REFACS

Physical activity on people with type 2 diabetes mellitus: cross section study*

A prática de atividade física em pessoas com Diabetes Mellitus tipo 2: estudo transversal

La actividad física en personas con diabetes mellitus tipo 2: estudio transversal

Bruna Yara Costa[1]
Suzel Regina Ribeiro Chavaglia[2]
Rosali Isabel Barduchi Ohl[3]
Mônica Antar Gamba[4]
Joilson Meneguci[5]

This is a cross-sectional, quantitative study carried out in 2017 with members of the Family Health Strategy Teams (*Equipes de Estratégias da Saúde da Família*) in a municipality in the state of Minas Gerais, Brazil, seeking to identify the association between sociodemographic and clinical characteristics with the practice of physical activity during leisure periods by people with Type 2 Diabetes Mellitus. An interview and clinical evaluation were used by applying a tool developed by the authors. For the analysis of self-reported data, descriptive statistics and logistic regression were used, with a significance level of 5% (α = 0.05). 558 people participated, predominantly: women (66.8%), ≥60 years of age (66.3%), had a disease duration <10 years (63.8%), with an altered Body Mass Index (69.2%) and practice reduced physical activity (73.1%). An association was identified between less physical activity and gender, income, blood glucose and comorbidities. There was an association between sociodemographic characteristics, clinical conditions of participants and less physical activity.
Descriptors: Diabetes mellitus; Type 2; Motor activity; Primary Health Care.

Estudo transversal, quantitativo, realizado em 2017 em cadastrados junto a Equipes de Estratégia da Saúde da Família de um município de Minas Gerais, com o objetivo de identificar a associação entre características sociodemográficas e clínicas com a prática de atividade física em momentos de lazer de pessoas com Diabetes Mellitus Tipo 2. Utilizou-se entrevista e avaliação clínica, aplicando-se instrumento elaborado pelos autores. Para análise dos dados autorreferidos utilizou-se estatística descritiva e regressão logística, com nível de significância de 5% (α=0,05). Participaram 558 pessoas, predominando: mulheres (66,8%), ≥60 anos (66,3%), tempo de doença <10 anos (63,8%), Índice de Massa Corpórea alterado (69,2%) e prática de atividade física reduzida (73,1%). Identificou-se associação entre menor prática de atividade física e sexo, renda, glicemia e comorbidades. Verificou-se associação entre características sociodemográficas, condições clínicas dos participantes com a menor prática de atividade física.
Descritores: Diabetes mellitus tipo 2; Atividade motora; Atenção Primária à Saúde.

Estudio cuantitativo transversal, realizado en 2017 en los inscritos en los Equipos de Estrategia de Salud Familiar de una ciudad de Minas Gerais, Brasil, con el objetivo de identificar la asociación entre las características sociodemográficas y clínicas con la práctica de la actividad física en los momentos de ocio de las personas con Diabetes Mellitus tipo 2. Se utilizaron la entrevista y la evaluación clínica, aplicando un instrumento preparado por los autores. Para el análisis de los datos autoinformados se utilizaron estadísticas descriptivas y regresión logística, con un nivel de significación del 5% (α=0,05). Hubo 558 participantes, predominantemente: mujeres (66,8%), ≥60 años (66,3%), tiempo de enfermedad <10 años (63,8%), Índice de Masa Corporal alterado (69,2%) y la práctica de actividad física reducida (73,1%). Se identificó una asociación entre la menor actividad física y el género, los ingresos, la glucemia y las comorbilidades. Hubo una asociación entre las características sociodemográficas, las condiciones clínicas de los participantes con menor actividad física.
Descriptores: Diabetes mellitus tipo 2; Actividad motora; Atención Primaria de Salud.

