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# Palmar strength and sociodemographic, clinical-functional, and psycho-cognitive factors in elderly with Diabetes Mellitus

## *Força de preensão palmar e fatores sociodemográficos, clínico funcionais e psicocognitivos em idosos com Diabetes Mellitus*

## *Fuerza de asimiento palmar y factores sociodemográficos, clínicos funcionales y psicos cognitivos en ancianos con Diabetes Mellitus*

**Vanessa da Nóbrega Dias, Alice Fernandes de Lemos, Bartolomeu Fagundes de Lima Filho, Maria das Graças de Araújo Lira, Fabrícia Azevedo da Costa Cavalcanti, Juliana Maria Gazzola***

Universidade Federal do Rio Grande do Norte (UFRN), Natal, RN, Brazil

### Abstract

**Introduction:** An important consequence of the aging of people with DM2 is physical disability, particularly the loss of mobility. **Objective:** To determine sociodemographic, clinical-functional, and psycho-cognitive factors related to the reduction in hand grip strength (HGS) in elderly patients with type 2 diabetes mellitus (DM2) and to verify the relationship between HGS and fragility. **Method:** This is an observational cross-sectional study with 156 elderly individuals aged 60 years and over, both male and female, diagnosed with DM2. The participants were assessed according to sociodemographic, clinical-functional, psycho-cognitive, and functional mobility data. HGS was evaluated using a manual dynamometer. The tests performed were: Mann-Whitney or Kruskal-Wallis, and Chi-square. The level of significance was set at 5% ($p < 0.05$). **Results:**

* VND: Doctoral student, e-mail: vanessanobrega.d@hotmail.com
AFL: BS, e-mail: lice_lemos@msn.com
BFL: Doctoral student, e-mail: bartolomeu_fagundes2@hotmail.com
MGAL: Master's student, e-mail: maria.galira@gmail.com
FACC: PhD, email: fabriciacosta@ufrnnet.br
JMG: PhD, email: juliana.gazzola@terra.com.br

A significant relationship was observed between HGS and each of the following: sex ($p < 0.001$), age range ($p = 0.04$), marital status ($p = 0.004$), physical activity ($p = 0.06$), number of conditions diagnosed ($p = 0.002$), use of insulin therapy ($p = 0.03$), complaint of pain in lower limb power ($p < 0.001$), falls in the last year ($p = 0.004$), fear of falling ($p = 0.003$), Mini-Mental State Examination ($p = 0.01$), Geriatric Depression Scale ($p = 0.008$), fragility phenotype ($p < 0.001$). **Conclusion:** HGS was reduced in elderly women with DM2, those who did not have a marital life had five or more diseases diagnosed with insulin therapy, did not engage in regular physical activity, complained of lower limb pain, had a history of two or more falls in the last year, had a fear of falling, had a cognitive deficit, had depressive symptoms, and were fragile.

**Keywords**: Hand Strengths. Aged. Diabetes Mellitus.

### *Resumo*

***Introdução:*** *Uma consequência importante do envelhecimento das pessoas com DM 2 é a incapacidade física, particularmente a perda de mobilidade.* ***Objetivo:*** *Determinar os fatores sociodemográficos, clínico-funcionais e psico-cognitivos relacionados à redução da força de preensão palmar (FPP) em idosos com Diabetes Mellitus tipo 2 (DM 2) e verificar a relação entre FPP e fragilidade.* ***Método:*** *Trata-se de um estudo observacional, transversal, com 156 idosos de 60 anos ou mais, com diagnóstico de DM 2, masculino e feminino. Os sujeitos foram avaliados segundo dados sociodemográficos, clínicos, funcionais, psicocognitivos e de mobilidade funcional. A FPP foi avaliada por meio do Dinamômetro Manual. Foram realizados os testes de Mann-Whitney ou Kruskal-Wallis e Qui-quadrado. O nível de significância foi estabelecido em 5% ($p < 0,05$).* ***Resultados:*** *Houve relação significante entre FPP e as variáveis: carga de fragilidade ($p < 0,001$), sexo ($p < 0,001$), faixa etária ($p = 0,04$), estado civil ($p = 0,004$), atividade física ($p = 0,06$), número de patologias ($p = 0,002$), uso de insulinoterapia ($p = 0,03$), queixa de dor em membros inferiores ($p < 0,001$), queda no último ano ($p = 0,004$), medo de cair ($p = 0,003$), MMSE ($p = 0,01$), GDS ($p = 0,008$), fenótipo de fragilidade ($p < 0,001$).* ***Conclusão:*** *A FPP é reduzida em idosas com DM 2 sem vida conjugal, com cinco ou mais doenças diagnosticadas, com uso de insulinoterapia, não praticantes de atividade física regular, que se queixaram de dor nos membros inferiores, com história de duas ou mais quedas no último ano, medo de cair, com déficit cognitivo, que apresentava sintomas depressivos e eram frágeis*

