Factors associated with the functional performance of older adults with type 2 Diabetes Mellitus

Fatores associados ao desempenho functional de idosos com Diabetes Mellitus tipo 2

Factores asociados al desempeño funcional en ancianos con diabetes mellitus tipo 2

Vanessa da Nóbrega Dias

ORCID: https://orcid.org/0000-0003-4064-7207

Federal University of Rio Grande do Norte, Brazil

E-mail: vanessanobrega.d@hotmail.com

Adriana Guedes Carlos

ORCID: https://orcid.org/0000-0003-0747-5044

Federal University of Rio Grande do Norte, Brazil

E-mail: adrianaguedes@hotmail.com

Alice Fernandes de Lemos

ORCID: https://orcid.org/0000-0001-9675-5704

University of the State of Rio de Janeiro, Brazil

E-mail: lice_lemos@msn.com

Bartolomeu Fagundes de Lima Filho

ORCID: https://orcid.org/0000-0002-3326-389X

Federal University of Rio Grande do Norte, Brazil

E-mail: bartolomeu_fagundes2@hotmail.com

Mônica Rodrigues Perracini

ORCID: https://orcid.org/0000-0001-9331-3820

University City of São Paulo, Brazil

E-mail: monica.perracini@unicid.edu.br

André Gustavo Pires de Sousa

ORCID: https://orcid.org/0000-0001-8426-2320

Federal University of Rio Grande do Norte, Brazil

E-mail: agpsousa@ig.com.br

Juliana Maria Gazzola

ORCID: https://orcid.org/0000-0002-9333-1831

Federal University of Rio Grande do Norte, Brazil

E-mail: juliana.gazzola@terra.com.br

Abstract

The aim of this study was to investigated factors associated with the functional impairment of older adult patients with type 2 diabetes mellitus (type 2 DM) and identify the influence of sociodemographic, clinical, and functional factors in this population. This is an observational analytical, and cross-sectional study, which evaluated 159 individuals of both genders, aged 60 years or older. The WHODAS (World Health Organization Disability Assessment Schedule) total score was analyzed in relation to other variables of the study, using the following statistical tests: Mann-Whitney, Kruskal-Wallis, Dunn's post hoc, Spearman correlation, and simple linear regression analysis. Significance level was set at 5% ($p<0.05$). In total, 12 linear regression models were generated and the latter was selected for elaborating the prediction equation and its possible interpretations. Functional impairment was associated with sociodemographic, clinical, and functional factors. Sedentary lifestyle, overweight, cognitive deficit, decreased mobility, and falls were the factors that predicted the restriction of functional performance in older adults with type 2 DM. This study assessed the relationship between sociodemographic, clinical, and functional factors concerning the functional impairment of older adults with type 2 DM, reaffirming that this disease causes negative impacts in a global way and that the association among these factors leads to a decrease in functionality and worsening of life quality in this population. The findings of this study point out the importance of preventive programs in order to promote behavioral changes that can reduce the impact of type 2 DM complications.

Keywords: Persons with disabilities; Functionally impaired older adults; Functional performance.

Resumo

O objetivo deste estudo foi investigar os fatores associados ao comprometimento funcional de idosos com diabetes mellitus tipo 2 (DM tipo 2) e identificar a influência de fatores sociodemográficos, clínicos e funcionais nesta população. Trata-se de um studo observacional, analítico e transversal, que avaliou 159 indivíduos de ambos os sexos, com 60 anos ou mais. O escore total do WHODAS (World Health Organization Disability Assessment Schedule) foi analisado em relação às outras variáveis do estudo, usando os seguintes testes estatísticos: Mann-Whitney, Kruskal-Wallis, post hoc de Dunn, correlação de Spearman e análise de regressão linear simples. O nível de significância foi estabelecido em

5% (p <0,05). No total, foram gerados 12 modelos de regressão linear, sendo este último selecionado para a elaboração da equação de predição e suas possíveis interpretações. O comprometimento funcional foi associado a fatores sociodemográficos, clínicos e funcionais. Sedentarismo, sobrepeso, déficit cognitivo, diminuição da mobilidade e quedas foram os fatores que predisseram a restrição do desempenho funcional em idosos com DM tipo 2. Este estudo avaliou a relação entre fatores sociodemográficos, clínicos e funcionais relativos ao comprometimento funcional de idosos com DM tipo 2, reafirmando que esta doença causa impactos negativos de forma global e que a associação entre esses fatores leva à diminuição da funcionalidade e piora da qualidade de vida dessa população. Os achados deste estudo apontam para a importância de programas preventivos a fim de promover mudanças comportamentais que possam reduzir o impacto das complicações do DM tipo 2.