1. Nurse. Specialist in Urgency and Emergency. Masters student in Health Care on the Universidade Federal do Triângulo Mineiro (UFTM), Uberaba, MG, Brazil. ORCID 0000-0003-1511-6877 E-mail: bruna.cst@yahoo.com
2. Nurse. Master, PhD and Post-Doctor in Nursing. Professor of the Department of Nursing in Hospital Care, UFTM, Uberaba, MG, Brazil. ORCID: 0000-0001-7033-0185 E-mail: suzel.ribeiro@yahoo.com.br
3. Nurse. Master and PhD in Nursing. Associate Professor of the Clinical and Surgical Nursing Department of the Escola Paulista de Enfermagem (EPE), Universidade Federal de São Paulo (UNIFESP), São Paulo, SP, Brazil. ORCID: 0000-0003-0369-1727 E-mail: rosaliohl@hotmail.com
4. Nurse. Master in Epidemiology. PhD in Public Health. Associate Professor of the Nursing in Collective Health Department, EPE/UNIFESP, São Paulo, SP, Brazil. ORCID: 0000-0003-1470-4474 E-mail: antar.gamba@unifesp.br
5. Physical Education Professional. Master in Physical Education. PhD in Health Care. Health Sciences Technologist in Research and Scientific Production Support Department of the Dean of Research and Graduate Studies at UFTM, Uberaba, MG, Brazil. ORCID: 0000-0003-2268-3589 E-mail: joilsonmeneguci@yahoo.com.br

INTRODUCTION

When investigating the population's health situation today, noncommunicable Chronic Diseases (NCDs) are considered a major challenge. NCDs have become the leading cause of mortality in the world, especially in low-income communities, leading to a significant reduction in this population's life expectancy[1,2].

Data from the National Health Survey (*Pesquisa Nacional de Saúde - PNS*) indicated that, in 2013, Diabetes Mellitus (DM) and Systemic Arterial Hypertension (SAH) were the most prevalent chronic conditions in Brazil. It was estimated that 21.4% of the Brazilian population aged 18 or over, corresponding to 31.3 million people and 6.2% of the country's population, were given these diagnosis, respectively [3,4].

DM is a multifactorial chronic disease characterized by metabolic disorders related to the decrease or absence of insulin in the body, which generates elevated blood glucose rates, potentially capable of leading to neurological and cardiocirculatory complications that can severely affect the quality of life of those affected[4,5].

Estimates indicate that in the year 2017, 425 million people lived with DM in the world and that, in 2045, this number may reach 629 million, that is, there will be a 48% increase in the amount of cases[6,7].

Studies indicate that this increase in the number of DM cases relates mainly to the demographic and epidemiological transition, and to other factors such as heredity, comorbidities, unhealthy lifestyle habits: sedentary lifestyle, smoking, alcoholism, drug addiction, diet, obesity and poor care management, such as inadequate glycemic control[4,8-10].

When not under control, the maintenance of high blood glucose levels can cause a series of problems, from SAH, retinopathy, renal failure, peripheral neuropathy and vasculopathy, to lower limb amputation and death, generating high social and economic costs for the population[5,6].

Among the types of DM, the most prevalent is Type 2 Diabetes Mellitus (DM2), which is responsible for 90-95% of all cases of the disease. This form of the disease causes the affected individuals to have relative insulin deficiency (and not absolute) and resistance to the action of insulin, which may or may not be associated with a defect in its secretion, but always leading to a significant increase in blood glucose levels[6-8].

As one of the therapeutic alternatives, both for the prevention and control of risk factors for chronic diseases, as well as their aggravations, physical activity (PA) has been considered an important strategy for the treatment of DM2. Evidence indicates that exercises improves glycemic control, contributes to weight loss and reduces cardiovascular risk factors, improving the quality of life of people with DM[11-13].

Studies indicate that the longer the sedentary lifestyle in people with DM2, the greater the risk of metabolic changes. They also report that the greater the number of interruptions in the sedentary period, the greater the metabolic profile of the diabetic person[12,14,15].

It is understood that PA corresponds to any movement of the organism generated through musculoskeletal action, which results in energy expenditure above baseline resting levels, including those practiced during work, games, performing household chores, traveling and in activities of leisure[16,17].

Physical exercise is already a more specific and elaborated form of PA, as it is structured and designed to improve the subject's physical fitness. Both PA and exercise are important in controlling DM. PA is as important for those with Type 1 Diabetes as it is for the general population, but its specific role in preventing complications from the disease and in managing blood glucose is still not so clear in people with DM2[16,17]. Other research has shown an inversely proportional relationship between the level of PA and the onset of chronic complications of the disease, as well as an inversely proportional relationship between the increase in intensity and the period of PA with the values of Body Mass Index (BMI) [11- 15,17].

Based on this evidence, the American Diabetes Association (ADA) recommends that individuals with DM2 perform at least 150 minutes of moderate to vigorous aerobic exercise weekly as a way to mitigate the risk of cardiovascular disease and contribute to the reduction of body weight. and blood pressure[16,18].

