Bruno de Souza Moreira

MEDO DE CAIR EM IDOSOS COM E SEM DIABETES MELLITUS:
Estudo conduzido em idosos da comunidade e da Rede FIBRA

Belo Horizonte
Escola de Educação Física, Fisioterapia e Terapia Ocupacional da UFMG
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MEDO DE CAIR EM IDOSOS COM E SEM DIABETES MELLITUS: Estudo conduzido em idosos da comunidade e da Rede FIBRA

Tese apresentada ao Programa de Pós-Graduação em Ciências da Reabilitação da Escola de Educação Física, Fisioterapia e Terapia Ocupacional da Universidade Federal de Minas Gerais, como requisito parcial para obtenção do título de Doutor em Ciências da Reabilitação.

Área de Concentração: Desempenho Funcional Humano
Linha de Pesquisa: Saúde e Reabilitação do Idoso
Orientadora: Profª. Dra. Renata Noce Kirkwood
Coorientadora: Profª. Dra. Rosângela Corrêa Dias

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Dedico esta tese a minha estimada mãe que durante sua breve jornada me estimulou a buscar continuamente o conhecimento.

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... E vamos lá para os novos desafios!

“Até onde posso vou deixando o melhor de mim...
Se alguém não viu, foi porque não me sentiu com o coração.”
Clarice Lispector

"Olhar para trás após uma longa caminhada pode fazer perder a noção da distância que percorremos, mas se nos detivermos em nossa imagem, quando a iniciamos e ao término, certamente nos lembraremos do quanto nos custou chegar até o ponto final, e hoje temos a impressão de que tudo começou ontem."
Guimarães Rosa

PREFÁCIO

Este volume contém a tese apresentada ao Programa de Pós-Graduação em Ciências da Reabilitação da Escola de Educação Física, Fisioterapia e Terapia Ocupacional da Universidade Federal de Minas Gerais e insere-se na linha de pesquisa denominada Saúde e Reabilitação do Idoso.

A presente tese tem como objetivo geral identificar fatores relacionados ao medo de cair em idosos da comunidade com e sem diabetes mellitus. Foram realizados dois estudos independentes a partir de dois bancos de dados distintos, sendo um banco de dados constituído somente por mulheres idosas diabéticas recrutadas por conveniência em Belo Horizonte e região metropolitana e, outro banco, formado pelos dados nacionais do estudo multicêntrico, multidisciplinar e epidemiológico denominado Estudo da Fragilidade em Idosos Brasileiros (Rede FIBRA).

A tese é apresentada no formato opcional, previsto pelo regulamento do Programa, sendo dividida nas seguintes seções: (a) introdução, contemplando a revisão da literatura e justificativas dos Estudos A e B; (b) objetivos e métodos expandidos dos estudos.

Os resultados desta pesquisa geraram dois artigos científicos. O primeiro artigo, intitulado **"*The geriatric depression scale and the timed up and go test predict fear of falling in community-dwelling elderly women with type 2 diabetes mellitus: a cross-sectional study*"[1]**,foi publicado, em março de 2016, no periódico ***BMC Geriatrics***. O segundo artigo, intitulado **"*Factors associated with fear of falling in community-dwelling older adults with and without diabetes mellitus: findings from the Frailty in Brazilian Older People Study (FIBRA-BR)*"[2]**, foi publicado, em março de 2017, no periódico ***Experimental Gerontology***.

Em seguida, estão apresentadas as considerações finais e referências bibliográficas utilizadas, as quais estão de acordo com as normas da Associação Brasileira de Normas Técnicas (ABNT). Por fim, estão incluídos os anexos pertinentes e os apêndices, com destaque para dois artigos publicados, um relacionado ao tema principal da tese, intitulado ***"Clinical functional tests help identify elderly women highly concerned about falls"[3]***, publicado no periódico ***Experimental Aging Research*** e, outro artigo, sobre a população de

interesse da presente tese, intitulado ***"The relationship between diabetes mellitus, geriatric syndromes, physical function, and gait: a review of the literature"***[4], publicado no periódico ***Current Diabetes Reviews***. Além disso, há uma breve apresentação de outras produções importantes publicadas e submetidas para publicação durante o período do doutorado.

[1]MOREIRA, B.S.; DOS ANJOS, D.M.; PEREIRA, D.S.; SAMPAIO, R.F.; PEREIRA, L.S.; DIAS, R.C.; KIRKWOOD, R.N. The geriatric depression scale and the timed up and go test predict fear of falling in community-dwelling elderly women with type 2 diabetes mellitus: a cross-sectional study. **BMC Geriatrics**, v. 16, n. 56, p. 1-10, 2016.

[2]MOREIRA, B.S.; SAMPAIO, R.F.; DIZ, J.B.M.; BASTONE, A. C.; FERRIOLI, E.; NERI, A.L.; LOURENÇO, R.A.; DIAS, R.C.; KIRKWOOD, R.N. Factors associated with fear of falling in community-dwelling older adults with and without diabetes mellitus: findings from the Frailty in Brazilian Older People Study (FIBRA-BR). **Experimental Gerontology**, v. 89, n. 3, p. 103-111, 2017.

[3]MOREIRA, B.S.; BARROSO, C.M.; FURTADO, S.R.C.; SAMPAIO, R.F.; VALLONE, M.L.D.C.; KIRKWOOD, R.N. Clinical functional tests help identify elderly women highly concerned about falls. **Experimental Aging Research**, v. 41, n. 1, p. 89-103, 2015.

[4]MOREIRA, B.S.; SAMPAIO, R.F.; FURTADO, S.R.C.; DIAS, R.C.; KIRKWOOD, R.N. The relationship between diabetes mellitus, geriatric syndromes, physical function, and gait: a review of the literature. **Current Diabetes Reviews**, v. 12, n. 3, p. 240-251, 2016.

RESUMO

O diabetes mellitus é uma condição de saúde muito prevalente, particularmente entre idosos. Essa doença metabólica tem efeitos deletérios em múltiplos sistemas orgânicos, que combinados com o processo natural de envelhecimento favorecem a ocorrência de desfechos adversos, tais como quedas e medo de cair. O medo de cair é um problema comum e potencialmente incapacitante na população idosa, que está presente inclusive em idosos sem história de quedas. Quando excessivo, o medo de cair pode levar à restrição ou evitação de atividades e, consequentemente, ao descondicionamento, atrofia muscular, perda do controle postural e redução da participação social. Os fatores associados ao medo de cair em idosos da comunidade em geral já foram investigados, entretanto, pouco é conhecido sobre o medo de cair em idosos com diabetes. Além disso, nenhum estudo investigou a existência de diferenças nos fatores associados com o medo de cair entre idosos com e sem diabetes. Portanto, dois estudos observacionais analíticos transversais foram realizados a fim de preencher as lacunas existentes na literatura acerca dos fatores relacionados ao medo de cair em idosos diabéticos. O primeiro estudo teve como objetivos investigar o impacto do medo de cair em variáveis clínicas, funcionais e da marcha em idosas da comunidade com diabetes mellitus tipo 2 e identificar quais variáveis poderiam predizer o medo de cair nessa população. Foram incluídas 99 idosas diabéticas, sendo 49 com medo de cair (72,6 ± 6,1 anos) e 50 sem medo de cair (71,8 ± 4,8 anos). As variáveis clínicas incluíram idade, índice de massa corporal, razão cintura-quadril, número de doenças e de medicamentos, nível de atividade física, história de quedas, nível de fragilidade, cognição, sintomas depressivos, glicemia em jejum e tempo de diagnóstico do diabetes. As variáveis funcionais incluíram o desempenho nos testes *Timed Up and Go* (TUG), teste de sentar e levantar e força de preensão manual. Os parâmetros da marcha foram obtidos pelo sistema GAITRite® e incluíram a velocidade, cadência, comprimento do passo, tempo do passo, tempo de oscilação, tempo de apoio e tempo de duplo apoio, além das medidas de variabilidade. O grupo com medo de cair apresentou maior frequência de indivíduos frágeis, maior

sintomatologia depressiva, pior desempenho no TUG e no teste de sentar e levantar, menor velocidade da marcha, cadência e comprimento do passo e maior variabilidade do tempo do passo e do tempo de oscilação comparado com o grupo sem medo de cair ($p < 0,05$). Além disso, a análise de regressão logística mostrou que a Escala de Depressão Geriátrica com 15 itens (OR = 1,34; IC95% = 1,11-1,61) e o TUG (OR = 1,36; IC95% = 1,07-1,73) eram preditores do medo de cair em idosas diabéticas da comunidade. Sendo assim, esses instrumentos devem ser considerados durante a avaliação de idosas diabéticas com medo de cair. O segundo estudo teve como objetivo determinar dentre diversos fatores sociodemográficos, clínicos (doenças crônicas e variáveis relacionadas à saúde) e funcionais, quais poderiam estar associados com o medo de cair em idosos da comunidade com e sem diabetes mellitus. Neste estudo, foram analisados os dados de 4.449 idosos com 65 anos ou mais (19,2% com diabetes) oriundos do estudo multicêntrico, multidisciplinar e epidemiológico denominado Estudo da Fragilidade em Idosos Brasileiros (Rede FIBRA). Os dados sociodemográficos incluíram o sexo, idade, estado civil, nível educacional e viver sozinho. As doenças crônicas autorrelatadas diagnosticadas por um médico no último ano incluíram diabetes, doença cardíaca (angina, infarto do miocárdio ou ataque cardíaco), hipertensão, acidente vascular cerebral ou isquemia, artrite ou reumatismo, doença pulmonar (bronquite ou enfisema), depressão e osteoporose, além do número total de doenças. As variáveis relacionadas à saúde incluíram o número de medicamentos usados regularmente nos últimos três meses, deficiência auditiva e visual, autopercepção de saúde, história de quedas nos últimos 12 meses, estado cognitivo, índice de massa corporal, sintomas depressivos e nível de fragilidade. As medidas de capacidade funcional incluíram o Índice de Katz, que avalia as atividades básicas de vida diária, Escala de Lawton, que avalia as atividades instrumentais de vida diária, força de preensão manual e teste de velocidade da marcha. Os resultados da análise de regressão logística mostraram que os fatores independentemente associados com o medo de cair em idosos não diabéticos foram: sexo feminino (OR = 1,69; IC95% = 1,36-2,11), artrite ou reumatismo (OR = 1,33; IC95% = 1,10-1,60), depressão (OR = 1,55; IC95% = 1,22-1,96), deficiência visual (OR = 1,18; IC95% = 1,01-1,39), autopercepção de saúde negativa (OR = 1,56; IC95% = 1,33-1,84), quedas nos

últimos 12 meses (OR = 1,35; IC95% = 1,13-1,61), obesidade (OR = 1,28; IC95% = 1,02-1,61), sintomas depressivos (OR = 1,28; IC95% = 1,02-1,61), fragilidade (OR = 1,79; IC95% = 1,18-2,71), Índice de Katz (OR = 1,42; IC95% = 1,11-1,80), Escala de Lawton (OR = 0,87; IC95% = 0,84-0,91), força de preensão manual (OR = 0,97; IC95% = 0,96-0,99) e teste de velocidade da marcha (OR = 0,33; IC95% = 0,24-0,46). Por outro lado, os fatores associados com o medo de cair nos idosos diabéticos foram: sexo feminino (OR = 1,93; IC95% = 1,36-2,75), artrite ou reumatismo (OR = 1,61; IC95% = 1,13-2,29), autopercepção de saúde negativa (OR = 1,77; IC95% = 1,27-2,46), Miniexame do Estado Mental (OR = 0,95; IC95% = 0,90-0,99), fragilidade (OR = 2,31; IC95% = 1,14-4,67), Escala de Lawton (OR = 0,85; IC95% = 0,78-0,93) e teste de velocidade da marcha (OR = 0,41; IC95% = 0,22-0,79). Portanto, os fatores associados com o medo de cair diferem entre idosos com e sem diabetes mellitus. Tais diferenças devem ser consideradas pelos profissionais de saúde no planejamento de suas abordagens terapêuticas para o manejo bem sucedido do medo de cair nessas populações.