Palavras-chave: Pessoas com deficiências; Funcionalidade em idodos; Desempenho funcional.

Resumen

El objetivo de este estudio fue investigar los factores asociados al deterioro funcional de los ancianos con diabetes mellitus tipo 2 (DM tipo 2) e identificar la influencia de factores sociodemográficos, clínicos y funcionales en esta población. Este es un estudio observacional, analítico y transversal, que evaluó a 159 individuos de ambos sexos, de 60 años o más. La puntuación total del WHODAS (Programa de evaluación de la discapacidad de la Organización Mundial de la Salud) se analizó en relación con las demás variables del estudio, mediante las siguientes pruebas estadísticas: Mann-Whitney, Kruskal-Wallis, Dunn's post hoc, correlación de Spearman y análisis de regresión lineal. sencillo. El nivel de significancia se fijó en 5% (p <0.05). En total, se generaron 12 modelos de regresión lineal, siendo este último seleccionado para la elaboración de la ecuación de predicción y sus posibles interpretaciones. El deterioro funcional se asoció con factores sociodemográficos, clínicos y funcionales. El estilo de vida sedentario, el sobrepeso, el deterioro cognitivo, la disminución de la movilidad y las caídas fueron los factores que predijeron la restricción del rendimiento funcional en los ancianos con DM tipo 2. Este estudio evaluó la relación entre factores sociodemográficos, clínicos y funcionales relacionados con el deterioro funcional de los ancianos con DM tipo. 2, reafirmando que esta enfermedad genera impactos negativos a nivel mundial y que la asociación entre estos factores conduce a una disminución de la funcionalidad y un empeoramiento de la calidad de vida de esta población. Los hallazgos de

este estudio señalan la importancia de los programas preventivos para promover cambios conductuales que puedan reducir el impacto de las complicaciones de la DM tipo 2.

Palabras clave: Personas con discapacidades; Adultos mayores con discapacidad funcional; Presentación funcional.

1. Introduction

The natural trajectory of type 2 Diabetes Mellitus (type 2 DM) is characterized by being multifactorial, however, insulin resistance and insulin secretion deficiency by β cells are the main factors in the pathogenesis of type 2 DM (Zhao, et al., 2017), which can cause changes in several organs and systems (Kanadani, et al., 2018). Therefore, people diagnosed with this disease are at greater risk of developing multiple complications (Carrera Boada & Martinéz-Moreno, 2013) that can be associated with physical limitations, causing important impairments in quality of life, especially in older adults.

Although research has shown that type 2 DM is associated with functional deficits, few studies have explored the risk factors (de Rekeneire & Volpato, 2015) and assessed the effect of this chronic disease on the functionality of older adults, which is important because it comprises several domains of life that cover the demands involved in different life activities, like cognition, mobility, self-care, balance, activities of daily living, and participation in society.

Thus, it becomes relevant to assess the conditions that are associated with diminished functionality of these persons. Considering that no studies were found in the literature that have evaluated the functionality of this population through the World Health Organization Disability Assessment Schedule (WHODAS), this study aimed to evaluate the factors associated with functional impairment of older adults with type 2 DM and identify the influence of sociodemographic, clinical, and functional factors in this population.

2. Material and Methods

2.1 Study design

This was an exploratory observational, quantitative, analytical, and cross-sectional study (Pereira, et al., 2018), developed in the city of Natal-RN. Initially, 166 older adults were invited to participate in the study, of which 159 (N=159) were selected and 12 were excluded,

according to the inclusion criteria: 1) age 60 years or older; and 2) diagnosis of type 2 DM, according to the American Diabetes Association (ADA). Exclusion criteria were: presence of physical and cognitive limitations that impeded the performance of tests, such as inability to understand and respond to simple verbal commands and imitate movements; presence of serious cognitive deficit evaluated by Mini-Mental State Examination (MMSE <13 points) (Bertolucci, et al., 1994); severely impaired visual and auditory acuity, which could not be compensated by corrective lenses and sound amplification systems, respectively; and refusing to perform all the tests proposed (Figure 1).