The guidelines proposed by the ADA should be better publicized and known to this population in order to encourage individuals to perform frequent and/or daily unstructured PA, as to increase the PA level of these people. Unfortunately, people with DM2 generally find it difficult to comply with these recommendations for a number of reasons, mainly resistance to changing habits and ignorance of effective and acceptable strategies such as domestic, occupational or routine tasks as determinants in daily energy expenditure[12,15.19]. In this sense, studies that seek to relate PA practices to the prevention of chronic diseases, such as DM2, generally focus on knowing the degree of adherence of these practices by patients in different environments, such as work and leisure time.

Because they take on the character of personal choice and because they are related to moments of relaxation and pleasure, PAs performed at leisure time have gained prominence in investigations on DM2. These activities are considered strategies that allow the subject to be more committed to preventive actions and to control risk factors[20]. Thus, investigations aimed at knowing the current context of PA performance by people with DM2 are of great importance for the health of this population, as well as for monitoring its prevalence in population subgroups with other chronic conditions.

Given the above, this study aims to identify the association between sociodemographic and clinical characteristics with the practice of PA at leisure times for people with DM2.

METHOD

This is a cross-sectional study with a quantitative approach, carried out with people diagnosed with DM2, registered with the Family Health Strategy Teams - FHS(*Estratégia de Saúde da Família - ESF*) in a city in the state of Minas Gerais (MG), Brazil. It is a subproject of the research "Social and risk determinants of diabetic people with extremity ulcers in the city of Uberaba - Minas Gerais, Brazil" (*Determinantes sociais e de risco de pessoas diabéticas com úlcera de extremidades no município de Uberaba - Minas Gerais, Brasil*).

For the selection of participants, a non-probabilistic sampling of users with a diagnosis of DM2 was used in medical records according to the International Disease Code - ICD-10: E11, both genders, over 18 years old, registered in the FHS teams.

After forwarding to the Research Ethics Committee of a Federal University of the researched city, and approval under No. 595.888-0 and CAAE 05762012.4.3001.5154, data collection started.

Participants were approached in offices in the Basic Health Units - UBS (*Unidade Básica de Saúde - UBS*) that support the FHS teams, or in their homes between February and November of 2017, ensuring the subject's privacy at the time of the evaluation. The data were obtained through interview and measurement of vital signs, anthropometric measurements, capillary blood glucose, all performed by students trained by the researchers, whose guidance was a structured instrument developed by the authors.

The instrument consists of a field designed for sociodemographic characterization with the variables: gender, age group, marital status, income, skin color and clinical variables: disease duration, capillary blood glucose, comorbidity, anthropometric assessment for calculating BMI and smoking. Another field with variables to characterize the regular practice of PA during leisure time. The information was self-reported, relating to the frequency of performing PA for a minimum period of 10 continuous minutes according to the specifics: jogging, cycling, swimming, gymnastics, football, basketball and others.

The data were coded and typed in an electronic spreadsheet in the Microsoft Excel® Program, according to the frequency of the weekly practice of PA by the participants. These

were classified into two groups: a) Less practice of PA during leisure time (0 to 3 times a week); and b) Greater PA practice at leisure time (4 times or more in the week). The data obtained were transferred to the statistical analysis software Statistical Package for the Social Sciences (SPSS) version 20.0 and later presented in the form of group tables, according to the steps established by the instrument used.

For data analysis, descriptive statistics, absolute and relative frequency were used for sociodemographic and clinical variables. In order to verify the aspects associated with less PA practice during leisure time, crude and adjusted analyzes were performed using Logistic Regression, with estimates of the odds ratios of prevalence (Odds Ratio - OR) and confidence interval (CI) of 95%.

Crude analyzes were performed between the explanatory variables and the practice of PA during leisure time. The variables that presented a value of $p \leq 0.20$ were included in the adjusted analysis. The variables considered associated were those that presented a p-value <0.05 after the Wald test. The study was funded by the *Fundação de Apoio à Pesquisa do Estado de Minas Gerais* (*FAPEMIG*) under APQ 00148-13.

RESULTS

In this study, 558 registered users of the FHS Teams of the investigated municipality participated, of which 66.8% (n = 373) were female, 66.3% (n = 370) aged 60 years or over, 54.3% (n = 303) lived with their partner, 62.9% (n = 351) had an individual income of up to one minimum wage and, in relation to skin color, 62.5% (n = 349) declared themselves white.