Palavras-chave: Diabetes mellitus. Idoso. Autoeficácia. Acidentes por quedas. Marcha. Fatores de risco.

ABSTRACT

Diabetes mellitus is a very prevalent health condition, particularly among older adults. This metabolic disease has deleterious effects on multiple organ systems, which combined with the natural aging process favor the occurrence of adverse outcomes, such as falls and fear of falling. Fear of falling is a common and potentially disabling problem in the elderly population, which is present even in older adults without a history of falls. When excessive, fear of falling can lead to a restriction or avoidance of activities and, consequently, to deconditioning, muscle atrophy, loss of postural control and reduced social participation. Factors associated with fear of falling in community-dwelling older adults in general have been investigated, however, little is known about the fear of falling in older adults with diabetes. In addition, no study has investigated the existence of differences in the factors associated with fear of falling between older adults with and without diabetes. Therefore, two cross-sectional analytic observational studies were conducted in order to fill the gaps in the literature about the factors related to fear of falling in diabetic older adults. The first study investigated the impact of the fear of falling on clinical, functional and gait variables in community-dwelling elderly women with type 2 diabetes mellitus and the variables that could predict the fear of falling in this population. Ninety-nine diabetic older women were included, 49 with fear of falling (72.6 ± 6.1 years) and 50 without fear of falling (71.8 ± 4.8 years). Clinical variables included age, body mass index, waist-to-hip ratio, number of diseases and medications, physical activity level, history of falls, frailty level, cognition, depressive symptoms, fasting blood glucose and time since diabetes diagnosis. Functional variables included the performance on the Timed Up and Go test (TUG), sit-to-stand test and handgrip strength. Gait parameters were obtained using the GAITRite® system and included velocity, cadence, step length, step time, swing time, stance time and double support time, in addition to the variability measures. The group with fear of falling showed a higher frequency of frail individuals, more depressive symptoms, worse performance on the TUG and sit-to-stand test, lower gait velocity, cadence and step length and increased step time and swing time variability compared to the group without fear of falling ($p < 0.05$). In addition, logistic regression analysis showed that the Geriatric

Depression Scale with 15 items (OR = 1.34; 95%CI = 1.11-1.61) and the TUG (OR = 1.36; 95%CI = 1.07-1.73) were predictors of fear of falling in community-dwelling diabetic older women. Thus, these instruments should be considered during the evaluation of diabetic older women with fear of falling. The second study aimed to determine among several sociodemographic, clinical (chronic diseases and health-related variables) and functional factors, which could be associated with fear of falling in community-dwelling older adults with and without diabetes mellitus. In this study, data from 4,449 older adults aged 65 years or older (19.2% with diabetes), resulting from a multicenter, multidisciplinary and epidemiological study named the Frailty in Brazilian Older People Study (FIBRA Network), were analyzed. Sociodemographic data included sex, age, marital status, educational level and living alone. The self-reported chronic diseases diagnosed by a physician within the last year included diabetes, cardiac disease (angina, myocardial infarction or heart attack), hypertension, stroke or cerebral ischemia, arthritis or rheumatism, pulmonary disease (bronchitis or emphysema), depression and osteoporosis, in addition to the total number of diseases. The health-related variables included the number of medications used regularly in the last three months, hearing and visual impairment, health self-perception, fall history in the previous 12 months, cognitive status, body mass index, depressive symptoms and frailty level. The functional capacity measures included the Katz Index, which assesses the basic activities of daily living, Lawton Scale, which assesses the instrumental activities of daily living, handgrip strength and gait speed test. The results of logistic regression analysis showed that the factors independently associated with fear of falling in non-diabetic older adults were female gender (OR = 1.69; 95%CI = 1.36-2.11), arthritis or rheumatism (OR = 1.33; 95%CI = 1.10-1.60), depression (OR = 1.55; 95%CI = 1.22-1.96), visual impairment (OR = 1.18; 95%CI = 1.01-1.39), negative health self-perception (OR = 1.56; 95%CI = 1.33-1.84), falls in the previous 12 months (OR = 1.35; 95%CI = 1.13-1.61), obesity (OR = 1.28; 95%CI = 1.02-1.61), depressive symptoms (OR = 1.28; 95%CI = 1.02-1.61), frailty (OR = 1.79; 95%CI = 1.18-2.71), Katz Index (OR = 1.42; 95%CI = 1.11-1.80), Lawton Scale (OR = 0.87; 95%CI = 0.84-0.91), handgrip strength (OR = 0.97; 95%CI = 0.96-0.99) and gait speed test (OR = 0.33; 95%CI = 0.24-0.46). On the other hand, the factors associated with fear of

falling in diabetic older adults were female gender (OR = 1.93; 95%CI = 1.36-2.75), arthritis or rheumatism (OR = 1.61; 95%CI = 1.13-2.29), negative health self-perception (OR = 1.77; 95%CI = 1.27-2.46), Mini-Mental State Examination (OR = 0.95; 95%CI = 0.90-0.99), frailty (OR = 2.31; 95%CI = 1.14-4.67), Lawton Scale (OR = 0.85; 95%CI = 0.78-0.93) and gait speed test (OR = 0.41; 95%CI = 0.22- 0.79). Therefore, the factors associated with fear of falling differ between older adults with and without diabetes mellitus. Such differences should be considered by health care professionals in the planning of their therapeutic approaches for a successful management of fear of falling in these populations.

Keywords: Diabetes mellitus. Aged. Self efficacy. Accidental falls. Gait. Risk factors.

SUMÁRIO

1 INTRODUÇÃO

1.1 Envelhecimento Populacional

O envelhecimento populacional refere-se à mudança na estrutura etária da população, na qual se observa o aumento do peso relativo de pessoas acima de uma determinada idade considerada como definidora do início da velhice (ANDRADE *et al.,* 2013; CARVALHO; GARCIA, 2003). O limite inferior da idade varia de sociedade para sociedade e não depende apenas de fatores biológicos, mas também de fatores econômicos, ambientais, científicos e culturais (CARVALHO; GARCIA, 2003). Para países em desenvolvimento, adota-se a idade cronológica de 60 anos, enquanto 65 anos é a idade usada para países desenvolvidos (CUNHA; CUNHA; BARBOSA, 2016).

O contingente de indivíduos idosos vem crescendo em diferentes regiões do mundo, detectando-se, no entanto, variações significativas na velocidade desse crescimento (ARAÚJO *et al.,* 2011). No Brasil, as modificações demográficas ocorreram de forma radical e bastante acelerada (VERAS, 2009). O número de idosos no Brasil passou de dois milhões em 1950 para 15,4 milhões em 2002, representando um aumento de 700% (ARAÚJO *et al.,* 2011). Tem sido reportado que, anualmente, 650 mil novos idosos são incorporados à população brasileira (VERAS, 2009).

Em nosso país, o processo de transição da estrutura etária teve início entre os anos 40 e 60, no qual a população brasileira experimentou um declínio significativo da mortalidade, mantendo as taxas de fecundidade em níveis bastante elevados, o que gerou uma população jovem quase estável e com rápido crescimento (CLOSS; SCHWANKE, 2012; NASRI, 2008). Essa redução da mortalidade é atribuída a diversos fatores concomitantes, tais como melhora no sistema de saúde pública, expansão da previdência social, urbanização, regulamentação do trabalho nas principais regiões do país, além de avanços da indústria químico-farmacêutica e importação de medicamentos, que resultaram no controle e redução de várias doenças, principalmente as infectocontagiosas e pulmonares (RIGOTTI, 2012).

No final da década de 60, os níveis de fecundidade passaram a apresentar trajetória descendente, começando nos grupos populacionais mais

privilegiados e nos polos mais desenvolvidos e, em seguida, generalizando para as demais regiões (CLOSS; SCHWANKE, 2012). No mesmo período, houve persistência na queda dos níveis de mortalidade. Consequentemente, as taxas de crescimento da população diminuíram e a estrutura etária começou sua grande transformação, isto é, iniciou-se o processo de envelhecimento (VASCONCELOS; GOMES, 2012).

De acordo com o último censo demográfico realizado em 2010, a população idosa brasileira é de 20.590.599 pessoas com 60 anos ou mais, o que representa 10,8% da população total (INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2011). Desse número de idosos, 55,5% (11.434.487) são mulheres e 44,5% (9.156.112) são homens, evidenciando o fenômeno de feminização da velhice (INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2011). Projeções indicam que, em 2025, o Brasil terá a sexta maior população mundial de idosos, correspondendo a aproximadamente 30 milhões de pessoas, ou seja, 15% do povo brasileiro (ARAÚJO *et al.,* 2011). Em 2050, estima-se que esse grupo etário corresponderá a cerca de 30% da população brasileira (INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2008).

1.2 Diabetes Mellitus no Idoso

Paralelamente à transição demográfica, ocorreu em nosso país a transição epidemiológica, caracterizada por mudanças no perfil de morbimortalidade da população, que antes era marcado pela elevada prevalência de doenças transmissíveis e passa a apresentar predomínio de doenças crônico-degenerativas e suas complicações (LEBRÃO, 2007). Neste cenário, o diabetes mellitus se destaca como um grave problema de saúde pública devido à alta prevalência no mundo, pela morbidade e por ser um dos principais fatores de risco para doenças cardiovasculares e cerebrovasculares (MENDES *et al.,* 2011). Estimativas apontam que, globalmente, o diabetes é o terceiro maior fator de risco para mortalidade prematura, atrás apenas da hipertensão arterial e tabagismo (WORLD HEALTH ORGANIZATION, 2009).