***Palavras-chave****: Força da Mão. Idoso. Diabetes Mellitus.*

### *Resumen*

***Introducción:*** *Una consecuencia importante del desarrollo de las tareas con DM 2 es una incapacidad física, particularmente una pierda de movilidad. Objetivo: Determinar los factores sociodemográficos, clínico-funcionales y psico-cognitivos relacionados a la reducción de la fuerza de asimiento palmar (FPP) en ancianos con Diabetes Mellitus tipo 2 (DM 2) e verificar la relación entre FPP y fragilidad. Método: Estudio observacional, transversal, con 156 ancianos de 60 años o más, con DM 2, masculino y femenino. Los sujetos fueron evaluados según datos sociodemográficos, clínicos, funcionales, psicocognitivos y de movilidad funcional. La FPP fue evaluada por medio del Dinamómetro Manual. Se realizaron las pruebas de Mann-Whitney o Kruskal-Wallis y Qui-cuadrado, $p < 0,05$. Resultados: La relación entre el FPP y las variantes de carga de fragilidad ($p < 0,001$), sexo ($p < 0,001$), faixa etária ($p = 0,04$), estado civil ($p = 0,004$), atividad física ( $p = 0,06$), número de patologias ($p = 0,002$), uso de insulinoterapia ($p = 0,03$), queixa de dor en miembros inferiores ($p < 0,001$), queda no último año ($p = 0,004$), medo de cair ($p = 0,003$), MMSE ($p = 0,01$), GDS ($p = 0,008$), fenótipo de fragilidade ($p < 0,001$). Conclusión: La FPP se reduce en ancianas con DM 2 sin vida conyugal, con cinco o más enfermedades diagnosticadas, con uso de insulinoterapia, no practicantes de actividad física regular, que se quejaron de dolor en los miembros inferiores, con historia de dos o más caídas en el último año, miedo a caer, con déficit cognitivo, que presentaba síntomas depresivos y eran frágiles.*

***Palabras clave****: Fuerza de la Mano. Ancianos. Diabetes Mellitus.*

## Introduction

Diabetes Mellitus (DM) is one of the most common chronic noncommunicable conditions worldwide, whose prevalence is increasing due to an aging population and the major lifestyle changes characterized by a sedentary lifestyle and obesity, which have occurred as a consequence of economic development and urbanization. This is one of the most important chronic diseases affecting the public health system, due to the high morbidity and mortality rates and to the high costs of metabolic control and treatment of its microvascular complications [1].

An important consequence of the aging of people with DM2 is physical disability, particularly the loss of mobility [2]. This pathology makes the elderly more susceptible to a gradual and successive decrease in functional capacity and reserves. This increases the rate of hospitalizations and the demand for health system services, which in turn makes the elderly more susceptible to physical frailty [3].

Hand grip strength (HGS) is an important indicator of changes in functionality in the elderly, which is used for various clinical purposes and can often be applied in physical fitness tests. The development of illnesses and the progressive loss of functional abilities interfere with the quality of life of the elderly, limiting their capacity to perform activities of daily living and negatively affecting their health [4].

The existing literature affirms a decline in HGS among DM patients, but further investigation is needed among the elderly population. Thus, the evaluation of HGS in elderly diabetics becomes relevant, because it serves as a predictor of functionality, acts as the base of a differential diagnosis, and allows follow-up for complications involving the DM2 patient. It also helps towards directing strategies for the prevention, promotion, and treatment of diseases to improve the health of the elderly and to enhance their quality of life. Thus, this study aimed to determine the sociodemographic, clinical-functional, and psycho-cognitive factors related to the reduction in the HGS of the elderly with DM2 and to verify the relationship between HGS and fragility.

## Method

### Design of the study

This is an observational, analytical, and transversal study. The outpatient evaluation was previously scheduled and performed by trained evaluators at the Laboratory of Technological Innovations in Health (LAIS) of the University Hospital Onofre Lopes (HUOL). Patients with DM2 were followed-up at the Geriatric and Endocrinological Outpatient Clinic of the referred hospital. The data collection started after obtaining approval from the HUOL Ethics Committee, whose project is part of a study already approved by the Central University of UFRN – Campus Central (number 45185915.9.0000.5537).

### Participants

We evaluated 156 (n = 156) elderly patients aged 60 years and over, who were diagnosed with Type 2 Diabetes Mellitus according to the American Diabetes Association (ADA) criteria [5]. Participants were both males and females who agreed to participate in the research after reading and signing the Informed Consent Form (TCLE).