Regarding clinical conditions, 63.8% (n = 356) had DM2 for less than 10 years, 83.5% (n = 466) had altered blood glucose levels and 87.8% (n = 490) had at least an associated comorbidity. Regarding BMI, 69.2% (n = 386) presented altered values (<18.5 kg/m^2 and > 24.9 kg/ m^2) and regarding smoking, most subjects, 87.5% (n = 488) denied being smokers.

Regarding the practice of PA during leisure time, 73.1% (n = 408) of the individuals reported a low frequency of PA practice, that is, they do not perform PA during leisure time or do it at most up to three times a week.

On the other hand, 26.9% (n = 150) of the participants reported performing PA during leisure time, with a frequency of four or more times a week. Among those who performed PA during leisure time, according to the guidelines established for the control of DM2, jogging was the most reported activity, with 16.8% practitioners (Table 1).

Table 1. Leisure physical activities according to their weekly frequency. Uberaba, MG, 2017.

Leisure activities	0 to 3 times a week		≥ 4 times a week	
	n	%	n	%
Soccer	558	100.0	0	0.0
Basketball	558	100.0	0	0.0
Swimming	557	99.8	1	0.2
Other*	553	99.1	5	0.9
Cycling	546	97.8	12	2.2
Gymnastics	545	97.7	13	2.3
Joggging	464	83.2	94	16.8

* Non-specific activities

As for the aspects associated with less practice of PA during leisure time, in the crude analysis the variables: gender, income, capillary blood glucose, comorbidity and body mass index showed p <0.20 and were selected for adjusted analysis.

When performing the adjusted analysis, only the Income variable remained associated with lower PA practice, both for income categories higher than one up to three minimum wages (OR = 2.75; 95% CI: 1.16-6.53), as for income equal to or less than a minimum wage (OR = 3.19; 95% CI: 1.36-7.51) (Table 2).

Table 2. Crude and adjusted regression analyzes of factors associated with less physical activity during leisure time (0 to 3 times a week). Uberaba. MG, 2017.

Variables	Less leisure-time physical activity			
	Crude Analysis		Adjusted Analysis	
	OR (IC 95%)	p	OR (IC 95%)	p
Sociodemographic				
Gender		0.038		0.126
Male	1		1	
Female	1.51 (1.02-2.23)		1.38 (0.91-2.09)	
Age Group		0.926		
< 60 years	1			
≥ 60 years	1,02 (0,69-1,51)			
Marital Status		0.635		
Single/Separated	1			
Cohabit with partner	1.08 (0.68-1.70)			
Widower	1.30 (0.74-2.28)			
Family Income		0.002		**0.029**
Up to 1 Minimum Wage	4.18 (1.82-9.55)		3.19 (1.36-7.51)	
> 1 to < 3 Minimum Wages	3.02 (1.29-7.01)		2.75 (1.16-6.53)	
≥ 3 Minimum Wages	1		1	
Skin Color		0.252		
Non White	1			
White	1.25 (0.85-1.83)			
Clinical Conditions*				
Amount of time with illness		0.463		
< 10 years	1.16 (0.78-1.70)			
> 10 years	1			
Capillary glycemia		0.063		0.116
Normal	1		1	
Altered	1.57 (0.98-2.53)		1.49 (0.91-2.45)	
Comorbidity		0.012		0.107
No	1		1	
Yes	1.96 (1.16-3.33)		1.59 (0.91-2.79)	
Body Mass Index		0.163		0.625
Normal	1		1	
Altered	1.33 (0.89-1.97)		1.11 (0.73-1.69)	
Smoking		0.601		
No	1			
Yes	1.17 (0.65-2.01)			

*Hba1c Variable was not part of the proposed analysis.

DISCUSSION

The results of this study pointed to a predominance of females, older than 60 years, with white skin color, characteristics that coincide with other similar studies[13,19-21].

Regarding marital status, there was a predominance of people who have a partner. It is believed that this constitutes to an important source of support for people with DM2, whether for accepting the disease and adhering to the care they demand, as well as for coping with treatment-related difficulties; this factor is reaffirmed by an Australian study that considers social support to be significant in adopting beneficial lifestyle changes for people with DM2[22].