Diabetes mellitus é o termo geral usado para distúrbios heterogêneos do metabolismo cujo achado principal é a hiperglicemia crônica (KERNER;

BRUCKEL, 2014). A desordem do metabolismo da glicose resulta de uma deficiência na secreção de insulina pelo pâncreas e/ou na ação da insulina nos tecidos alvos (resistência à insulina) (CHENTLI; AZZOUG; MAHGOUN, 2015). O diabetes mellitus pode ser classificado em quatro categorias: diabetes tipo 1, diabetes tipo 2, diabetes mellitus gestacional e tipos específicos de diabetes devido a outras causas (AMERICAN DIABETES ASSOCIATION, 2015). O diabetes tipo 1 é responsável por aproximadamente 5-10% dos indivíduos com diabetes. Corresponde aos casos decorrentes da destruição autoimune das células β do pâncreas, o que frequentemente resulta em deficiência absoluta de insulina, além dos casos em que a etiologia da doença não é conhecida (origem idiopática) (AMERICAN DIABETES ASSOCIATION, 2014). O diabetes tipo 2 corresponde a cerca de 90-95% daqueles com diabetes e engloba os indivíduos que têm resistência à insulina e, geralmente, apresentam deficiência relativa de insulina (AMERICAN DIABETES ASSOCIATION, 2014). O diabetes mellitus gestacional é o diabetes diagnosticado no segundo ou terceiro trimestre da gravidez (AMERICAN DIABETES ASSOCIATION, 2015). Já os tipos específicos de diabetes incluem os defeitos genéticos da função da célula β, defeitos genéticos na ação da insulina, doenças do pâncreas exócrino, diabetes induzido por drogas ou substâncias químicas e por infecções e síndromes genéticas associadas com diabetes (AMERICAN DIABETES ASSOCIATION, 2014). Na população geriátrica, a maioria dos indivíduos diabéticos apresenta diabetes tipo 2 (VILJOEN; SINCLAIR, 2011).

Estimativas recentes da *International Diabetes Federation* (2015) revelaram que a prevalência global de diabetes na população entre 20 e 79 anos foi, em 2015, de 8,8%, ou seja, acometeu 415 milhões de pessoas. Esse número indica que um em cada 11 adultos tinha diabetes. Se essas tendências continuarem, em 2040, 10,4% (642 milhões de pessoas) terão diabetes no mundo. Em relação à população idosa (65-79 anos), o número de pessoas com diabetes passará de 94,2 milhões em 2015 para 200,5 milhões em 2040.

De acordo com dados do sistema de Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico (VIGITEL), que monitora anualmente a frequência e distribuição dos principais determinantes das doenças crônicas não transmissíveis em todas as capitais dos 26 estados brasileiros e Distrito Federal, a frequência de adultos (≥ 19 anos) que referiram

diagnóstico médico prévio de diabetes foi, em 2014, de 7,1%, sendo 6,9% entre os homens e 7,3% entre as mulheres (MINISTÉRIO DA SAÚDE, 2015). Em ambos os sexos, o diagnóstico médico de diabetes tornou-se mais comum com o avanço da idade, principalmente após os 45 anos. Na população com 65 anos ou mais de idade, 24,4% referiram diagnóstico médico de diabetes, acometendo 26,2% e 23,4% dos indivíduos do sexo masculino e feminino, respectivamente (MINISTÉRIO DA SAÚDE, 2015). A literatura reporta que diversos fatores estão relacionados à alta prevalência de diabetes entre idosos, tais como genética, doenças coexistentes, diminuição da secreção de insulina relacionada à idade, aumento da resistência à insulina relacionada à idade, obesidade, baixo nível de atividade física e medicação concomitante (VILJOEN; SINCLAIR, 2011).

As complicações decorrentes do diabetes são a principal causa de redução da qualidade de vida e mortalidade prematura nos diabéticos (INTERNATIONAL DIABETES FEDERATION, 2015). Tais complicações podem afetar várias partes do corpo (coração, vasos sanguíneos, olhos, rins e nervos), manifestando de maneiras diferentes entre as pessoas (INTERNATIONAL DIABETES FEDERATION, 2015). Dentre as diversas complicações que acometem o diabético, destacam-se as complicações vasculares, que podem ser classificadas em microvasculares (retinopatia, neuropatia e nefropatia) e macrovasculares (doença arterial coronariana, acidente vascular cerebral e doença arterial periférica) (VILJOEN; SINCLAIR, 2011). Na população geriátrica, indivíduos com diabetes têm taxas aumentadas de complicações relacionadas à doença e maior probabilidade de apresentar desfechos negativos, tais como incapacidade física, disfunção cognitiva, quedas e fraturas, depressão, úlceras de pressão, deficiências visual e auditiva e dor (INTERNATIONAL DIABETES FEDERATION, 2013).

A carga econômica do diabetes e suas complicações é bastante expressiva. A *International Diabetes Federation* (2015) estimou que, em média, 1.622 a 2.886 dólares por pessoa foram gastos globalmente para o tratamento e manejo da doença em 2015. Nos Estados Unidos, estimativas apontam que os custos totais (médicos e não médicos) relacionados ao diabetes aumentarão de 407,6 bilhões de dólares em 2015 para 622,3 bilhões de dólares em 2030, representando um aumento de 53% (ROWLEY *et al.,* 2016). No Brasil, Bahia *et*

al. (2011) estimaram os custos diretos (despesas com medicamentos, testes diagnósticos, consultas médicas e outras) e indiretos (absenteísmo, licença médica e aposentadoria precoce) do diabetes tipo 2 a partir de dados coletados durante 1.000 entrevistas (59,0 ± 9,1 anos; 66,5% de mulheres) realizadas em oito cidades brasileiras em 2007. O custo total anual por paciente foi de 2.108 dólares, dos quais 1.335 dólares (63,3%) foram custos diretos e 773 dólares (36,7%) foram custos indiretos (BAHIA *et al.,* 2011). Outro estudo publicado recentemente estimou os custos anuais por paciente com o diabetes tipo 2 usando dados coletados, durante os anos de 2009 e 2010, de 209 pacientes (63,34 ± 9,98 anos; 58,4% de mulheres) oriundos de um centro ambulatorial especializado no cuidado de diabéticos na cidade de São Paulo (BORGES; FERRAZ; CHACRA, 2014). Os autores encontraram que o custo médio anual foi de 1.844 dólares por paciente, sendo 1.012 dólares (55%) e 831 dólares (45%) correspondentes aos custos diretos e indiretos, respectivamente. Dos custos médicos diretos, os medicamentos foram os responsáveis pela maior proporção (42%), seguidos pelas tiras reativas (27%), hospitalização e procedimentos (14%), testes laboratoriais e exames de imagem (7%) e consultas médicas (4%). Os custos não médicos (transporte) corresponderam a 7% dos custos diretos totais (BORGES; FERRAZ; CHACRA, 2014).

1.3 Medo de Cair no Idoso

O medo de cair foi definido pela primeira vez, em 1982, como ptofobia, ou seja, uma reação fóbica para ficar de pé ou caminhar devido à preocupação em cair (BHALA; O'DONNELL; THOPPIL, 1982). Outras definições descrevem o medo de cair como síndrome pós-queda (MURPHY; ISAACS, 1982), antecipação temerosa de uma queda (TIDEIKSAAR,1989), perda de confiança na capacidade para manter o equilíbrio (MAKI; HOLLIDAY; TOPPER, 1991) e baixa autoeficácia percebida, isto é, baixa autoconfiança para evitar quedas durante a realização de atividades essenciais da vida diária (TINETTI; RICHMAN; POWELL, 1990).

A prevalência do medo de cair varia entre 33 e 46% em idosos que nunca caíram e entre 21 e 85% naqueles com história prévia de quedas (KUMAR *et al.,* 2014). Recentemente, uma pesquisa brasileira conduzida com

742 idosos (76,7 ± 7,03 anos; 70,2% de mulheres), usando a base de dados do Estudo da Fragilidade em Idosos Brasileiros (Rede FIBRA) da cidade do Rio de Janeiro, encontrou que 51,9% dos participantes apresentavam medo de cair, definido como um escore maior ou igual a 23 na *Falls Efficacy Scale-International* (FES-I) (MALINI; LOURENÇO; LOPES, 2016). Em relação à população idosa diabética, estudos prévios realizados na Austrália, Bélgica e Turquia mostraram que a prevalência do medo de cair varia entre 24 e 66% (BRUCE *et al.,* 2015; TANDER *et al.,* 2015; ROMAN DE METTELINGE *et al.,* 2013). No Brasil, um estudo de base populacional e domiciliar, conduzido com 266 idosos de Florianópolis com história de queda no ano anterior (77 diabéticos), encontrou que cerca de 60% dos idosos diabéticos apresentavam medo de cair novamente (ANTES *et al.,* 2013).

Um nível adequado de consciência sobre quedas (ou medo de cair) pode melhorar as estratégias de enfrentamento para a prevenção efetiva das quedas (LIU, 2015). No entanto, o medo de cair excessivo pode afetar o bem estar físico e psicossocial do indivíduo devido à restrição ou evitação de atividades (DELBAERE *et al.,* 2004). Em longo prazo, a restrição de atividades pode levar ao descondicionamento, atrofia muscular e redução do equilíbrio, favorecendo a ocorrência de futuras quedas (MOREIRA *et al.,* 2016). Além disso, o medo de cair pode desencadear um recrutamento simultâneo dos músculos agonistas e antagonistas, em que a reação resultante de congelamento (*freezing*) pode levar a anormalidades na marcha e estratégias posturais inadequadas durante uma perturbação postural, aumentando o risco de cair (DELBAERE *et al.,* 2006). Deste modo, idosos com medo de cair podem entrar em um processo debilitante de perda de confiança, restrição de atividades físicas e participação social, fragilidade física, quedas e perda de independência, contribuindo para o aumento do uso de medicação, da utilização de cuidados, de custos associados com a saúde e do risco de institucionalização (GREENBERG, 2012).

Adicionalmente, foi demonstrado que idosos da comunidade que reportavam restrição de atividades por medo de cair apresentavam maior autorrelato de depressão e presença de sintomatologia depressiva, menor autoeficácia em relação às quedas, menor nível de independência para realização de atividades instrumentais de vida diária, maior número de doenças

e pior autopercepção de saúde (DIAS *et al.,* 2011). Considerando o desempenho da marcha, um estudo realizado com 860 idosos hígidos com idade entre 65 e 70 anos (54,9% de mulheres) mostrou que o medo de cair com restrição de atividades estava associado com menor velocidade, comprimento da passada e cadência e maior fase de duplo apoio e variabilidade da velocidade da marcha, mesmo após ajustar para diversas covariáveis, tais como idade, sexo, viver sozinho, nível educacional, quedas nos últimos 12 meses, sintomas depressivos, deficiência visual, comorbidade e deficiência funcional (ROCHAT *et al.,* 2010).