Elderly individuals who presented physical and cognitive limitations that prevented palmar grip strength tests, such as inability to understand and to respond to simple verbal commands and/or mimic movements, as well as arthrosis or any other rheumatic/orthopedic incapacitating disease were excluded from the study. Those who had severely impaired visual and auditory acuity that completely prevented them from performing activities of daily living, even using corrective lenses and/or sound amplification devices, were also excluded from the study.

Participants received information about the basic objectives and procedures of the survey, and those who decided to participate in the study were scheduled to complete the protocol.

### Procedure

The participants underwent a clinical evaluation, consisting of sociodemographic data (gender, age, age group, and civil status), clinical-functional

data, psycho-cognitive data (Geriatric Depression Scale (GDS-15) and Mini-Mental State Examination (MMSE), and functional mobility evaluation using the Time Up and Go (TUG) test.

The following clinical-functional data were obtained: the participant's subjective perception of health; vision and hearing; height; weight and Body Mass Index (BMI); regular physical activity; number of diseases; number of medications used; diagnosis time of diabetes; laboratory test results in the last six months for the control of DM; use of antidiabetic drugs and/or insulin; use of a gait aid device; presence of lower extremity pains and their severity; occurrence of falls; and presence of dizziness and HGS analysis.

The HGS measurement was performed using the Saehan™ hand grip dynamometer following the recommendation of the American Society of Hand Therapists (ASHT) [6]. The patient remained seated, feet resting on the floor, holding the dynamometer in the dominant hand, with the arm slightly abducted, forearm flexed at 90°, and wrist in neutral position. Before starting the test, the needle was in the zero (neutral) position. The evaluator gave a voice command, and the participant applied the maximum force to bring together the two rods of the device. Three results were collected for each participant, with a rest interval of one minute between them. The final score was obtained in kilogram strength (kgf) and was the mean of the three measurements. Adjustments were made for gender and BMI. Thus, for males, the following BMI ranges and corresponding HGS values were considered: $0 < BMI \leq 23$ ($\leq 27.00$ kgf); $23 < BMI < 28$ ($\leq 28.67$ kgf); $28 \leq BMI < 30$ ($\leq 29.50$ kgf); $BMI \geq 30$ ($\leq 28.67$ kgf). For females, the following values were used: $0 < BMI \leq 23$ ($\leq 16.33$ kgf); $23 < BMI < 28$ ($\leq 16.67$ kgf); $28 \leq BMI < 30$ ($\leq 17.33$ kgf); $BMI \geq 30$ ($\leq 16.67$ kgf) [7].

The BMI was obtained by dividing body mass in kilograms by height in meters squared ($BMI = Kg/m^2$). The following cut-off points for different categories used by the Nutrition Surveillance System – SISVAN – of the Ministry of Health were used: Low Weight ($\leq 22$), Eutrophic ($> 22$), Overweight ($\geq 27$) [8]. Physical activity was considered regularly practiced if the elderly individual had participated in leisure time physical activities thrice or more in a week for more than thirty minutes in the last two weeks (WHO) [9].

Regarding DM, data on the time of diagnosis of the disease, the values of laboratory tests of glycated hemoglobin and glycemia for the last six months, and medication used for diabetes (oral medication, insulin therapy, or oral medication associated with insulin therapy) were collected.

The patient reported on the occurrence of falls in the last six months and the fear of falls. In addition, all the participants were asked about whether they felt dizzy. Any feeling of spinning, turning, feeling empty or heavy headed, dizziness, or fluctuation were considered dizziness [10].

The mobility assessment was performed through the TUG test. This is a simple, quick application method that has great value for mobility assessment involving dynamic balance, gait speed, and functional capacity. This test consists of timing the time spent on the task of getting up from a chair (from the leaning position), walking three meters on a path on the ground, turning and walking back on the same course, and sitting again with the back supported on the back of the chair [11]. The factors related to the performance on the test, such as reaction time, lower limb muscle strength, balance, and gait ease can be used as a predictor of decreased functional capacity. If the test performance exceeds 13.6 seconds, it may indicate the likelihood of decreased mobility and increased risk of falls.

The psycho-cognitive data were evaluated using the MMSE and the GDS-15. The MMSE was used to track cases with suspected cognitive impairment. The cut-off grades were adopted according to years of schooling: 20 for those who had no formal education, 25 for patients with 1 to 4 years of schooling, 26 for patients with 5 to 8 years of schooling, 28 for patients with 9 to 11 years of schooling, 29 for individuals with schooling over 11 years [12]. The authors suggest individuals with scores lower than the medians described should undergo a more detailed neuropsychological evaluation.