This study identified that the majority of participants, 289 (51.8%) have low individual income of up to one minimum wage. However, there was no determination of the number of people who are dependent on this income. These data are considered important, as they can facilitate or hinder adherence of people with DM2 to strategies for coping with the disease[4].

The predominance of non-smokers was also verified. The amount and duration of smoking directly correlates with the progression of NCDs, especially DM and cardiovascular diseases[1,4].

Although most of the participants report not smoking currently, it cannot be said that they were not smokers prior to the research, as this was not explored. A study based on data collected by the PNS, observed the association between diabetes and former smokers, which could indicate that people with a diagnosis of DM quit smoking or that the disease would affect especially after weight gain associated with quitting smoking[4].

Regarding the time of diagnosis, people with 10 or more years of DM2 diagnosis tend to have a lower rate of adherence to guidelines and alternative therapies for disease control. On the other hand, it is expected that the longer the duration of the disease, the greater the subject's knowledge about DM2 and its risk factors, consequently the better their self-management with regard to their therapeutic scheme[10,16,23].

The evidence of pathologies associated with DM2, such as arterial hypertension, heart disease and visual changes identified in this study are corroborated with other studies, which state that 50% of diabetic people have some type of comorbidity; and, the longer the disease lasts, several acute and chronic pathological processes may appear, such as cardiovascular dysfunction, renal failure, loss of vision, microvascular complications, neuropathy and ischemia[4,5,10,24].

As for the measurement of capillary glycemia, most subjects presented altered values, which ranged from 51 mg/dl to 559 mg/dl, based on the guidelines recommended by the ADA for the control of DM, which establish the normal value preprandial capillary glycemia between 80 and 130 mg/dl and postprandial glycemia < 180 mg / dl[8].

The ADA proposes general goals appropriate for many patients, but emphasizes the importance of individualization based on the patient's characteristics. Thus, glycemic goals must be individualized to meet the personal needs, characteristics and preferences of each patient[8].

Currently, the measurement of glycated hemoglobin (Hba1c) is the gold standard test for glycemic control of patients with DM, since, in addition to measuring fasting and postprandial glycemic levels, the measurement of this hemoglobin reflects the average of values of glucose for approximately the past 3 months, suggesting a better representation of glycemic fluctuation. The desirable Hba1c target for adults is < 7% (53 mmol/mol) [8.25].

Hba1c is the main tool to assess glycemic control, having a strong predictive value for DM complications. Thus, the Hba1c test should be routinely requested by the physician and performed on all patients with initial DM assessment and as part of clinical follow-up[8,25]. There is current scientific evidence that correlates long-term complications of the disease with high levels of Hba1c and inadequate control of this indicator[8,18,26,27].

Despite this evidence, Hba1c was not counted in this study, since almost all of the people interviewed, 97.5% (n = 544) did not know whether they had already done this control, saying they were unaware or had never performed this type of test, and only 2.5% (n = 14) indicated having performed this exam at least once, but were unable to inform which values were obtained. In view of this reality, health professionals have the responsibility to guide the general population, and especially diabetic people, on the importance of periodically carrying out this exam, as a way of preventing their problems[19].

According to the recommendation of the Brazilian Diabetes Society, Hba1C tests should be performed at least twice a year for all patients with DM and every three months for patients who have undergone changes in the treatment regimen or who are not managing to achieve the objectives proposed by the current treatment[28].

In the evaluation of the BMI, the prevalence of individuals with altered values was observed, as 378 (67.7%) individuals had their BMI elevated, above 25 kg/m², indicating overweight and obesity in different degrees, an important factor to be considered due to the relationship between DM2 and obesity, which has been widely demonstrated, as well as a significant increase in the risk of developing complications of the disease[28,29].

As for the assessment of physical activities performed by people with DM2, six specific leisure-related activities and one activity classified as "other" were investigated when there was no relationship with specific activities. The classification occurred by grouping those who performed some activity for up to three times a week and in the group of four or more times a week, thus seeking to approach the guidelines established by the World Health Organization (WHO) regarding the minimum necessary frequency for the control of DM[16,30].

In all the activities evaluated, the group that had low PA frequency were predominant, however, the total time that the subject uses for each of the listed activities and the energy expenditure of each one was not investigated. Recent WHO data indicate that, worldwide, 23% of adults and 81% of adolescents (11 to 17 years) do not meet the global recommendations on performing PA necessary for health maintenance, and that the prevalence of inactivity varies considerably between countries, and in some of them it can reach 80% among adult populations, being higher in regions of the Eastern Mediterranean, in the Americas, Europe and Western Pacific and lower in the region of Southeast Asia[30].