Poucos estudos investigaram a associação entre medo de cair e medidas funcionais na população diabética (TANDER *et al.,* 2015; KELLY *et al.,* 2013; VAN SLOTEN *et al.,* 2011). Por exemplo, em um estudo conduzido com 100 indivíduos com diabetes tipo 2 (64,5 ± 9,4 anos; 31% de mulheres), van Sloten *et al.* (2011) mostraram que o medo de cair durante a deambulação estava associado com o tempo necessário para realizar o teste de escada (subir e descer oito lances de escada sem usar o corrimão), mas não apresentava associação com o desempenho no *Timed Up and Go* (TUG) e teste de caminhada de seis minutos. Kelly *et al.* (2013), em um estudo com 34 indivíduos com diabetes tipo 2 com níveis variados de neuropatia (67,6 ± 9,2 anos; 56% de mulheres), encontraram correlação significativa do medo de cair, operacionalizado pelo escore da FES-I, com a velocidade da marcha e comprimento da passada (ambas correlações com r = -0,30). Recentemente, Tander *et al.* (2015) demonstraram que, em pacientes idosos com diabetes tipo 2 (n = 100; 66,83 ± 4,31 anos; 63% de mulheres), os escores da FES-I estavam significativamente associados com o equilíbrio estático (β = -0,125), controle postural (β = -0,509) e nível de incapacidade nas atividades de vida diária (β = -0,216), avaliados, respectivamente, pelo teste de apoio unipodal, Escala de Equilíbrio de Berg e Índice Modificado de Barthel.

Diversos estudos têm investigado os fatores associados com o medo de cair em idosos vivendo na comunidade (CHANG; CHEN; CHOU, 2016; MALINI; LOURENÇO; LOPES, 2016; LIU, 2015; OH *et al.,* 2015; KUMAR *et al.,* 2014; MANE *et al.,* 2014; KIM; SO, 2013). Os fatores reportados na literatura incluem idade avançada, sexo feminino, baixo nível educacional, viver sem cônjuge, história prévia de quedas, dificuldade na realização das atividades básicas e

instrumentais de vida diária, depressão, ansiedade, dor, artrite, deficiência visual, ter várias doenças, usar vários medicamentos, problemas de equilíbrio e força muscular, velocidade da marcha reduzida, uso de dispositivo de auxílio à deambulação, pobre autopercepção de saúde, entre outros (CHANG; CHEN; CHOU, 2016; MALINI; LOURENÇO; LOPES, 2016; LIU, 2015; OH *et al.,* 2015; KUMAR *et al.,* 2014; MANE *et al.,* 2014; KIM; SO, 2013). O Quadro1 fornece uma visão geral dos estudos mais recentes que examinaram os fatores associados com o medo de cair na população idosa em geral. É importante destacar que existe inconsistência nos achados entre os estudos, que pode ser parcialmente explicada por variações nas características das populações estudadas. Além disso, a falta de padronização na terminologia, a variedade de instrumentos de medida e os diferentes pontos de corte usados para estabelecer a presença do medo de cair também podem contribuir para os resultados divergentes.

Recentemente, uma revisão sistemática, conduzida nas bases de dados PubMed, PsychINFO e Cochrane no período entre 2006 e 2013, identificou 20 estudos (transversais e prospectivos) examinando fatores associados ou fatores de risco para o medo de cair em idosos residentes na comunidade (DENKINGER *et al.,* 2015). Os autores mostraram que os fatores de risco fortemente associados aos diferentes construtos ou domínios relacionados ao medo de cair (medo de cair avaliado por uma única pergunta; autoeficácia relacionada à queda/confiança no equilíbrio; restrição de atividades relacionada ao medo de cair) foram sexo feminino, uso de dispositivo de auxílio à deambulação e deficiência na função física avaliada por questionários ou medidas baseadas em desempenho envolvendo particularmente tarefas de mobilidade. Também foram observadas associações menos robustas do medo de cair com história de quedas e pobre autoavaliação de saúde, assim como resultados conflitantes quanto à depressão, ansiedade, múltiplas medicações e uso de psicofármacos. Além disso, os autores encontraram que potenciais fatores de risco para medo de cair como deficiência visual, viver sozinho (integração social), baixo nível socioeconômico, deficiência cognitiva incluindo demência em suas várias entidades, múltiplas doenças/comorbidades e pobre suporte social foram reportados como insignificantes na maioria dos estudos incluídos (DENKINGER *et al.,* 2015).

QUADRO 1

Estudos transversais investigando os fatores associados com o medo de cair na população idosa da comunidade

Autoria e ano **País do estudo**	**Amostra**	**Avaliação do medo de cair**	**Prevalência do medo de cair**	**Fatores associados (resultados de análises multivariadas)**
KIM; SO, 2013 Coreia	9.033 idosos (≥ 65 anos) Média de idade = 73 anos 61,8% de mulheres	Por meio da questão: "Você tem medo de cair?" Respostas: sem medo, algum receio ou temor/pavor	76,6% (algum receio + temor/pavor)	- História prévia de quedas (OR = 6,41); - Dor corporal (OR = 2,45); - Pobre estado de saúde percebido (OR = 1,89); - Presença de depressão (OR = 1,82); - Receber uma ou duas doses diárias de medicamentos (OR = 1,72); - Idade ≥ 75 anos (OR = 1,68); - Receber três ou mais doses diárias de medicamentos (OR = 1,67); - Sexo feminino (OR = 1,64); - Dependência nas atividades instrumentais de vida diária (OR = 1,55); - Dependência nas atividades básicas de vida diária (OR = 1,44); - Baixo nível educacional (OR = 1,18).
MANE *et al.*, 2014 Índia	250 idosos (≥ 60 anos) 69,4 ± 7,5 anos 48% de mulheres	Short FES-I Sem medo: escore 7 Com medo: escore 8-28	33,2% (escore 8-28)	- Restrição de atividades diárias (OR = 3,6); - Idade > 70 anos (OR = 3,2); - Nível educacional (analfabeto) (OR = 3,1); - História de quedas nos últimos seis meses (OR = 2,6).

KUMAR *et al.*, 2014 Reino Unido	1.088 idosos (≥ 65 anos) 72,9 ± 6,0 anos 63% de mulheres	Short FES-I Baixa preocupação com quedas (sem medo): escore 7-10 Alta preocupação com quedas (com medo): escore ≥ 11	19,0% (escore ≥ 11)	- Incapacidade para levantar-se de uma cadeira da altura do joelho (OR = 7,39); - Baixa renda familiar (OR = 4,58); - Uso de dispositivo de auxílio à deambulação (OR = 4,32); - Dificuldade para usar o transporte público (OR = 4,02); - Pobre saúde física percebida (OR = 2,85); - Pertencer a grupo étnico minoritário ou negro (OR = 2,42); - Autorrelato de problemas de equilíbrio (OR = 2,17); - Baixo nível educacional (OR = 2,01); - Maior índice de massa corporal (OR = 1,06).
LIU, 2014 Hong Kong	445 idosos (≥ 65 anos) 52,58% com idade entre 75-84 anos 75,29% de mulheres	FES-I Baixa preocupação com quedas (sem medo): escore 16-22 Alta preocupação com quedas (com medo): escore 23-64	64,73% (escore 23-64)	- Sexo feminino (OR = 2,442); - Artrite (OR = 2,054); - Pobre visão (OR = 1,742); - Maior escore na CGDS (sintomas depressivos) (OR = 1,132); - Maior escore na CGAD-7 (ansiedade) (OR = 1,073); - Pobre desempenho no TUG (OR = 1,071); - Menor escore no CPWI (bem estar pessoal) (OR = 0,979).

OH *et al.*, 2015 Coreia	7.924 idosos (≥ 65 anos) 73,51 ± 6,04 anos 60,9% de mulheres	Por meio da questão: "Você costuma ter o sentimento de medo de cair?" Respostas: de modo nenhum, algum ou muito/bastante	75,6% (algum + muito/bastante)	- História prévia de quedas (OR = 3,734); - Limitações no desempenho de exercício envolvendo os membros inferiores (OR = 2,428); - Sexo feminino (OR = 2,335); - Ter mais do que três doenças crônicas (OR = 1,994); - Limitações nas atividades instrumentais de vida diária (OR = 1,745); - Limitações no desempenho de exercício envolvendo os membros superiores (OR = 1,646); - Viver sem cônjuge (OR = 1,626); - Ter pobre saúde autoavaliada (OR = 1,571); - Limitações na força muscular (OR = 1,455); - Idade ≥ 75 anos (OR = 1,320); - Baixo nível educacional (0-6 anos) (OR = 1,231); - Baixo nível de satisfação com a vida (OR = 1,104).
MALINI; LOURENÇO; LOPES, 2016 Brasil	742 idosos (≥ 65 anos) 76,7 ± 7,03 anos 70,2% de mulheres	FES-I Sem medo: escore < 23 Com medo: escore ≥ 23	51,9% (escore ≥ 23)	- Saúde autoavaliada como pobre ou muito pobre (OR = 4,92); - História de três ou mais quedas (OR = 2,72); - História de uma ou duas quedas (OR = 2,18); - Saúde autoavaliada como razoável (OR = 1,89); - Dependência funcional nas atividades de vida diária (OR = 1,73); - Uso de sete ou mais medicamentos (OR = 1,70); - Sintomas depressivos (OR = 1,68); - Deficiência auditiva (OR = 1,66); - Velocidade da marcha reduzida (OR = 1,64).

CHANG; CHEN; CHOU, 2016 Taiwan	3.824 idosos (≥ 65 anos) 73,9 ± 5,8 anos 43,6% de mulheres	Por meio da questão: “Você apresenta medo de cair?” Respostas: sim ou não	53,4% (sim)	- Saúde subjetiva ruim (OR = 2,52); - História de quedas no último ano (OR = 2,23); - Acidente vascular cerebral (OR = 1,94); - Sexo feminino (OR = 1,78); - Escore da GDS ≥ 5 (sintomas depressivos) (OR = 1,78); - Idade ≥ 75 anos (OR = 1,52); - Insônia (OR = 1,50); - Saúde subjetiva boa ou razoável (OR = 1,35); - Diabetes mellitus (OR = 1,32); - Ajuda de parentes (OR = 1,32); - Ajuda de recursos públicos (OR = 1,28); - Doenças cardiovasculares (OR = 1,19).

OR: *odds ratio*; FES-I: *Fall Efficacy Scale-International*; CGDS: *Chinese Geriatric Depression Scale-Short Form*; CGAD-7: *Chinese General Anxiety Disorder Questionnaire-7*; TUG: *timed up and go test*; CPWI: *Chinese Personal Wellbeing Index*; GDS: *Geriatric Depression Scale*.

1.4 Justificativas

1.4.1 Estudo A

Poucos estudos investigaram o medo de cair na população com diabetes (BRUCE *et al.,* 2015; ROMAN DE METTELINGE *et al.,* 2013). Por exemplo, Bruce *et al.* (2015) encontraram que o medo de cair e a restrição de atividades associada ao medo eram mais comuns em indivíduos com diabetes em relação aos controles normoglicêmicos. Os autores sugeriram que a maior prevalência do medo de cair nos diabéticos poderia ser explicada pelas deficiências de equilíbrio e mobilidade, obesidade, depressão e outras complicações relacionadas ao diabetes.