The Abridged GDS-15 is an instrument that can be easily and quickly applied, and is capable of identifying signs of depression in elderly patients. This version consists of 15 questions, with scores from 0 to 4 indicating non-depressed patients, 5 to 10 points indicating mild or moderate depression, and 11 to 15 points indicating evidence of severe or severe depression [13].

The fragility phenotype was evaluated according to the recommendations established in the literature, using the following five items [14]:

1) Unintentional weight loss: The participants were asked if they had lost 4.5 kg or more

or approximately 5% of their previous year's body weight in the past one year from the interview date. If yes, one point was added.

2) Low level of physical activity: It was evaluated using the short version of the International Physical Activity Questionnaire (IPAQ) [15]. One point was added for the elderly classified as irregularly active or sedentary;
3) Exhaustion by self-report of fatigue: Assessment of the elderly according to the cut off on two items of the Center for Epidemiologic Studies for Depression (CES-D) Scale [16] , namely, "I was bothered by things that usually don't bother me" and "I did not feel like eating; my appetite was poor." These questions could be responded on the following scale: "Rarely or none of the time (less than 1 day )" "Some or a little of the time (1-2 days)," "Occasionally or a moderate amount of time (3-4 days)," Most or all of the time (5-7 days)." If a score of 3 or 4 was obtained on any of the statements, one point was added;
4) Decrease in gait speed: It was calculated by the time in seconds spent to cover 4.6 meters in three trials. The average of the values was taken adjusted for sex and height [17]. The following values were used for men: 0 < height ≤ 168 (≤ 5.49 seconds); height > 168 (≤ 5.54 seconds). The following values were used for women: 0 < height ≤ 155 (≤ 6.61 seconds); height > 155 (≤ 5.92 seconds). If the participant scored higher than expected, one point was added;
5) Decreased hand grip strength evaluated using the hand grip dynamometer: The participant was in a sitting position, with feet resting on the floor and the dominant hand on the evaluation table. The hold was gripped thrice to obtain a mean. The following values of BMI and grip strength were used [7]: For men: 0 < BMI ≤ 23 (≤ 27.00 kgf); 23 < BMI < 28 (≤ 28.67 kgf); 28 ≤ BMI < 30 (≤ 29.50 kgf); BMI ≥ 30 (≤ 28.67 kgf). For women: 0 < BMI ≤ 23 (≤ 16.33 kgf); 23 < BMI < 28 (≤ 16.67 kgf); 28 ≤ BMI < 30 (≤ 17.33 kgf); BMI ≥ 30 (≤ 16.67 kgf). One point was added for the elderly who scored below the value expected.

At the end of the phenotype assessment, the participant was categorized as fragile when they had scored three points or more, pre-fragile when they had scored one or two points, and non-fragile when they had not scored any points [14].

### Statistical analysis

All statistical procedures were performed using SPSS software version 20.0 for Windows. Initially, simple descriptive analyses were performed. For the bivariate analysis, associations between the dependent variable HGS (reduced HGS / normal HGS) and the independent qualitative variables were verified using the chi-square test. For quantitative independent variables, the Mann-Whitney or Kruskal-Wallis test was used, considering that the dependent variable showed a non-normal distribution, using the Kolmogorov-Smirnov test. For all statistical analyses, a significance level of 5% ($p < 0.05$) was adopted.

## Results

The sample comprised 156 elderly individuals (n = 156) with a diagnosis of DM2, with an average age of 69.7 ± 6.5 years. The characteristics of the sample are shown in Table 1.

**Table 1** – Descriptive and inferential analysis of sociodemographic, clinical, and psychocognitive data of a sample of 156 elderly people with Type 2 Diabetes Mellitus evaluated in a university hospital in the Northeast of Brazil (Natal, 2017)

| Hand Strength | Groups | N | % | p value |
|---|---|---|---|---|
| Sex | Female | 102.0 | 65.4 | p < 0.001 |
| | Male | 54.0 | 34.6 | |
| Age group | 60-64 years | 44.0 | 28.2 | p = 0.049 |
| | 65-69 | 50.0 | 32.1 | |
| | 70-74 | 27.0 | 17.3 | |
| | 75-79 | 20.0 | 12.8 | |
| | 80 years or more | 15.0 | 9.6 | |

(To be continued)