These international data on lower PA coincide with the analysis carried out in this study, since it was observed that people with DM2 perform physical activities at leisure time with frequency well below the established guidelines.

PA must be accompanied by a specialized professional, so that he/she can evaluate the type, duration and intensity of activities, identify possible difficulties for the person and provide guidance for reaching a proposal based on his/her needs and specifics and not suffering complications [3,6, 15, 20, 30].

CONCLUSION

The results obtained in this study made it possible to know the sociodemographic and clinical conditions of people with DM2 in the city and the association of these variables with the practice of PA during leisure, allowing the discussion of the benefits of performing PA to prevent complications of the disease, improve the conditions of health and quality of life of these subjects.

Among the variables investigated on people with DM2, the income factor was the only one associated with less PA practice at leisure, indicating that those individuals who have income up to a minimum wage present a tendency to practice PA at a frequency below the recommended.

PA performed in everyday household, at leisure time, or as a programmed exercise for physical conditioning, in addition to providing better control of clinical parameters, such as glycemic profile and weight, also contributes to the psychological well-being of people with DM2, controlling or decreasing anxiety, which can directly interfere with the maintenance of health and quality of life of this population.

The limitations of the research were the cross-sectional nature of the research, the use of self-reported information, the difficulty in counting the total time of activities and the absence of validated studies on the theme of leisure activities such as PA.

Despite this, the study highlights the need for health professionals to develop awareness and awareness strategies for this population in order to increase the practice of PA. The possibility of subsidizing public actions and policies is added, as well as strengthening management with regard to PA in people with DM2.

REFERENCES

1. Malta DC, Silva MMA. As doenças e agravos não transmissíveis, o desafio contemporâneo na saúde pública [Editorial]. Ciênc Saúde Colet. [Internet]. 2018 [cited 16 Sep 2018]; 23(5):1350. DOI: http://doi.org/10.1590/1413-81232018235.31552 017
2. Malta DC, Oliveira TP, Santos MAS, Andrade SSCA, Silva MMA, et al. Progress with the strategic action plan for tackling chronic non-communicable diseases in Brazil, 2011-2015. Epidemiol

Serv Saúde [Internet]. 2016 [cited 21 Mar 2019]; 25(2):373-90. DOI: http://dx.doi.org/10.5123/S1679-49742016000200016

3. Ministério da Saúde (Br), Instituto Brasileiro de Geografia e Estatística -IBGE. Pesquisa Nacional de Saúde 2013 - Percepção do estado de saúde, estilos de vida e doenças crônicas [Internet]. Rio de Janeiro: IBGE; 2014 [cited 21 Mar 2019]. 181p. Available from: https://biblioteca.ibge.gov.br/visualizacao/livros/liv91110.pdf

4. Malta DC, Bernal RTI, Iser BPM, Szwarcwald CL, Duncan BB, Schmidt MI. Factors associated with self-reported diabetes according to the 2013 National Health Survey. Rev Saúde Pública [Internet]. 2017 [cited 17 Sep 2018]; 51(Supl 1):12s. DOI: http://dx.doi.org/10.1590/s1518-8787.2017051000011

5. American Diabetes Association. Classification and diagnosis of diabetes: standards of medical care in diabetes - 2019. Diabetes Care [Internet]. 2019 [cited 13 Mar 2019]; 42(Suppl 1):S13-S28. DOI: https://doi.org/10.2337/dc19-S002

6. Cho NH, Shaw JE, Karuranga S, Huang Y, Fernandes JDR, Ohlrogge AW, et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes Res Clin Pract. [Internet]. 2018 [cited 12 Mar 2019]; 138:271-81. Available from: www.ncbi.nlm.nih.gov/pubmed/29496507

7. International Diabetes Federation. IDF Diabetes Atlas [Internet]. 8ᵗʰed. Brussels: IDF; 2017 [cited 21 Mar 2019]. Available from: http://www.diabetes atlas.org

8. American Diabetes Association. Glycemic targets: standards of medical care in diabetes – 2019. Diabetes Care [Internet]. 2019 [cited 13 Mar 2019]; 42(Suppl 1):S61–S70. DOI: https://doi.org/10.2337/dc19-S006

