to the teaching process<sup>(21)</sup>.

In the present study, we used the final Portuguese version of the adapted<sup>(15)</sup> questionnaire "Are you at risk for type 2 diabetes?". The language used in the questionnaire was considered simple and plain by the authors of this study, since the translation and back-translation were identical, even when carried out independently.

The population studied in this research was significant, reaching 34.89% of the total population of the UFPI campus in Parnaíba, satisfying the sample calculation. The risk of developing type 2 diabetes was found significantly different in G1 (16.21%) and G2 (13.82%) compared to G3 (1.23%).

There are not many reports in the literature on the risk for T2DM within the university environment. One study<sup>(22)</sup> applied a questionnaire prepared by the authors investigating socioeconomic variables (age, gender, semester, course, household income, and marital status), family history of NCDs (hypertension, diabetes mellitus and obesity), physical activity frequency, use of dietary supplement (quantity and indication), and eating habits (frequency of consumption of fruits, juices, vegetables, milk and dairy products) in 383 students of the health field, with average age of 23.8 years. It found that 60.1% of the students had family history of hypertension, 46.2% had history of T2DM, and 33.4% history of obesity.

In emerging countries, there is a tendency of increasing DM frequency in all age groups, especially in younger individuals (under 40)<sup>(23)</sup>. This did not occur in this study. That trend is due to the increased risk factors for overweight and cardiovascular disease, such as body mass index (BMI) ranging from 26-38 kg/m<sup>2</sup>, high blood pressure and triglycerides<sup>(24)</sup>.

By performing an individual analysis of the factors addressed in the questionnaire, it can be seen in this study that the risk for T2DM in G3 is low. The majority of its members are under the age of 40 years (97.22%), as they are students and usually enter universities around 18 to 22 years; they presented low incidence of gestational diabetes (18%) and hypertension (5.9%), and 53.40% of the subjects

in this group had appropriate weight, according to the questionnaire used. Thus the risk of developing T2DM is low, since the basal blood glucose increases progressively with age, as well as the incidence of hypertension<sup>(24)</sup>.

The analysis of the survey responses in G1 and G2 evidences that most of the volunteers are under forty years (63.1% and 70.2%), male (60.4% and 61.7%), and family history of diabetes is found in 50.50% and 35.1% of the subjects, respectively.

The prevalence of common noncommunicable diseases increases with advancing age, as well as increases the life expectancy, and the burden of noncommunicable diseases is also expected to increase<sup>(23,25)</sup>. In the present investigation, for the sample in G1 and G2, most were aged under forty years, given that the campus where the study took place participated in the recent expansion program of the federal universities, opening up opportunities for new professors and, consequently, greater hiring of administrative technicians<sup>(21)</sup>.

Studies directed to calculate the overall prevalence inadvertently do not calculate the predominance of male and female genders, as can be seen in the current study, because in many cases this information was not reported. Access to such information would reduce the number of assumptions that have to be made for the missing data and, in addition, allow a more accurate estimate<sup>(23)</sup>.

Heredity is a non-modifiable risk factor that increases the risk of developing T2DM by up to ten times compared to people without family history of the disease<sup>(26)</sup>.

Literature provides a directly proportional relationship between diabetes prevalence and age<sup>(27-30)</sup>. In Brazil, a multicenter study on the prevalence of DM showed a prevalence of 7.6% among the population aged 30-69 years. This rate increased with age, reaching 17.4% in the age group of 60-69 years<sup>(27)</sup>.

A study with 484 active police officers, males aged 30-59, was conducted in the city of Teresina, PI, analysing the prevalence distributed in age groups. It revealed that 3% of the diabetics were aged between 30 and 39 years, 7% were between 40 and 49 years, and 15% between 50 and 59 years, thus corroborating the increasing incidence of diabetes with age<sup>(28)</sup>.

G1 and G3 differed in the evaluation of hypertension (17.10% and 5.9%, respectively). In a previous study<sup>(29)</sup>, hypertensive or dyslipidemic subjects had risk about three times higher for the development of diabetes compared to people without these factors.

In this study, professors had the highest incidence rates of hypertension. This may be explained by a combination of factors, such as physical inactivity (59.5%) and stress, which can lead to the elevation of blood pressure, as professors are

exposed to numerous stressful situations, causing them to be a professional category at higher risk<sup>(30)</sup>.

One noticeable factor in the current study is the percentage of overweight volunteers in G1 (66.66%) and G2 (62.76%). Excess weight, especially abdominal obesity, is a major risk factor for the development of diabetes, since the accumulation of adipose tissue is associated with glucose intolerance and hyperinsulinemia. The presence of visceral abdominal obesity seems to be the main determinant of the metabolic syndrome and should be prevented by physical activity programs and healthy diet<sup>(31)</sup>.