**Table 1** – Descriptive and inferential analysis of sociodemographic, clinical, and psychocognitive data of a sample of 156 elderly people with Type 2 Diabetes Mellitus evaluated in a university hospital in the Northeast of Brazil (Natal, 2017)

| Hand Strength | Groups | N | % | p value |
|---|---|---|---|---|
| Schooling | No formal education | 28.0 | 17.9 | p = 0.86 |
| | Incomplete Elementary I | 57.0 | 36.5 | |
| | Complete Elementary I | 40.0 | 25.6 | |
| | Post Elementary I | 31.0 | 19.9 | |
| Civil status | Without marital life | 56.0 | 35.9 | p = 0.004 |
| | With marital life | 100.0 | 64.1 | |
| Subjective perception of health | Excellent | 4.0 | 2.6 | p = 0.13 |
| | Very good | 13.0 | 8.3 | |
| | Good | 71.0 | 45.5 | |
| | Bad | 59.0 | 37.8 | |
| | Very bad | 9.0 | 5.8 | |
| Subjective perception of vision | Excellent | 7.0 | 4.5 | p = 0.25 |
| | Very good | 8.0 | 5.1 | |
| | Good | 69.0 | 44.2 | |
| | Bad | 57.0 | 36.5 | |
| | Very bad | 15.0 | 9.6 | |
| Subjective perception of hearing | Excellent | 10.0 | 6.4 | p = 0.17 |
| | Very good | 17.0 | 10.9 | |
| | Good | 86.0 | 55.1 | |
| | Bad | 37.0 | 23.7 | |
| | Very bad | 6.0 | 3.8 | |
| Physical activity practice | Yes | 38.0 | 24.4 | p = 0.006 |
| | No | 118.0 | 75.6 | |
| Number of diseases | One or two | 25.0 | 16.0 | p = 0.022 |
| | Three or four | 74.0 | 47.4 | |
| | Five or more | 57.0 | 36.5 | |
| Number of drugs | Without use | 1.0 | 0.6 | p = 0.144 |
| | One or two | 13.0 | 8.4 | |
| | Three or four | 42.0 | 27.3 | |
| | Five or more | 98.0 | 63.6 | |
| Use of insulin therapy | Yes | 48.0 | 31.4 | p = 0.031 |
| | No | 105.0 | 68.6 | |
| Gear assist device | Use | 11.0 | 7.1 | p = 0.84 |
| | Without use | 145.0 | 92.9 | |
| Pain in lower limbs | Yes | 82.0 | 52.6 | p < 0.001 |
| | No | 74.0 | 47.4 | |
| Falls in the last year | None | 93.0 | 59.6 | p = 0.004 |
| | One fall | 30.0 | 19.2 | |
| | Two or more | 33.0 | 21.2 | |
| Fear of falls | Yes | 121.0 | 78.1 | p = 0.003 |
| | No | 34.0 | 21.9 | |
| Dizziness | Yes | 70.0 | 44.9 | p = 0.133 |
| | No | 86.0 | 55.1 | |
| Mini mental state examination | With cognitive deficit | 68.0 | 43.9 | p = 0.019 |
| | Without cognitive deficit | 87.0 | 56.1 | |
| Geriatric depression scale | Depressive symptoms | 80.0 | 51.6 | p = 0.008 |
| | Normal | 75.0 | 48.4 | |
| Fragility phenotype | Non-fragile | 12.0 | 9.7 | p < 0.001 |
| | Pre-fragile | 58.0 | 46.8 | |
| | Fragile | 54.0 | 43.5 | |

Elderly participants reported good general health (45.5%), good vision (44.2%), and good hearing (55.1%), and most reported not practicing physical activity (75.6%). Of these, 47.4% reported having three or four diagnosed conditions and 63.6% reported using five or more drugs, with a mean of 5.9 ± 2.8. The diagnosis time of DM2 prevailed for more than five years (65.4%), the most used medication for the control of the disease was oral medication (63.2%), and 68.6% reported not using insulin in the treatment of DM2.

The participants reported not using a gait aid device (92.9%) and complained of pain in the lower limb (52.6%) with a mean of 3.4 ± 3.7 pain according to EVA. The participants reported not feeling dizzy (55.1%), 59.6% did not report falls in the last year, 46.8% of the elderly were pre-fragile, and 43.5% were fragile.

Of the sample, 56.1% did not present cognitive deficits, with a mean score of 23.6 ± 4.3 on the MMSE and 51.6% exhibited depressive symptoms. The mean GDS was 4.9 ± 2.7 points, and the mean TUG was 11.5 ± 4.5 seconds. The mean HGS was 22.2 ± 8.4 kg/F, and 58.1% of the elderly did not present HGS reduction.

Regarding the reduction in HGS, evaluated using a qualitative variable, a significant relationship was found with the following variables: TUG ($p = 0.01$), fragility burden ($p < 0.001$), EVA ($p = 0.02$), MMSE ($p = 0.04$). Individuals who presented lower palmar grip strength had a longer TUG time, were fragile, complained of pain in lower limbs, and had cognitive deficit. The other quantitative variables were not significant, as shown in Table 2.