9. Lima CLJ, Costa MML, Oliveira JS, Ferreira TMC, Ferreira JDL, Nascimento JA. Risk screening for Diabetes mellitus development in users of Basic Health Care. Enferm Glob. [Internet]. 2018 [cited 21 Mar 2019]; 52:124-36. DOI: http://dx.doi.org/10.6018/eglobal.17.4.307521

10. Cardona Garbey DL, Borges Carcasés D, Cala Cardona JC, Mora García G, Rodriguez Salvá A. Características clínico-epidemiológicas de pacientes con diabetes mellitus de tipo 2 en un área de salud. Medisan [Internet]. 2018 [cited 21 Mar 2019]; 22(7):522-39. Available from: http://scielo.sld.cu/pdf/san/v22n7/1029-3019-san-22-07-522.pdf

11. Micali PN, Schwartz GM, Fukushima RLM, Carmo EG, Codogno JS, Costa JLR. Nível de atividade física e índice de massa corporal sobre a prevalência de doenças crônicas não transmissíveis em aposentados residentes em Rio Claro, SP. Rev Kairós [Internet]. 2017 [cited 21 Mar 2019]; 20(4):233-48. DOI: http://dx.doi.org/ 10.23925/2176-901X.2017v20i4p233-248

12. Gonela JT, Santos MA, Castro V, Teixeira CRS, Damasceno MMC, Zanetti ML. Level of physical activity and caloric expenditure of individuals with diabetes mellitus during leisure activities. Rev Bras Educ Fís Esp. [Internet]. 2016 [cited 17 Sep 2018]; 30(3):583-90. DOI: http://dx.doi.org/10.1590/1807-55092016000300583

13. Shakil-Ur-Rehman S, Karimi H, Gillani SA. Effects of supervised structures aerobic exercise training program on fasting blood glucose level, plasma insulin level, glycemic control, and insulin resistance in type 2 diabetes mellitus. Pak J Med Sci. [Internet]. 2017 [cited 21 Mar 2019]; 33(3):576-80. DOI: http://dx.doi.org/10.12669/pjms.333.12023

14. Balducci S, D'Errico V, Haxhi J, Sacchetti M, Orlando G, Cardelli P, et all. Effect of a behavioral intervention strategy for adoption and maintenance of a physically active lifestyle: the Italian Diabetes and Exercise Study 2 (IDES_2): a randomized controlled trial. Diabetes Care [Internet]. 2017 [cited 21 Mar 2019]; 40:1444-52. DOI: https://doi.org/10.2337/dc17-0594

15. Amadid H, Johansen NB; Bjerregaard AL, Vistisen D, Færch K, Brage S, et al. Physical activity dimensions associated with impaired glucose metabolism. Med Sci Sports Exerc. [Internet]. 2017 [cited 21 Mar 2019]; 49(11):2176-84. DOI: http://doi.org/10.1249/MSS.0000000000001362

16. American Diabetes Association. Lifestyle management: Standards of Medical Care in Diabetes – 2019. Diabetes Care [Internet]. 2019 [cited 21 Mar 2019]; 42(Supl 1):S46-S60. DOI: https://doi.org/10.2337/dc19-S005

17. Gallè F, Krakauer JC, Krakauer NY, Valerio G, Liguori G. Can an exercise-based educational and motivational intervention be durably effective in changing compliance to physical activity and anthropometric risk in people with type 2 diabetes? A follow-up study. Int J Environ Res Public Health [Internet]. 2019 [cited 21 Mar 2019]; 16(5):701. DOI: http://doi.org/10.3390/ijerph 16050701

18. American Diabetes Association. Obesity management for the treatment of type 2 diabetes: Standards of Medical Care in Diabetes – 2019. Diabetes Care [Internet]. 2019 [cited 21 Mar 2019]; 42(Suppl 1):S81–S9. DOI: https://doi.org/10.2337/dc19-S008

19. Sociedade Brasileira de Diabetes. Atividade física e diabetes mellitus. In: Diretrizes da Sociedade Brasileira de Diabetes – 2017-2018 [Internet]. São Paulo: Ed Clannad; 2017 [cited 21 Mar 2019]. 383 p. Available from: https://www. diabetes.org.br/profissionais/images/2017/diretrizes/diretrizes-sbd-2017-2018.pdf