Estudos têm mostrado que idosos com medo de cair adotam um padrão da marcha mais cauteloso, caracterizado por velocidade mais lenta, menor comprimento da passada e maior tempo de duplo apoio (CHAMBERLIN *et al.,* 2005; MAKI, 1997). Recentemente, uma metanálise mostrou que o medo de cair está associado com aumento na variabilidade da marcha em idosos (AYOUBI *et al.,* 2015). Adicionalmente, Park *et al.* (2014) demonstraram que idosos com medo de cair tinham pior desempenho em testes funcionais - TUG e força de preensão manual - comparados com aqueles sem medo de cair. Apenas um estudo prévio examinou a relação entre medo de cair e parâmetros da marcha em indivíduos com diabetes, e encontrou que o medo de cair estava inversamente correlacionado com a velocidade da marcha e comprimento da passada (KELLY *et al.,* 2013). Além disso, uma revisão narrativa recente apontou que pouco é conhecido sobre medo de cair em idosos com diabetes (MOREIRA *et al.,* 2016b). Portanto, mais estudos são necessários para melhor entender o efeito do medo de cair na funcionalidade de indivíduos com diabetes, visto que é um problema comum e potencialmente incapacitante entre idosos.

1.4.2 Estudo B

Vários estudos investigaram os fatores associados com o medo de cair em idosos residentes na comunidade (CHANG *et al.*, 2016; MALINI *et al.*, 2016;

LIU, 2015; OH *et al.*, 2015; KUMAR *et al*., 2014; MANE *et al*., 2014; KIM; SO, 2013). Entretanto, esses estudos foram conduzidos em populações idosas em geral, ou seja, incluíram ambos idosos diabéticos e não diabéticos. De nosso conhecimento, apenas dois estudos examinaram variáveis associadas com o medo de cair em idosos com diabetes e suas limitações incluem tamanhos amostrais pequenos e a seleção dos participantes baseada em conveniência (MOREIRA *et al.*, 2016a; TANDER *et al.*, 2015). Além disso, nenhum estudo prévio investigou os fatores associados com o medo de cair naqueles sem diabetes.

2 ESTUDO A

“A Escala de Depressão Geriátrica e o teste Timed Up and Go predizem medo de cair em mulheres idosas residentes na comunidade com diabetes mellitus tipo 2: um estudo transversal”

2.1 Objetivos do Estudo

- Investigar o impacto do medo de cair em variáveis clínicas, funcionais e da marcha em idosas com diabetes mellitus tipo 2.
- Identificar dentre as variáveis avaliadas quais poderiam predizer o medo de cair nesta população.

2.2 Métodos

2.2.1 Delineamento do Estudo e Aspectos Éticos

Trata-se de um estudo observacional analítico do tipo transversal desenvolvido a partir da análise do banco de dados da tese de doutorado intitulada “Análise dos parâmetros espaçotemporais da marcha, capacidade funcional e índices plasmáticos de mediadores inflamatórios e o efeito do treinamento aeróbico em idosas diabéticas da comunidade” (ANJOS, 2014), desenvolvida no Programa de Pós-Graduação em Ciências da Reabilitação da Universidade Federal de Minas Gerais (UFMG). O estudo original foi aprovado pelo Comitê de Ética em Pesquisa da UFMG sob o parecer nº ETIC 0144.0.203.000-10 (ANEXO A). Antes de iniciar a coleta de dados, as idosas receberam esclarecimentos sobre a pesquisa, seus objetivos e procedimentos, e aquelas que concordaram em participar do estudo, assinaram o termo de consentimento livre e esclarecido.

2.2.2 Amostra

A amostra deste estudo foi composta por 99 idosas diabéticas residentes em Belo Horizonte e região metropolitana que foram selecionadas por

conveniência e recrutadas na comunidade geral por meio de folhetos de convocação em centros de convivência para idosos, contato telefônico a partir de listas de espera de projetos de atividade física da UFMG e anúncios em jornais locais e ônibus.

A presença de diabetes foi determinada por autorrelato, em resposta a pergunta: “O médico já disse que a senhora tem diabetes?”. Além da resposta afirmativa à pergunta, a idosa deveria estar em uso de medicamentos para diabetes (hipoglicemiantes orais e/ou insulina).

Os critérios de inclusão do estudo foram: sexo feminino, idade ≥ 65 anos, possuir diabetes mellitus tipo 2, viver independentemente na comunidade e ter capacidade para caminhar sem assistência humana ou uso de dispositivo mecânico de auxílio à marcha. Os critérios de exclusão foram: apresentar deficiência cognitiva detectável pelo Miniexame do Estado Mental (MEEM) considerando os pontos de corte brasileiros conforme o grau de escolaridade (< 13 pontos para analfabetas, < 18 pontos para idosas com menos de oito anos de escolaridade e < 26 pontos para aquelas com oito ou mais anos de escolaridade) (BERTOLUCCI *et al.*, 1994), possuir sintomas neuropáticos avaliados pelo Escore de Sintomas Neuropáticos (MOREIRA *et al.*, 2005) (ANEXO B) e ter sequelas ou complicações de doenças neurológicas, vasculares, ortopédicas ou reumáticas que pudessem afetar o desempenho físico. As idosas foram avaliadas no Laboratório de Dor, Inflamação, Reabilitação e Envelhecimento (LADIRE) e no Laboratório de Análise do Movimento (LAM) da Escola de Educação Física, Fisioterapia e Terapia Ocupacional da UFMG.

2.2.3 Variáveis e Instrumentos de Medida

2.2.3.1 Dados Demográficos, Clínicos e Antropométricos

Um questionário estruturado desenvolvido pelos pesquisadores foi aplicado em forma de entrevista às participantes para obtenção de dados demográficos e clínicos, tais como idade, escolaridade, medicamentos em uso, doenças crônicas, história de quedas nos últimos 12 meses e tempo de diagnóstico do diabetes. A informação sobre a glicemia em jejum foi obtida a

partir dos laudos de exames laboratoriais realizados em até seis meses antes do início da pesquisa. Além disso, foram coletadas medidas antropométricas como massa corporal, altura, circunferência da cintura e circunferência do quadril a fim de calcular o índice de massa corporal (IMC) e o índice cintura-quadril.

2.2.3.2 Medo de Cair

O medo de cair foi avaliado por meio da versão brasileira da FES-I (CAMARGOS *et al.*, 2010). Este instrumento apresenta questões sobre a preocupação do indivíduo com a possibilidade de cair ao realizar 16 atividades, incluindo atividades básicas e instrumentais de vida diária, além de atividades externas ao domicílio e de participação social (YARDLEY *et al.*, 2005). Cada item do questionário apresenta quatro possibilidades de resposta, com escores variando de 1 (nem um pouco preocupado) a 4 (extremamente preocupado). O escore total é calculado pela soma dos valores de cada item e varia de 16 a 64 pontos. Quanto maior o escore, maior o medo de cair apresentado pelo indivíduo. A adaptação transcultural da FES-I para o português do Brasil, na população idosa comunitária, mostrou adequada consistência interna (alfa de Cronbach = 0,93) e boa confiabilidade intra e interexaminadores do escore total, com coeficiente de correlação intraclasse (CCI) de 0,84 e 0,91, respectivamente (CAMARGOS *et al.*, 2010). Adicionalmente, o medo de cair foi avaliado por meio da seguinte pergunta “A senhora tem medo de cair?”, com opção dicotômica de resposta: sim ou não.

2.2.3.3 Nível de Atividade Física

O nível de atividade física foi avaliado pela versão brasileira do *Minnesota Leisure Time Activities Questionnaire* (MLTAQ) (LUSTOSA *et al.*, 2011). Este questionário é um instrumento válido para estimar o gasto energético em atividades físicas de tempo de lazer (TAYLOR *et al.*, 1978). O MLTAQ avalia o gasto energético do indivíduo na realização de atividades físicas agrupadas em nove categorias: (1) caminhada; (2) exercício de condicionamento; (3) atividades aquáticas; (4) atividades de inverno; (5)

esportes; (6) atividades no jardim e na horta; (7) atividades de reparos domésticos; (8) pesca; (9) outras atividades (LUSTOSA *et al.*, 2011). O gasto energético foi calculado pela seguinte equação: gasto energético (kcal) = 0,0175 x tempo da atividade realizada na semana (minutos) x equivalente metabólico da atividade (MET) x massa corporal (kg). O gasto energético total foi determinado pela somatória do gasto energético de todas as atividades realizadas pela participante nas duas últimas semanas. O nível de atividade física foi operacionalizado pelo gasto energético semanal (kcal/semana), ou seja, foi o gasto energético total dividido por 2. A adaptação transcultural do MLTAQ para o português do Brasil, em idosos da comunidade, apresentou forte concordância intra e interexaminadores para a aplicação referente às duas últimas semanas, com CCI de 0,911 e 0,777, respectivamente (LUSTOSA *et al.*, 2011).

2.2.3.4 Sintomas Depressivos

Os sintomas depressivos foram avaliados pela versão brasileira da GDS-15 (ALMEIDA; ALMEIDA, 1999a). Este instrumento contém 15 questões com opções de resposta “sim/não” que avaliam o estado socioafetivo do idoso, com domínios que compreendem humor, sintomas somáticos, interações com outros indivíduos e funcionamento motor. O escore total corresponde à soma do número de itens com resposta “sim”, podendo variar de 0 a 15 pontos. Quanto maior a pontuação, maior o estado depressivo. Além disso, o ponto de corte de 5/6 (não caso/caso) tem sido recomendado para determinar a presença de sintomas depressivos (HERRMANN *et al.*, 1996). A versão brasileira da GDS-15 é uma ferramenta válida para a detecção de episódio depressivo maior em idosos (ALMEIDA; ALMEIDA, 1999b) e seus escores totais apresentaram boa concordância na condição teste-reteste, com kappa ponderado de 0,64 (ALMEIDA; ALMEIDA, 1999a).

2.2.3.5 Nível de Fragilidade

O nível de fragilidade foi operacionalizado pelo fenótipo de fragilidade criado por Fried *et al.* (2001), composto pelos seguintes critérios:

(1) Perda de peso não intencional: avaliada, no período referente ao último ano, por meio das seguintes perguntas: “A senhora perdeu peso involuntariamente?” e “Se sim, quantos quilos aproximadamente?”. A participante com perda de peso ≥ 4,5kg ou ≥ 5% do peso corporal pontuou nesse critério para fragilidade.

(2) Exaustão: avaliada, no período referente à última semana, por duas perguntas da escala *Center for Epidemiologic Studies – Depression* (CES-D): “Sentiu que teve que fazer esforço para dar conta das suas tarefas habituais?” e “Não conseguiu levar adiante suas coisas?”. As respostas foram avaliadas por uma escala *Likert* (1 = nunca/raramente; 2 = poucas vezes; 3 = na maioria das vezes; 4 = sempre). A participante pontuou nesse critério para fragilidade diante da resposta “na maioria das vezes” ou “sempre” em pelo menos uma das questões.

(3) Baixo nível de atividade física: avaliado pela versão brasileira do MLTAQ (LUSTOSA *et al.*, 2011).

(4) Fraqueza muscular: avaliada por meio do teste de força de preensão manual, utilizando o dinamômetro do tipo *JAMAR*®.

(5) Lentidão da marcha: avaliada pelo tempo gasto, em segundos, para percorrer em velocidade usual uma distância de 4,6 metros de um total de 8,6 metros, sendo dois metros para aceleração e dois metros para desaceleração.