Literature shows that one of the most common risk factors for T2DM in the population is overweight, assessed mainly through values of body mass index (BMI)<sup>(31-34)</sup>. In a previous study<sup>(32)</sup>, it was found that 51.5% of the sample was above the expected BMI. Study<sup>(35)</sup> conducted with industrial workers found that excess weight, alterations in total cholesterol and in triglycerides presented respectively, 1.93, 1.30, and 1.88 times the chance of having DM. The same value was found for the association with obesity, with 1.9 increase in the prevalence of diabetes adjusted for age<sup>(27)</sup>.

For the weight status assessed in this study, obtaining a zero score would be the ideal situation, as higher scores demonstrate a risk for developing T2DM. Upon data analysis, 66.66% of G1 are shown overweight, and 62.75% of G2 as well. The influence of weight as a risk factor for the development of the disease in this population was thus evidenced.

Overweight was also a worrying factor in G3, since 46.07% of the volunteers were found overweight. This rate does not correspond to the majority of the group, but it is extremely high, demanding a reflection on the subject. Studies<sup>(27,36)</sup> indicate a trend towards overweight in adolescents, suggesting that the causal factors are food habits and the decrease in the physical activity practice.

In this study, physical inactivity proved to be an important risk factor for the groups. It reached most of the volunteers (59.50%) only in the G1. In the other groups (G2 and G3), the values obtained show that a large portion of this population, though not the majority of the volunteers, does not practice regular physical activity. G2 was the most active group, with 38.30% of the volunteers considered sedentary. This group has an interesting feature, because the volunteers who declared themselves physically active (38.3%) did so because of the daily use of bike to go to work, pedalling for more than thirty minutes in this route.

Physical inactivity was reported by 41.26% of the study participants in G3. In other study<sup>(22)</sup> performed with college students, physical inactivity reached 33.7% of respondents, and that rate would be higher if the undergraduates of

Physical Education were excluded from the analysis. This can be explained by the fact that they present overload of class hours, besides the need for dedication to studies and other extracurricular activities<sup>(22)</sup>.

A study held with civil servants<sup>(36)</sup> found that 24.6% were sedentary, adults, and economically active, without distinction of sex. Those results are lower than the findings of the current study, which show that 42.42% of the individuals are sedentary, by taking the employee groups (G1 and G2) together. Another study found that the majority of volunteers (59%) were sedentary<sup>(37)</sup>.

Among the factors studied in the questionnaire of this study, only obesity and physical activity are modifiable factors, i.e., it is possible to decrease the risk of developing DM in the population by improving diet and performing physical activity frequently<sup>(14)</sup>.

SAH can also be prevented with proper nutrition and regular physical activity, but, once diagnosed, the maintenance of blood pressure occurs through medicines and physical activity<sup>(38)</sup>.

It can thus be seen that, to reduce the risk for DM in the overall population, physical activity programs should be devised and implemented, and this issue should be part of discussions concerning public health programs in universities<sup>(14)</sup>. Regular physical activity favours the adoption of healthy habits and impacts on smoking, inadequate caloric intake, stress, and drug addiction<sup>(39)</sup>. Generally, adequate nutrition associated with regular physical activity is recommended to decrease the risk for T2DM<sup>(14)</sup>. Physical exercise, whether aerobic or muscular endurance training, plays a fundamental role in the prevention and control of T2DM and diabetes-related health complications. The practice, however, needs to be regular for the benefits related to quality of life and health promotion to be achieved<sup>(39)</sup>.

With this research, it was found that the university population can be studied as a health model. The risk of developing T2DM was substantial for UFPI professors and employees on the campus of Parnaíba. However, the applied questionnaire should be extrapolated to other populations in order to identify its effectiveness and reliability.

The most important factors identified as risk in the population were obesity and physical inactivity. Considering the recommendations towards a combined approach, the information obtained, and the performance limits of the health services, the following strategies are suggested: developing health education activities, with emphasis on healthy eating, weight control, and physical activity; monitoring of food intake and identified risk factors as tools for assessment and subsidy for intervention planning<sup>(40)</sup>.

## CONCLUSION

The study found the prevalence of the risk for developing type 2 diabetes mellitus (T2DM) of 16.21% in the group of professors, 13.82% in administrative staff group, and 1.23% in the students group. Among the most common risk factors, obesity and physical inactivity stood out.

## CONFLICT OF INTEREST

The authors deny any conflicts of interest related to this study.

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