Figure 1: Flow diagram for the evolution.
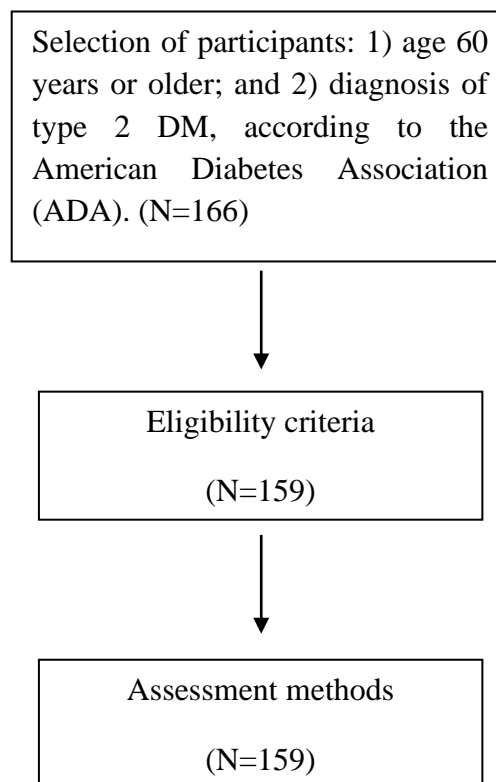
Source: Personal archives, (2020).

This study was approved by the Human Research Ethics Committee of the Federal University of Rio Grande do Norte (UFRN) (Protocol Nº 45185915.9.0000.5537).

2.2 Clinical evaluation

The variables analyzed were classified into sociodemographic data (age, gender, educational level, marital status, and marital life), clinical variables, psycho-cognitive aspects

(MMSE and Abbreviated Geriatric Depression Scale (GDS-15), and evaluation of functionality. Clinical variables included: subjective perception of health, vision and hearing, height, weight and body mass index (BMI), regular physical activity, number of diagnosed diseases, number of medications used, time of diagnosis of type 2 DM, laboratory tests of the last six months for controlling type 2 DM (fasting glycemia and glycated hemoglobin), use of antidiabetic drugs, presence of lower extremity pain (LEP), occurrence, fear and tendency to fall, and presence of dizziness.

2.3 Functional evaluation

Muscle strength was measured by the Hand grip strength test (HSG). This was performed with the SaehanTM palmar grip dynamometer. After adjusting for gender, the mean values found in the three measures were weighed and 37 kg and 21 kg were considered the cutoff points for the male and female older adults, respectively (Sallinen, et al., 2010).

The Timed Up And Go test (TUG) was used to assess mobility (Podsiadlo & Richardson, 1991). A time of 10 seconds or less was considered to indicate older adults who did not present changes of balance nor physical dependencies (Shumway-Cook, et al., 2000). To evaluate the body balance, the Mini-Balance Evaluation Systems Test (MiniBESTest) was used. This instrument consists of 14 tests, including four domains: 1. Anticipatory postural changes and adjustments; 2. Postural responses to disturbance; 3. Sensory orientation; and 4. Stability in gait. The score ranges from 0 to 28 points and higher scores indicate a better body balance of the individual (Padgett, et al., 2012).

Functional performance was assessed using WHODAS 2.0, a short version of 12 items. The scoring method used was a simple sum, with answers ranging from 0 (no problems) to 4 (very serious problems). The general score for the 12 questions ranges between zero and 48 points, which is then converted to a percentile score (Loke, et al., 2011). In this study, the highest quartile values (Q75) were considered as indicating a restriction in functional performance.

2.4 Statistical analysis

A descriptive analysis was used for the initial presentation of the data. Associations were found between the WHODAS 2.0 total score (dependent variable) and the independent qualitative variables using the Mann-Whitney and Kruskal-Wallis tests. When there was a

significant difference, Dunn's post hoc test was applied in order to identify differences between categories. Correlations were verified between the total score of the dependent variable and the independent quantitative variables, using Spearman correlation (ρ), simple linear regression analysis, and the prediction equation. For all statistical analyses, a significance level of 5% ($p < 0.05$) was adopted.

3. Results

The sociodemographic and clinical characteristics of the sample are presented in Table 1.

Table 1: Sociodemographic and clinical characteristics of study participants. Natal, RN.

Variables	Groups	F	%
Gender	Female	102.0	64.2
	Male	57.0	35.8
Subjective perception of health	Excellent/very good/good	90.0	56.6
	Bad/very bad	69.0	43.4
Physical activity practice	Yes	39.0	24.5
	No	120.0	75.5
Type 2 DM medication (N=158)	Does not use oral medication	104.0	65.8
	Insulin/oral medication + insulin	54.0	34.2
Pain in lower limbs	Yes	84.0	52.8
	No	75.0	47.2
Risk of falls (MiniBESTest) (N=152)	High risk of fall	17.0	11.2
	Low high risk of fall	135.0	88.8
Falls in the last year	Yes	62.0	39.0
	No	97.0	61.0
Dizziness	Yes	70.0	44.0
	No	89.0	56.0

Source: Personal archives, (2020).