Neste estudo, os pontos de corte usados para definir a presença ou ausência de fragilidade nos seguintes critérios – baixo nível de atividade física, fraqueza muscular e lentidão da marcha – foram os mesmos propostos por Fried *et al.* (2001). Foi considerado baixo nível de atividade física, o gasto energético < 270 kcal/semana. Foi considerada fraqueza muscular, a força de preensão manual ≤ 17 kg para idosas com IMC ≤ 23 kg/m^2, ≤ 17,3 kg para idosas com IMC entre 23,1 e 26 kg/m^2, ≤ 18 kg para idosas com IMC entre 26,1 e 29 kg/m^2 e ≤ 21 kg para idosas com IMC > 29 kg/m^2. Foi considerada lentidão da marcha, o tempo de deambulação ≥ 7 segundos para idosas com estatura ≤ 159 cm e ≥ 6 segundos para idosas com estatura > 159 cm (FRIED *et al.*, 2001).

De acordo com a pontuação nos cinco critérios do fenótipo, as participantes foram classificadas como frágeis se apresentaram três ou mais critérios, pré-frágeis se apresentaram um ou dois critérios e não frágeis na

ausência dos critérios. O fenótipo de fragilidade possui validade preditiva para desfechos adversos em idosos como quedas, incapacidade, hospitalização e morte (FRIED *et al.*, 2001).

2.2.3.6 Mobilidade Funcional

O TUG foi usado para avaliar a mobilidade funcional das participantes (HERMAN; GILADI; HAUSDORFF, 2011). Este teste consistiu em mensurar o tempo, em segundos, gasto pela participante para realizar a tarefa de levantar-se de uma cadeira (sem apoio para os braços), caminhar três metros, girar 180º, retornar para a cadeira e sentar-se novamente (PODSIADLO; RICHARDSON, 1991). No presente estudo, as participantes caminharam o mais rápido possível de forma segura (MOREIRA *et al.*, 2015). O TUG apresentou validade concorrente de moderada à alta quando correlacionado com a Escala de Equilíbrio de Berg (r = -0,81), velocidade da marcha (r = -0,61) e Índice de Barthel (r = -0,78) e alta confiabilidade intra e interexaminadores (ambas CCI = 0,99) (PODSIADLO; RICHARDSON, 1991).

2.2.3.7 Força Muscular de Membros Inferiores

O teste de sentar e levantar da cadeira por cinco vezes consecutivas foi usado como uma medida funcional para avaliar força muscular dos membros inferiores (BOHANNON, 2012). Este teste consistiu em registrar o tempo, em segundos, gasto pela participante para levantar-se de uma cadeira e retornar à posição sentada por cinco vezes, o mais rápido possível, com os braços cruzados em frente ao tórax (GURALNIK *et al.*, 1994). A validade deste teste como uma medida funcional de força muscular foi suportada pela correlação do tempo de execução do teste com a força ou torque de extensão de joelho (r = -0,48 a -0,57) (BOHANNON *et al.*, 2010). Em relação à confiabilidade teste-reteste, uma revisão sistemática resumiu os achados de 10 estudos e encontrou CCI variando de 0,64 a 0,96 (média ajustada = 0,81) (BOHANNON, 2011).

2.2.3.8 Força de Preensão Manual

A força de preensão manual foi obtida por meio do dinamômetro *JAMAR*®, de acordo com as diretrizes da *American Society of Hand Therapists* (FESS, 1992). As idosas foram posicionadas sentadas com ombro aduzido, cotovelo flexionado a 90°, antebraço em posição neutra e punho entre 0° e 30° de extensão e 0° e 15° de desvio ulnar (FESS, 1992). As participantes foram instruídas e encorajadas verbalmente a apertar a alça do dinamômetro com a mão dominante com força máxima durante seis segundos. Três medidas foram coletadas com intervalo de 60 segundos de repouso entre as mensurações e o valor médio foi obtido para as análises. O dinamômetro *JAMAR*® demonstrou validade concorrente aceitável com pesos conhecidos (r = 0,9998) (MATHIOWETZ, 2002) e excelente confiabilidade teste-reteste em um intervalo de 12 semanas em idosos da comunidade aparentemente saudáveis, com CCI de 0,954 e 0,912 para as mãos esquerda e direita, respectivamente (BOHANNON; SCHAUBERT, 2005).

2.2.3.9 Marcha

Os parâmetros espaçotemporais da marcha e as medidas de variabilidade da marcha foram obtidos por meio de um tapete computadorizado portátil com sensores de pressão embutidos (*GAITRite®, CIR Systems, USA*). O tapete utilizado neste estudo tem 5,74 metros de comprimento, 91 centímetros de largura e 0,6 centímetros de espessura com uma área ativa de 4,88 metros de comprimento por 61 centímetros de largura. À medida que a participante deambulava sobre a área ativa do tapete, a pressão mecânica dos pés sobre o tapete ativava os sensores e o sistema capturava a geometria e a configuração relativa de cada pegada por meio de algoritmos. Uma vez formada a pegada, a mesma era dividida em áreas quadriláteras, permitindo a identificação das regiões plantares do pé (antepé, mediopé e retropé) e do centroide de cada região. A partir dessas regiões e dos centroides eram calculadas as relações espaciais e temporais de cada pegada. A frequência de captura dos dados foi de 120 Hz.

As participantes foram orientadas a deambular sobre o tapete por seis vezes, na velocidade usual, usando seus calçados habituais. As idosas iniciaram e terminaram a deambulação a dois metros das bordas do tapete para permitir aceleração inicial e desaceleração final. O percurso foi delimitado por cones. O seguinte comando verbal foi dado às idosas: “Por favor, caminhe até o cone da forma que a senhora anda normalmente. Vai!”.

Posteriormente, cada uma das seis voltas coletadas foi processada separadamente usando o *software* próprio do sistema *GAITRite*®. Em seguida, os dados processados foram agrupados, criando um arquivo único com todas as passadas juntas. Esse arquivo correspondia à somatória de todas as voltas coletadas, contendo os valores médios das variáveis da marcha para o membro inferior direito e esquerdo. Logo após, os dados foram exportados e armazenados em planilhas do *Microsoft Excel*.

Os parâmetros espaçotemporais da marcha de interesse foram: (1) velocidade: distância percorrida dividida pelo tempo de deambulação, expressa em centímetros/segundo; (2) cadência: número de passos por minuto; (3) comprimento do passo: medido ao longo da linha de progressão, sendo a distância do centro do calcanhar de uma pegada até o centro do calcanhar da pegada do pé oposto, expresso em centímetros; (4) tempo do passo: tempo decorrido do primeiro contato de um pé com o solo até o primeiro contato do pé oposto, expresso em segundos; (5) tempo de oscilação: parte do ciclo da marcha sem suporte de peso, expresso em segundos; (6) tempo de apoio: parte do ciclo da marcha com suporte de peso, expresso em segundos; (7) tempo de duplo apoio: tempo correspondente aos dois períodos do ciclo da marcha em que ambos os pés estão em contato com o solo, expresso em segundos.

As medidas de variabilidade da marcha consideradas neste estudo foram: variabilidade da velocidade da marcha, variabilidade do comprimento do passo, variabilidade do tempo do passo, variabilidade do tempo de oscilação, variabilidade do tempo de apoio e variabilidade do tempo de duplo apoio. Essas medidas foram calculadas como coeficiente de variação (CV), que é a razão entre o desvio padrão e a média, multiplicada por 100.

Em relação às propriedades clinimétricas, o sistema *GAITRite*® mostrou alta validade concorrente quando comparado ao padrão-ouro (sistema

tridimensional de análise de movimento), com CCI de 0,92 (tempo do passo) a 0,99 (velocidade, cadência e comprimento do passo) (WEBSTER; WITTWER; FELLER, 2005). Além disso, apresentou excelente confiabilidade teste-reteste em idosos, com CCI de 0,91 (velocidade), 0,82 (cadência) e 0,89 (comprimento do passo) (MENZ *et al.*, 2004).

2.2.4 Análise Estatística

As participantes foram divididas em dois grupos: com e sem medo de cair. Essa distribuição foi baseada no resultado da *Receiver Operating Characteristic curve* (curva ROC), que foi construída para determinar o ponto de corte na FES-I, considerando a resposta à questão “A senhora tem medo de cair?”, com sim = 1 e não = 0. O ponto de corte ótimo foi o valor que maximizou a soma da sensibilidade e especificidade.

As variáveis categóricas foram apresentadas como porcentagens e as variáveis contínuas como médias e desvios padrão. As diferenças entre os grupos com e sem medo de cair nos dados clínicos, testes funcionais e parâmetros da marcha foram determinadas por meio do teste qui-quadrado para as variáveis categóricas, teste *t* independente para as variáveis contínuas com distribuição normal e teste de Mann-Whitney *U* para as variáveis contínuas sem distribuição normal. A normalidade das variáveis contínuas foi avaliada pelo teste de Kolmogorov-Smirnov.

A regressão logística binária foi usada para determinar quais variáveis poderiam predizer o medo de cair em mulheres idosas com diabetes mellitus tipo 2. Antes da análise de regressão, foi realizada uma análise fatorial com componente principal e rotação *varimax* em um conjunto de 13 parâmetros da marcha. Essa análise foi conduzida para reduzir o número de parâmetros da marcha ao formar subgrupos de novas variáveis, denominados fatores, que são não correlacionados e que juntos explicam grande parte da variância nos dados. O objetivo foi eliminar a redundância entre os parâmetros da marcha fortemente correlacionados, o que poderia levar a estimativas incorretas na análise de regressão. A extração dos fatores foi baseada em autovalores maiores que 1. Em seguida, o teste de Mann-Whitney *U* foi aplicado aos

escores dos fatores para determinar quais fatores eram diferentes entre os grupos com e sem medo de cair.

As variáveis com valor de *p* menor que 0,20 na análise univariada (dados clínicos, testes funcionais e fatores extraídos) foram inseridas na análise de regressão logística utilizando o critério *forward* para a entrada das variáveis no modelo. A ordem de entrada das variáveis foi da mais significativa para a menos significativa. O nível de significância de 0,05 foi adotado para a permanência das variáveis no modelo final. *Odds ratios* (OR) com intervalos de confiança de 95% (IC95%) foram calculados. A existência de multicolinearidade entre as variáveis preditoras foi testada por meio do teste de correlação de Spearman. A adequação do modelo multivariado foi avaliada pelo teste de Hosmer-Lemeshow, no qual um resultado não significativo indica um bom ajuste. Todas as análises foram realizadas usando o *software* SPSS® versão 20, com nível de confiança estabelecido em 5%.

3 ESTUDO B

“Fatores associados com o medo de cair em idosos residentes na comunidade com e sem diabetes mellitus: resultados do Estudo da Fragilidade em Idosos Brasileiros (FIBRA-BR)”

3.1 Objetivo do Estudo

- Determinar quais fatores sociodemográficos, clínicos (doenças crônicas e variáveis relacionadas à saúde) e funcionais estão associados com o medo de cair em idosos da comunidade com e sem diabetes mellitus.