**Table 2** – Inferential analysis between the reduction in the palmar grip strength and the clinical-functional, and cognitive variables of a sample of 156 elderly people with Type 2 Diabetes Mellitus evaluated in a university hospital in northeastern Brazil (Natal, 2017)

| Hand Strength Reduction | Means (ST) | Median | Variation | CI (95%) | p-value |
|---|---|---|---|---|---|
| Age | 69.7 (6.5) | 67.0 | 60.0-86.0 | 67.7-69.9 | p = 0.07 |
| Years of schooling | 7.0 (5.1) | 7.0 | 0.0-21.0 | 6.0-8.0 | p = 0.16 |
| Body Mass Index | 28.6 (4.3) | 28.4 | 16.8-41.6 | 27.8-29.4 | p = 0.19 |
| Number of drugs | 5.7 (2.8) | 5.0 | 0.0-14.0 | 5.1-6.2 | p = 0.63 |
| Analogic visual scale | 2.9 (3.6) | 0.0 | 0.0-10.0 | 2.3-3.6 | p = 0.02 |
| Geriatric depression scale | 4.9 (2.7) | 5.0 | 0.0-12.0 | 4.4-5.4 | p = 0.17 |
| Mini mental state examination | 23.9 (4.3) | 25.0 | 14.0-30.0 | 23.1-24.7 | p = 0.04 |
| Timed up and go | 10.8 (3.6) | 10.0 | 6.1-25.0 | 10.1-11.5 | p = 0.007 |
| Frailty burden | 2.2 (1.6) | 2.0 | 0.0-5.0 | 1.9-2.4 | p < 0.001 |

Significant relationships were found between the "mean HGS" and the other qualitative variables: gender ($p < 0.001$), age group ($p = 0.049$), marital status ($p = 0.040$), physical activity ($p = 0.001$), number of diagnosed conditions ($p = 0.022$), use of insulin therapy ($p = 0.031$), complaint of pain in the lower limbs ($p < 0.001$), MMSE ($p = 0.019$), GDS ($p = 0.008$), fragility phenotype ($p < 0.001$); the mean of HGS was lower in female participants with a more advanced age group (80 years or more), who did not have a marital life, had five or more conditions diagnosed, did not practice physical activity regularly, were using insulin therapy, complained of pain in the lower limb, had a history of two or more falls in the last year, were afraid of falls, had a cognitive deficit, presented depressive symptoms, and were characterized as fragile, as shown in Table 1.

## Discussion

This study aimed to determine the sociodemographic, clinical-functional, and psycho-cognitive factors related to the reduction in the palmar grip strength among elderly with type 2 DM and to verify the relationship between HGS and frailty.

The sociodemographic data from this study demonstrate a prevalence of DM2 in women, according to other authors [18, 19] and among obese people. The study also identified a predominant age group prone to DM2 agreeing with the previously identified survival bias in diabetes, in which complications caused by the disease led to early deaths among the elderly. Low schooling, in turn, hampers the acquisition of knowledge of diabetes,

the new life habits, and the guidelines related to disease care, such as the practice of physical activity, since sedentarism is one of the risk factors.

A consequence already described in the literature is the association between falls and DM2 among the elderly. In this study, 50% of the sample reported at least one episode of fall from the previous year to the time of the evaluation. This is a cause of concern owing to the negative consequences of an episode of fall in this population.

The chronicity of DM2, evidenced by the time of diagnosis, physical inactivity, and deregulated feeding [20] are associated with health complications such as cardiovascular diseases, amputation, renal insufficiency, retinopathies, neuropathy, foot ulcers [21], as well as the use of polypharmacy to maintain metabolic control and prevent the progression of comorbidities [22].

The most suitable measure for the evaluation of muscular strength in the elderly population is the HGS, since it is indicative of global muscle shape [23] and is considered a predictor of disability, in addition to not requiring excessive effort. Regarding the reduction in HGS, an inverse association was found with the time reached in the TUG by the elderly. It has already been described in the literature that impairment in the mobility of the elderly, evaluated through changes in the dynamic balance, gait speed, and functional capacity by TUG, are related to the reduction in the lower limb muscle strength [24].

The greater reserve of muscle mass in males [25] may explain why HGS was higher in males. In addition, elderly individuals who did not have pain in the lower limbs or did not have a history of falls, practiced physical activity, and did not use a walking aid had normal HGS. Pain in the lower limbs is associated with a lower gait velocity in the elderly [26], as well as with loss of muscle strength due to disuse, prolonged rest, or lack of physical activity, which influences the occurrence of falls [27] and not using walking aids for fear of recurrent falls [28].

Similar to another study [29], an inverse association was found between the decrease in HGS and frailty burden. Reduction in HGS has been identified as an initial manifestation, present in other disabilities, and the most frequent phenotype in the fragility syndrome.