The mean BMI was 28.5 (4.4) kg/m², with 56.8% presenting a value greater than 27 kg/m², demonstrating that a large number of participants were overweight.

The majority of the older adults reported having a diagnosis of type 2 DM for more than five years (65.6%), with 66.9% not using insulin to control the disease. The mean of glycated hemoglobin (HbA1c) was $9.3 \pm 9.4\%$, a value considered high according to ADA.

Regarding functionality, the mean in the TUG was 11.5 (4.5) seconds, which is considered within the normal limits for mobility of older adults in this community. The mean of HSG was 29.3 (7.4) kg for males and 18.1 (5.8) kg for females. Values for muscle strength were lower than expected for the different categories and mean of the MiniBESTest was between 22.2 (4.5) and 79.2 (16.2) points, indicating good postural balance.

The interviewees presented an average of 11.0 (8.6) and a median of 10.0 points in the WHODAS 2.0. Of the sample, 58.4% presented scores below the upper quartile, that is, they did not experience a restriction on functional performance. Table 2 shows the significant relationships found in this study.

Table 2: Inferential analysis between functional performance assessed by WHODAS 2.0 and sociodemographic, clinical, and functional variables of study participants. Natal-RN.

Variables	Median	Percentiles (IQ25 – IQ75)	Variation	CI (95%)	p[a,b]
Gender					
Female	11.0	2.5-14.5	0.0-28.0	10.7-14.0	**0.008[a]**
Male	5.0	4.7-20.0	0.0-37.0	6.3-10.8	
Subjective perception of health					
Excellent/very good/good	4.0	2.0-10.0	0.0-37.0	5.6-8.6	**<0.001[a]**
Bad/very bad	16.0	11.0-22.0	0.0-33.0	14.2-18.0	
Physical activity practice					
Yes	6.0	2.0-11.0	0.0-28.0	5.6-10.3	**0.004[a]**
No	11.0	4.0-19.0	0.0-37.0	10.6-14.0	
Type 2 DM medication					
Does not use oral medication	9.0	2.5-11.7	0.0-37.0	8.2-11.5	**0.029[b]**

Insulin/oral medication + insulin	14.0	3.7-15.0	0.0-28.0	10.7-15.8	
Pain in lower limbs					
Yes	14.0	8.0-20.0	0.0-33.0	12.4-16.0	**<0.001ᵃ**
No	4.0	2.0-11.0	0.0-37.0	5.6-9.2	
Falls in the last year					
Yes	14.5	3.0-14.0	0.0-33.0	12.2-16.7	**<0.001ᵇ**
No	6.0	3.0-20.5	0.0-37.0	7.2-10.4	
Risk of falls (MiniBESTest)					
High risk of fall	21.0	13.0-25.5	4.0-33.0	15.4-23.7	**<0.001ᵃ**
Low high risk of fall	8.0	3.0-15.0	0.0-28.0	8.2-10.8	
Dizziness					
Yes	13.5	7.7-20.0	0.0-37.0	11.8-16.0	**<0.001ᵃ**
No	6.0	3.0-14.0	0.0-28.0	7.0-10.3	

[a]*Mann-Whitney*
[b]*Kruskal-Wallis*
Level of significance: α=0.05
In order to perform the linear regression analysis, we selected the variables that presented a statistically significant correlation (p<0.05) in the inferential analysis.
Source: Personal archives, (2020).

The quantitative variables with significant correlations were: years of education ($p<0.001$; $r=-0.33$), BMI ($p=0.005$; $r=0.22$), number of diseases ($p<0.001$; $r=0.40$), number of drugs ($p<0.001$; $r=0.31$), diagnostic time ($p=0.02$; $r=0.18$), glycated hemoglobin ($p=0.01$; $r=0.22$), dynamometry ($p=0.006$; $r=-0.27$), MMSE ($p<0.001$; $r=-0.32$), GDS ($p<0.001$; $r=0.61$), MiniBESTest ($p<0.001$; $r=-0.49$), and TUG ($p<0.001$; $r=0.45$).

A total of 12 linear regression models were generated, and the latter was selected. It was verified that physical activity practice, risk of falls, history of falls in the last year, BMI, MMSE, and motor TUG were the significant predictive variables of impairment in functional performance. According to the value of adjusted R, these variables explained 56.2% of the study outcome. Table 3 shows the relationship between variables and functional performance.

Table 3: Multivariate linear regression analysis with the WHODAS score results. Natal-RN.