3.2 Métodos

3.2.1 Delineamento do Estudo e Aspectos Éticos

Trata-se de um estudo observacional analítico do tipo transversal subprojeto do Estudo da Fragilidade em Idosos Brasileiros (Rede FIBRA). O estudo FIBRA foi um estudo transversal, multicêntrico, multidisciplinar e epidemiológico concebido para determinar a prevalência e os fatores relacionados à síndrome da fragilidade em idosos brasileiros, de acordo com o fenótipo de fragilidade criado por Fried *et al.* (2001). A Rede FIBRA foi liderada por pesquisadores de quatro universidades públicas brasileiras (Universidade do Estado do Rio de Janeiro – UERJ, Universidade Federal de Minas Gerais – UFMG, Universidade Estadual de Campinas – UNICAMP e Universidade de São Paulo – USP). Todos os voluntários assinaram o termo de consentimento livre e esclarecido antes da participação no estudo e os Comitês de Ética em Pesquisa das instituições envolvidas aprovaram a pesquisa. No polo UFMG, o projeto foi aprovado sob o parecer nº ETIC 187/07 (ANEXO C).

3.2.2 Amostra

A amostra do estudo FIBRA foi selecionada por amostragem probabilística entre idosos da comunidade estratificados por sexo e idade com

base nos dados do censo demográfico realizado pelo Instituto Brasileiro de Geografia e Estatística (IBGE) no ano de 2000. Para o cálculo amostral, estipulou-se o valor de 5% de erro amostral para cidades com menos de 1.000.000 de habitantes e de 4% para cidades com mais de 1.000.000 de habitantes, resultando em um tamanho de amostra de 385 e 601 indivíduos, respectivamente. Foram acrescidos 30% a esses valores, prevendo possíveis perdas e recusas. Sendo assim, estimou-se a amostra nacional do estudo FIBRA em 7.983 idosos. Contudo, ao final da coleta de dados, a amostra foi constituída por 8.608 idosos (VIEIRA, 2013). O efeito da estratificação amostral foi testado, mas não foi significativo para o cálculo das prevalências ou estimativas da fragilidade. Todos os idosos foram avaliados por avaliadores treinados no período de 2009 a 2010.

A área de abrangência do estudo FIBRA envolveu 17 cidades, escolhidas por conveniência dos coordenadores da pesquisa, com variados Índices de Desenvolvimento Humano (IDH) das cinco regiões geográficas brasileiras: Região Norte: Belém (PA); Região Nordeste: Parnaíba (PI), Fortaleza (CE), Santa Cruz (RN), Campina Grande (PB) e Recife (PE); Região Centro Oeste: Cuiabá (MT); Região Sudeste: Belo Horizonte (MG), Juiz de Fora (MG), Poços de Caldas (MG), Rio de Janeiro (RJ), Botucatu (SP), Ribeirão Preto (SP), Barueri (SP), Campinas (SP) e Distrito de Ermelino Matarazzo (SP); Região Sul: Ivoti (RS). No entanto, o banco nacional final foi composto por dados de 15 das 17 cidades. Foram excluídos os dados das cidades do Rio de Janeiro (RJ) devido à modificação no método amostral e Botucatu (SP) por incompatibilidade no formato do banco de dados (VIEIRA, 2013).

Os critérios de inclusão foram: idosos de ambos os sexos, com idade ≥ 65 anos, residentes na comunidade e capazes de deambular com ou sem dispositivo de auxílio à marcha. Os critérios de exclusão foram: deficiência cognitiva definida como um escore inferior a 17 pontos no MEEM (NERI, ONGARATTO; YASSUDA, 2012), deficiências motoras e afasia devido ao acidente vascular cerebral (AVC), déficits sensoriais severos que dificultassem a comunicação, presença de doença de Parkinson no estágio avançado ou com sintomas instáveis, estar acamado ou restrito à cadeira de rodas e presença de doença em estágio terminal.

De um total de 6.762 idosos que compuseram o banco de dados nacional da Rede FIBRA com 15 cidades, 2.313 indivíduos foram excluídos das análises do presente estudo devido à ausência de dados sobre diabetes e pontuação da FES-I. Deste modo, a amostra final consistiu de 4.449 idosos, que foram estratificados de acordo com o autorrelato do diagnóstico médico de diabetes mellitus: 3.594 (80,8%) sem diabetes e 855 (19,2%) com diabetes.

3.2.3 Variáveis e Instrumentos de Medida

O medo de cair foi avaliado pela versão brasileira da FES-I (CAMARGOS *et al.*, 2010). Os participantes com escore < 23 na FES-I foram classificados como “sem medo de cair” e aqueles com escore ≥ 23 como “com medo de cair” (MOREIRA *et al.*, 2016; DELBAERE *et al.*, 2010).

Os possíveis fatores associados com o medo de cair em idosos com e sem diabetes foram obtidos por meio de um inquérito multidimensional padronizado (ANEXO D) aplicado na forma de entrevista aos participantes. As variáveis foram agrupadas nos seguintes blocos investigativos:

(1) Dados sociodemográficos: Sexo (feminino/masculino), faixa etária (65–74 e ≥ 75 anos), estado civil [casado(a) ou vivendo com um companheiro(a), solteiro(a), divorciado(a) ou separado(a) e viúvo(a)], nível educacional (analfabeto(a), 1–5, 6–11 e ≥ 12 anos de escolaridade) e morar sozinho (sim/não).

(2) Doenças crônicas: A presença de doenças crônicas diagnosticadas por um médico no último ano foi baseada no autorrelato (sim/não). As seguintes doenças foram investigadas: doença cardíaca (angina, infarto do miocárdio ou ataque cardíaco), hipertensão, derrame/AVC/isquemia cerebral, artrite ou reumatismo, doença pulmonar (bronquite ou enfisema), depressão e osteoporose. Além disso, o número total de doenças crônicas foi registrado e categorizado como 0, 1–2 e ≥ 3 doenças para os idosos sem diabetes e 1–2 e ≥ 3 doenças para os idosos com diabetes.

(3) Variáveis relacionadas à saúde: Número de medicamentos usados regularmente nos últimos três meses (0, 1–2 e ≥ 3 medicamentos), deficiência auditiva (sim/não), deficiência visual (sim/não), autopercepção de saúde (negativa/positiva) avaliada pela seguinte pergunta: “Em geral, o(a) senhor(a)

diria que a sua saúde é?" (participantes cujas respostas foram "regular", "ruim" e "muito ruim" foram agrupados na categoria autopercepção de saúde negativa, enquanto aqueles cujas respostas foram "muito boa" e "boa" compuseram a categoria autopercepção de saúde positiva) (CONFORTIN *et al.*, 2015), história de quedas nos últimos 12 meses (sim/não), estado cognitivo avaliado pelo MEEM - versão de Brucki *et al.* (2003) (escore total - variável contínua), IMC categorizado como baixo peso (IMC < 18,5 kg/m^2), eutrófico (18,5 ≤ IMC < 25,0 kg/m^2), sobrepeso (25,0 ≤ IMC < 30,0 kg/m^2) e obeso (IMC ≥ 30,0 kg/m^2) (WORLD HEALTH ORGANIZATION, 1997), sintomas depressivos avaliados pela GDS-15 (ALMEIDA; ALMEIDA, 1999a), com ponto de corte de 5/6 (não caso/caso) (HERRMANN *et al.*, 1996) e nível de fragilidade operacionalizado pelo fenótipo de fragilidade (não frágil, pré-frágil e frágil) (FRIED *et al.*, 2001).
(4) Medidas de capacidade funcional: A capacidade funcional foi avaliada por dois questionários de autorrelato: Índice de Katz (LINO *et al.*, 2008) e Escala de Lawton (LAWTON; BRODY, 1969) e por duas medidas de desempenho: força de preensão manual e teste de velocidade da marcha. Essas medidas foram analisadas como variáveis contínuas.

3.2.3.1 Índice de Katz

A versão brasileira do Índice de Katz foi utilizada para avaliar as atividades básicas de vida diária (LINO *et al.*, 2008). Esse instrumento possui seis itens que avaliam o desempenho autorrelatado do indivíduo nas seguintes atividades de autocuidado: (1) tomar banho; (2) vestir-se; (3) uso do vaso sanitário; (4) transferência; (5) continência; (6) alimentação. Cada item do questionário apresenta três opções de resposta, classificadas como I = independente ou D = dependente. Três itens da escala apresentam duas opções de resposta I e três itens, duas opções de resposta D. Em cada item, atribui-se 1 ponto quando a resposta dada pelo indivíduo for uma opção classificada como D. O escore total é obtido pela soma dos pontos e varia de 0 a 6 pontos. Escores mais baixos indicam maior independência. A consistência interna dos itens da versão adaptada do Índice de Katz para a população idosa brasileira apresentou alfa de Cronbach variando de 0,80 a 0,92 e a concordância entre observadores, no mesmo dia e com sete dias de intervalo,

foi quase perfeita (kappa ponderado = 0,91) e substancial (kappa ponderado = 0,67), respectivamente (LINO *et al.*, 2008).

3.2.3.2 Escala de Lawton

A Escala de Lawton foi utilizada para avaliar as atividades instrumentais de vida diária (LAWTON; BRODY, 1969). Foram considerados sete itens do instrumento original, a saber: (1) usar o telefone; (2) uso de transporte; (3) fazer compras; (4) preparo de alimentos; (5) tarefas domésticas; (6) uso de medicação; (7) manejo do dinheiro. O item “lavar roupa” foi excluído. Cada item da escala apresenta três opções de resposta com as seguintes pontuações: I = independente (3 pontos), A = necessidade de ajuda (2 pontos) e D = dependente ou incapaz de realizar a tarefa (1 ponto). O escore total é calculado pela soma dos pontos e, na versão usada pela Rede FIBRA, pode variar de 7 a 21 pontos. Escores mais altos indicam maior independência. O coeficiente de reprodutibilidade da versão original do instrumento foi de 0,96 para homens (escala apenas com cinco itens, excluindo preparo de alimentos, tarefas domésticas e lavar roupa) e de 0,93 para mulheres (escala completa com os oito itens) (LAWTON; BRODY, 1969).

3.2.3.3 Teste de Velocidade da Marcha

Para a realização do teste de velocidade da marcha, os participantes foram orientados a deambular na velocidade usual e com o dispositivo de auxílio à marcha (se necessário) por um percurso de 8,6 metros, usando seus calçados habituais. Contudo, apenas o tempo gasto para percorrer os 4,6 metros centrais foi cronometrado. Foram desconsiderados os dois metros iniciais e finais para fins de aceleração e desaceleração. Cada participante realizou o teste por três vezes e a média dos tempos, em segundos, foi usada nas análises. O resultado do teste foi expresso em metros/segundo. O teste de velocidade da marcha no percurso de 4,0 metros apresenta excelente confiabilidade teste-reteste em idosos (CCI = 0,96) (PETERS; FRITZ; KROTISH, 2013).