20. Cruz MS, Bernal RTI, Claro RM. Tendência da prática de atividade física no lazer entre adultos no Brasil (2006-2016). Cad Saúde Pública [Internet]. 2018 [cited 21 Mar 2019]; 34(10):e00114817. DOI: http://doi.org/10.1590/0102-311X00114817

21. Freitas EF, Moreira OC, Oliveira CEP, Doimo LA, Loch MR. Prevalência de diabetes mellitus e prática de exercício em indivíduos que procuraram atendimento na Estratégia Saúde da Família de Viçosa/MG. Rev Educ Fís UEM [Internet]. 2015 [cited 01 Mar 2019]; 26(4):549-56. DOI: http://dx.doi.org/10.4025/reveducfis.v26i4.25202

22. Crotty MM, Henderson J, Ward PR, Fuller J, Rogers A, Kralik D, et al. Analysis of social networks supporting the self-management of type 2 diabetes for people with mental illness. BMC Health Serv Res. [Internet]. 2015. [cited 21 Mar 2019]; 15:257. DOI: http://doi.org/10.1186/s12913-015-0897-x

23. Vicente NG, Goulart BF, Iwamoto HH, Rodrigues LR. Prevalencia de adhesión al tratamiento medicamentoso de personas con Diabetes Mellitus. Enferm Glob. [Internet]. 2018 [cited 21 Mar 2019]; 17(4):446-59. DOI: http://dx.doi.org/10.6018/eglobal.17.4.302481

24. Ding L, Xu Y, Liu S, Bi Y, Xu Y. Hemoglobin A1c and diagnosis of diabetes. J Diabetes [Internet]. 2018 [cited 21 Mar 2019]; 10(5):365-72. DOI: http://doi.org/10.1111/1753-0407.12640

25. Despaigne OLP, Despaigne MSP, Rodríguez Cascaret A, Neyra Barros RM, Chia Mena MLA. Hemoglobina glucosilada en pacientes con diabetes mellitus. MEDISAN [Internet]. 2015 [cited 21 Mar 2019]; 19(4):551-7. Available from: http://www.medisan.sld.cu/index.php/san/article/view/271

26. Selvin E. Are there clinical implications of racial differences in HbA1c? A difference, to be a difference, must make a difference. Diabetes Care [Internet]. 2016 [cited 21 Mar 2019]; 39(8):1462-7. DOI: https://doi.org/10.2337/dc16-0042

27. Sociedade Brasileira de Diabetes. Atualização sobre hemoglobina glicada (A1C) para avaliação do controle glicêmico e para o diagnóstico do diabetes: aspectos clínicos e laboratoriais. Grupo Interdisciplinar de Padronização da Hemoglobina Glicada – A1C [Internet]. São Paulo: SBD; 2017 [cited 20 Oct 2019]. Available from: https://www.diabetes.org.br/publico/images/banners/posicionamento-3-2.pdf

28. Bueno DR, Marucci MFN, Gouveia LA, Duarte YAO, Lebrão ML. Abdominal obesity and healthcare costs related to hypertension and diabetes in older adults. Rev Nutr. [Internet]. 2017. [cited 21 Mar 2019]; 30(2):209-18. DOI: http://dx.doi.org/10.1590/1678-98652017000200006

29. Flor LS, Campos MR, Oliveira AF, Schram JMA. Diabetes burden in Brazil: fraction attributable to overweight, obesity, and excess weight. Rev Saúde Pública [Internet]. 2015 [cited 21 Mar 2019]; 49(29):1-10. DOI: https://doi.org/10.1590/S0034-8910.2015049005571

30. World Health Organization. More active people for a healthier world: global recommendations on physical activity for health – 18-64 years old [Internet]. Geneva: World Health Organization; 2018. [cited 21 Mar 2019]. Available from: https://apps.who.int/iris/bitstream/handle/10665/272722/9789241514187-eng.pdf

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CONTRIBUTION
Bruna Yara Costa collaborated with the conception, collection and analysis of data, and writing. **Rosali Isabel Barduchi Ohl** and **Suzel Regina Ribeiro Chavaglia** collaborated with the conception, collection and analysis of data, writing and revision. **Joilson Meneguci** contributed with the collection and analysis of data, writing and revision. **Mônica Antar Gamba** participated on the conception and revision.

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