In turn, muscle weakness is one of the factors affecting reversible fragility in the elderly population. Several studies have shown that resistance training should be provided for elderly individuals as an effective and safe way to improve muscle strength and functional capacity.

Significant relationships were found between reduction in HGS among elderly individuals who did not have a marital life, had five or more comorbidities, and used polypharmacy, which agrees with the literature [29]. It is known to trigger the cycle of fragility in the elderly owing to the presence of many diseases [30] and the use of drugs to control them, such as psychotropic [31] and cardiovascular [32], also intervening in the reduction of HGS and affecting the population's functional capacity.

The reduction in FGS in most of diabetic patients observed in this study is attributed to insulin resistance and hyperglycemia, which causes changes in the energetic properties of muscle cells (reduction in the number of mitochondria, glycogen synthesis, and increase in circulating systemic inflammatory cytokines) and detriment of skeletal muscle structure and function [33].

A multidisciplinary approach, with the participation of several health professionals, is the most appropriate form of treatment. Physiotherapy plays an important role in the rehabilitation of patients with HGS reduction, helping both the reversal of the condition and the prevention of the onset of global muscle strength and Frailty Syndrome, as well as the promotion of independence and quality of life.

## Conclusion

Based on the data, one can conclude that palmar grip strength reduced in elderly individuals with Type 2 Diabetes Mellitus who were female, did not have a marital life, had five or more diseases diagnosed, were using insulin therapy, were not engaged in regular physical activity, complained of pain in lower limbs, had a history of two or more falls in the last year, had a fear of falling, had a cognitive deficit, presented depressive symptoms, and were fragile.

The HGS assessment is a valuable tool for predicting overall muscle strength, physical fitness, functionality, and consequently, functional capacity. The knowledge of the variables related to the reduction in HGS in diabetic elderly can serve as a basis for offering adequate diagnosis and therapeutic planning, focusing on the complications of the disease and on its repercussions in this population.

Based on the results of this study, identifying the factors related to HGS reduction in the elderly with DM2 was possible, and one suggests performing future studies with this population.

## References

1. Cecilio HPM, Arruda GO, Teston EF, Santos AL, Marcon SS. Comportamentos e comorbidades associados às complicações microvasculares do diabetes. Acta Paul Enferm. 2015;28(2):113-9.

2. Ferreira MC, Tozatti J, Fachin SM, Oliveira PP, Santos RF, Silva MER. Redução da mobilidade functional e da capacidade cognitiva no Diabete Melito tipo 2. Arq Bras Endocrinol Metab. 2014;58(9):946-52.

3. Silva AP, Pureza DY, Landre CB. Síndrome da fragilidade em idosos com diabetes mellitus tipo 2. Acta Paul Enferm. 2015;28(6):503-9.

4. Belmonte LM, Lima IAX, Belmonte LAO, Gonçalves VP, Conrado JC, Ferreira, DA. Força de preensão manual de idosos participantes de grupos de convivência. Rev Bras Promoç Saude. 2014;27(1):85-91.

5. American Diabetes Association. Diagnosing Diabetes and learning about prediabetes. 2016 [cited 2017 Apr 29]. Available from: http://bit.ly/2EdDLlb .

6. Bohannon RW, Peolsson A, Massy-Westropp N, Desrosiers J, Bear-Lehman J. Reference values for adult grip strength measured with a Jamar dynamometer: a descriptive metaanalysis. Physiother. 2006;92(1):11-5.

7. Maruccim BA. Estado nutricional e capacidade física. In: Lebrão ML, Duarte YAO. Sabe: saúde, bem-estar e envelhecimento: projeto Sabe no município de São Paulo: uma abordagem inicial. Brasília, DF: Organização PanAmericana da Saúde; 2003. p. 93-118.

8. Brasil. Ministério da Saúde. Vigilância alimentar e nutricional: Sisvan: orientações básicas para a coleta, processamento, análise de dados e informação em serviços de saúde. Brasília, DF: Ministério da Saúde, 2004.

9. World Health Organization-WHO. Physical activity and older adults. 2010 [cited 2019 Apr 30]. Available from: http://bit.ly/2VLoRgC.

10. Ganança MM, Caovilla HH. Desequilíbrio e reequilíbrio: vertigem tem cura? São Paulo: Lemos; 1998. p. 13-9.

11. Aveiro MC, Driusso P, Barham EJ, Pavarini SCI, Oishi J. Mobilidade e risco de quedas de população idosa da comunidade de São Carlos. Cienc Saude Coletiva. 2012;17(9):2481-8.

12. Brucki SMD, Nitrini R, Caramelli P, Bertolucci PHF, Okamoto IH. Sugestões para o uso do mini-exame do estado mental no Brasil. Arq Neuropsiquiatr. 2003;61(3B):777-81.