Variables	B	β	p	CI 95%
Physical activity practice	3.86	0.21	0.015	0.67 - 7.05
Risk of falls	-5.45	-0.21	0.022	-10.17 - 0.72
Falls in the last year	3.08	0.18	0.077	-0.30 - 6.48
Body Mass Index	0.45	0.25	<0.001	0.12 - 0.78
Mini Mental State Examination	-0.67	-0.31	<0.001	-1.07 - -0.27
Time Up and Go	0.28	0.38	<0.001	0.15 - 0.40

The influence of the variables can be expressed from the prediction equation: WHODAS = 10.58 + [regular practice of physical activity x (3.86)] + [risk of falls x (-5.45)] + [falls in the last year x 3.08] + [BMI x 0.45] + [MMSE x (-0.67)] + [motor TUG x 0.28].
Source: Personal archives, 2020.

4. Discussion

This study assessed the relationship between sociodemographic, clinical, and functional factors concerning the functional impairment of older adults with type 2 DM, reaffirming that this disease causes negative impacts in a global way and that the association among these factors leads to a decrease in functionality and worsening of life quality in this population.

Previous studies have shown that older adults with diabetes have two to three times greater risk of developing functional disabilities than non-diabetic individuals due to the occurrence of an accelerated loss of muscle mass (Chau, et al., 2011). Older adults that suffer from mobility deficiency, pain in the lower limbs, history of falls, and dizziness have greater impairment in daily life activities. In addition, those with cognitive decline and depressive symptoms present difficulties in managing medication, using health care services, and dealing with complications (Kim, et al., 2015), which makes it even more difficult to control the disease and practice physical activity, leading to worsening health conditions and functional limitations due to the impact on self-care.

A systematic review (Kan, et al., 2013) suggested that there is a bidirectional association between diabetes and depression. Depression may lead to non-adherence to treatment, poor sleep quality, and decreased metabolism of medications, as well as loss of self-confidence and independence in daily and social life activities, causing isolation in

geriatric individuals. These factors can aggravate patients' condition and have been related to an increased risk of falls.

Our results confirm the findings of previous studies revealing that there is a high risk of falls and disability in diabetic older adults (Roman de Metteling, et al., 2013; Kachro, et al., 2015). According to research, this is associated with cognitive impairment due to attention deficit, slowing of the gait speed, and orthotic hypotension. In addition, these individuals present postural balance and gait impairment due to changes in sensory systems and decreased muscle strength, demonstrated in peripheral neuropathy and sarcopenia, respectively (Chiba, et al., 2015).

A meta-analysis indicated that the annual incidence of disability in people with diabetes is about 10% compared with less than 5% in people without diabetes (Wong, et al., 2013). This points to the fact that evaluating the factors that are related to functional impairment in this population is critical to attaining a preventive approach and emphasizes the need for understanding functional incapacity and diabetes, especially in middle-aged and older people. Early diagnosis will allow interventions that are preventive and directed at individuals who are at greater risk (Mendes, et al., 2011).

The evidence found in the present study that functional limitations in older adults with type 2 DM are associated with socio-demographic, clinical, and functional factors needs to be disclosed among health professionals, due to the negative impacts caused globally on these individuals with the consequent impairment in quality of life. These findings highlight the need to prioritize research concerning the factors associated with the appearance of functional deficits in this population, considering that the possibility of intervening in the delay of the onset of disability can reduce the number of dependent older adults.

Finally, it is important to carry out longitudinal studies that more accurately assess the impact of the pathophysiology of type 2 DM on the organs and systems of the body and its consequences on the functional limitations of older adults.

5. Conclusion

In summary, this study showed that female gender, poor perception of health, no physical activity, use of oral medication and insulin to control the disease, presence of pain in the lower limbs, increased risk of falls, and dizziness were factors associated with the functional impairment in older adults with type 2 DM. Being sedentary, overweight, cognitive deficit, mobility decrease, and falls were factors that predicted restriction related to functional

performance in this population.

Maintaining the functionality of older adults with type 2 DM is assuredly related to a better quality of life. The findings of this study point to the importance of preventive programs in order to provide behavioral changes that can reduce type 2 DM complications. Clinical trials are suggested to confirm the findings of this observational study.

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Percentage of contribution of each author in the manuscript

Vanessa da Nóbrega Dias – 40%

Adriana Guedes Carlos – 10%

Alice Fernandes de Lemos – 10%

Bartolomeu Fagundes de Lima Filho – 10%

Mônica Rodrigues Perracini – 5%

André Gustavo Pires de Sousa – 5%

Juliana Maria Gazzola – 20%