13. Yesavage JA, Brink TL, Rose Tl, Lum O, Huang V, Adey M, et al. Development and validation of geriatric depression screening scale: a preliminary report. J Psychiatr Res. 1983;17(1):37-49.

14. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci. 2001;56(3):M146-56.

15. Mazo GZ, Benedetti TRB. Adaptação do questionário internacional de atividade física para idosos. Rev Bras Cineantropom Desempenho Hum. 2010;12(6):480-4.

16. Batistoni SST, Neri AL, Cupertino APFB. Validity of the Center for Epidemiological Studies depression scale among Brazilian elderly. Rev Saude Publica. 2007;41(4):598-605.

17. CostaTB, Neri AL. Medidas de atividade física e fragilidade em idosos: dados do FIBRA Campinas, São Paulo, Brasil. Cad Saude Publica. 2011;27(8):1537-50.

18. Silva AB, Engroff P, Sgnaolin V, Ely LS, Gomes I. Prevalência de diabetes mellitus e adesão medicamentosa em idosos da Estratégia Saúde da Família de Porto Alegre/RS. Cad. Saude Colet. 2016;24(3):308-16.

19. Francisco PMSB, Belon AP, Barros MBA, Carandina L, Alves MCGP, Goldbaum M, et al. Diabetes auto-referido em idosos: prevalência, fatores associados e práticas de controle. Cad Saude Publica. 2010;26(1):175-84.

20. Organização Pan-Americana da Saúde. Doenças crônico-degenerativas e obesidade: estratégia mundial sobre alimentação saudável, atividade física e saúde. Brasília: Organização Pan-Americana da Saúde; 2003.

21. Sousa EL, Martins MM, Costa MS, Moreira MRC, Silva AO. Qualidade de vida e fatores associados à saúde de idosos diabéticos. Rev Enferm UERJ. 2016;24(5):e8456.

22. Rozenfeld S. Prevalência, fatores associados e mau uso de medicamentos entre os idosos: uma revisão. Cad Saude Publica. 2003;19(3):717-24.

23. Wu SW, Wu SF, Liang HW, Wu Z, Huang S. Measuring factors affecting grip strength in a Taiwan Chinese population and a comparison with consolidated norms. Appl Ergon. 2009;40(4):811-5.

24. Buchner DM, Larson EB, Wagner EH, Koepsell TD, Lateur BJ. Evidence for a non-linear relationship between leg strength and gait speed. Age Ageing. 1996;25(5):386-91.

25. Adedoyin RA, Ogundapo FA, Mbada CE, Adekanla BA, Johnson OE, Onigbinde TA, et al. Reference values for handgrip strength among healthy adults in Nigeria. Hong Kong Physiother J. 2009;27:21-9.

26. Chaiwanichsiri D, Janchai S, Tantisiriwat N. Foot disorders and falls in older persons. Gerontol. 2009;55(3):296-302.

27. Cruz HMF, Pimenta CAM, Dellarozza MSG, Braga PE, Lebrão ML, Duarte YAO. Quedas em idosos com dor crônica: prevalência e fatores associados. Rev Dor. 2011;12(2):108-14.

28. Rossetin LL, Rodrigues EV, Gallo LH, Macedo DS, Schieferdecker MEM, Pintarelli VL, et al. Indicadores de sarcopenia e sua relação com fatores intrínsecos e extrínsecos às quedas em idosas ativas. Rev Bras Geriatr Gerontol. 2016;19(3):399-414.

29. Lenard MH, Binotto MA, Carneiro NHK, Cechinel C, Betiolli E, Lourenço TM. Força de preensão manual e atividade física em idosos fragilizados. Rev Esc Enferm USP. 2016;50(1):88-94.

30. Fried L, Ferrucci L, Darer J, Williamson JD, Anderson G. Untangling the concepts of disability, frailty and comorbidity: implications for improved targeting and care. J Gerontol A Biol Sci Med Sci. 2004;59(3):255-63.

31. Galik E, Resnick B. Psychotropic medication use and association with physical and psychosocial outcomes in nursing home residents. J Psychiatr Ment Health Nurs. 2013;20(3):244-52.

32. Ashfield TA, Syddall HE, Martin HJ, Dennison EM, Cooper C, Sayer AA. Grip strength and cardiovascular drug use in older people: findings from the Hertfordshire Cohort Study. Age Ageing. 2010;39(2):185-91.

33. Helmersson, J, Vessby B, Larsson A, Basu S. Association of type 2 diabetes with cyclooxygenase-mediated inflammation and oxidative stress in an elderly population. Circulat. 2004;109:1729-34.

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