3.2.4 Análise Estatística

As variáveis categóricas foram apresentadas como frequência absoluta e porcentagem, e as variáveis contínuas como média e desvio padrão. O teste qui-quadrado e o teste de Mann-Whitney *U* foram usados para comparar as variáveis categóricas e contínuas, respectivamente, entre os participantes não diabéticos com e sem medo de cair e entre os participantes diabéticos com e sem medo de cair. Todas as variáveis contínuas apresentaram distribuição não normal de acordo com o teste de Kolmogorov-Smirnov. OR não ajustados com IC95% também foram calculados. A análise de regressão logística binária foi utilizada para identificar os fatores associados com o medo de cair em idosos com e sem diabetes. Foram criados dois modelos multivariados distintos. Devido ao grande número de fatores avaliados, a modelagem foi realizada inicialmente em blocos. Foram considerados quatro blocos investigativos: dados sociodemográficos, doenças crônicas, variáveis relacionadas à saúde e medidas de capacidade funcional. Variáveis com valor de *p* menor que 0,20 na análise univariada foram incluídas no modelo de cada bloco. Foi utilizado o critério *backward*, isto é, todas as variáveis foram incluídas no modelo de cada bloco, seguida pela retirada de uma a uma, começando com a variável menos significativa (maior valor de *p*). O nível de significância de 0,05 foi adotado para a permanência das variáveis no modelo de cada bloco. Posteriormente, as variáveis que permaneceram no modelo de cada bloco foram inseridas no modelo global e novo ajuste foi realizado, utilizando novamente o critério *backward*, permanecendo no modelo final apenas as variáveis com valor de *p* menor que 0,05. Foi calculado o OR ajustado de cada fator com respectivo IC95%. A adequação dos modelos multivariados foi avaliada pelo teste de Hosmer-Lemeshow, onde um resultado não significativo indica um bom ajuste do modelo. Todas as análises foram realizadas usando o *software* SPSS® versão 20.0.

4 ARTIGO 1

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The geriatric depression scale and the timed up and go test predict fear of falling in community-dwelling elderly women with type 2 diabetes mellitus: a cross-sectional study

Bruno de Souza Moreira[1*], Daniela Maria da Cruz dos Anjos[2], Daniele Sirineu Pereira[3], Rosana Ferreira Sampaio[1,4], Leani Souza Máximo Pereira[1], Rosângela Corrêa Dias[1] and Renata Noce Kirkwood[1]

Abstract

Background: Fear of falling is a common and potentially disabling problem among older adults. However, little is known about this condition in older adults with diabetes mellitus. The aims of this study were to investigate the impact of the fear of falling on clinical, functional and gait variables in older women with type 2 diabetes and to identify which variables could predict the fear of falling in this population.

Methods: Ninety-nine community-dwelling older women with type 2 diabetes (aged 65 to 89 years) were stratified in two groups based on their Falls Efficacy Scale-International score. Participants with a score < 23 were assigned to the group without the fear of falling ($n = 50$) and those with a score ≥ 23 were assigned to the group with the fear of falling ($n = 49$). Clinical data included demographics, anthropometrics, number of diseases and medications, physical activity level, fall history, frailty level, cognition, depressive symptoms, fasting glucose level and disease duration. Functional measures included the Timed Up and Go test (TUG), the five times sit-to-stand test (5-STS) and handgrip strength. Gait parameters were obtained using the GAITRite® system.

Results: Participants with a fear of falling were frailer and presented more depressive symptoms and worse performance on the TUG and 5-STS tests compared with those without a fear of falling. The group with the fear of falling also walked with a lower velocity, cadence and step length and increased step time and swing time variability. The multivariate regression analysis showed that the likelihood of having a fear of falling increased 1.34 times (OR 1.34, 95 % CI 1.11–1.61) for a one-point increase in the Geriatric Depression Scale (GDS-15) score and 1.36 times (OR 1.36, 95 % CI 1.07–1.73) for each second of increase in the TUG performance.

Conclusions: The fear of falling in community-dwelling older women with type 2 diabetes mellitus is associated with frailty, depressive symptoms and dynamic balance, functional mobility and gait deficits. Furthermore, both the GDS-15 and the TUG test predict a fear of falling in this population. Therefore, these instruments should be considered during the assessment of diabetic older women with fear of falling.

Keywords: Fear of falling, Diabetes mellitus, Elderly, Frailty, Depressive symptoms, Functional mobility, Balance, Gait

* Correspondence: brunosouzamoreira@gmail.com
[1]Graduate Program in Rehabilitation Science, Universidade Federal de Minas Gerais, Minas Gerais, Belo Horizonte, Brazil
Full list of author information is available at the end of the article

Background

Diabetes mellitus is a highly prevalent metabolic disease, particularly in the elderly population [1]. According to the International Diabetes Federation, 134.6 million people (18.6 %) aged between 60 and 79 years were estimated to have diabetes in 2013 [2]. This disease has detrimental effect on multiple organ systems that when combined with the natural aging process and other age-related conditions leads to poorer outcomes compared to those without diabetes [2]. In addition, persons with diabetes tend to have a faster aging process, which puts them at a higher risk of developing frailty at an earlier age [3]. The major cause of frailty is sarcopenia [4], which can be defined as a progressive decline of skeletal muscle mass, strength and quality associated with aging [5]. The factors associated to the development of sarcopenia in persons with diabetes include insulin resistance, glucose toxicity, increased inflammatory cytokine levels, testosterone deficiency and increased fat accumulation [4, 5]. Previous longitudinal study demonstrated that type 2 diabetes is associated with an accelerated loss of leg muscle strength and quality in community-dwelling older adults [6].

The literature reports that elderly population with diabetes is at greater risk for microvascular (retinopathy, nephropathy and neuropathy) and macrovascular (coronary heart disease, cerebrovascular disease and peripheral vascular disease) complications [7]. Diabetes in older adults is also linked to reduced functional status, increased risk of institutionalization and higher mortality [8]. Moreover, several studies have shown that older adults with diabetes fall more often compared to their counterparts without diabetes [9–11]. Reduced muscle strength, poor balance and gait performance alterations have been associated with the history of falls in older adults with diabetes [12]. In this sense, it could be speculated that such deficits may also contribute to the emergence of fear of falling in elderly diabetic patients.

Fear of falling can be defined as a low perceived self-efficacy at avoiding falls during essential, nonhazardous activities of daily living [13]. It is also considered a protective response since it allows the individuals to be more conscious of their surroundings. However, an extreme fear can lead to a restriction of activities, which may generate serious long-term negative effects including physical deconditioning, muscle atrophy, loss of postural control and reduced social participation [14, 15].

Recently, Liu [16], in a cross-sectional study carried out with 445 robust community-dwelling older adults (≥65 years), demonstrated that fear of falling was associated with female gender, poor vision, arthritis, poor performance on the Timed Up and Go (TUG) test, depressive and anxiety symptoms and low self-perceived well-being. Another recent study, using data of 742 participants (≥65 years) from the Research Network Frailty in Brazilian Older People, found that history of falls, use of seven or more medications, hearing impairment, functional dependency in activities of daily living, reduced gait speed, poor self-rated health and depressive symptoms were related to fear of falling [17].

Few studies have investigated fear of falling in population with diabetes [11, 18]. For example, Bruce et al. [18] found that the fear of falling and fear-associated activity restrictions were more common in participants with diabetes than normoglycemic controls. The authors suggested that the increased prevalence of fear of falling in individuals with diabetes could be explained by the excess balance and mobility impairments, obesity, depression and other diabetes-related complications.

In addition, several studies have shown that fearful older adults adopt a more cautious gait pattern, characterized by slower speed, shorter stride length and prolonged double support time [19, 20]. Recently, a meta-analysis provided evidence that the fear of falling is associated with an increase in gait variability in older adults [21]. Additionally, Park et al. [22] demonstrated that a group of older adults with a fear of falling had a significantly worse performance on functional tests - TUG and handgrip strength - compared to those without a fear of falling. To our knowledge, only one study has examined the relationship between the fear of falling and gait data in patients with diabetes, and found that the fear of falling was inversely correlated with gait velocity and stride length (both $r = -.30$) [23]. Furthermore, a recent narrative review pointed out that little is known about fear of falling in older adults with diabetes [5]. Thus, more studies are necessary to better understand the effect of the fear of falling in the functionality of individuals with diabetes, since it is a common and potentially disabling problem among older adults.

Therefore, the objectives of this paper were 1) to investigate the impact of the fear of falling on clinical, functional and gait variables in older women with type 2 diabetes mellitus (DM2) and 2) to determine which variables could predict the fear of falling in this population.

Methods

Study design and participants

A cross-sectional observational study was conducted in 99 elderly women with DM2. The participants were recruited from the general community in the city of Belo Horizonte, Brazil. The inclusion criteria were as follows: females aged 65 years or older with DM2, in use of hypoglycemic medication, living independently in the community and able to walk without assistance or walking-devices. The exclusion criteria included cognitive impairment detectable by the Mini-Mental State Examination considering the Brazilian cutoff points based on the degree of education [24], neuropathic symptoms evaluated by the Neuropathy Symptom Score [25] and neurological,

orthopedic or rheumatic diseases that could affect physical performance. The present study received approval from the Ethics Committee of the Universidade Federal de Minas Gerais under process number ETIC 0144.0203000-10. All participants signed an informed consent form before participation.

Data collection

Demographic data, health status and anthropometric measures were collected. Recent blood exam records were consulted regarding the participants' fasting glucose level. The physical activity level was evaluated by the Brazilian version of the Minnesota Leisure Time Activities Questionnaire (MLTAQ) [26]. This questionnaire is a valid instrument to estimate energy expenditure in leisure time physical activity [27]. The MLTAQ-Brazil presented adequate intra- and inter-rater reliability in community-dwelling elders, with intraclass correlation coefficient (ICC) of .911 and .777, respectively [26]. Depressive symptoms were assessed by the Brazilian version of the Geriatric Depression Scale with 15 items (GDS-15) [28]. The scores range from 0 to 15 points, with a higher score indicating a more depressive state. The Brazilian version of the GDS-15 is a valid tool for the detection of a major depressive episode in older adults [29] and exhibited good level of agreement in test-retest conditions (weighted Kappa = .64) [28]. The frailty level was operationalized by the phenotype created by Fried and coworkers composed of five criteria: unintentional weight loss, self-reported exhaustion, weakness, slow walking speed and low physical activity [30]. In the present study, the cutoff points used to define the presence or absence of frailty in the following criteria - weakness, slow walking speed and low physical activity - were those proposed by Fried et al. [30]. Participants were classified as frail if they presented three or more of the above-mentioned criteria, pre-frail if they presented one or two criteria and non-frail if they presented none of the criteria [30]. The frailty phenotype demonstrated predictive validity for adverse outcomes in older adults, such as falls, disability, hospitalization and death [30].

Fear of falling assessment

The Brazilian version of the Falls Efficacy Scale-International (FES-I) was used to assess the level of concern about falls when performing 16 activities, from simple in-home activities to more demanding physical and social activities [31]. Each item of the FES-I can be scored from 1 (not at all concerned) to 4 (very concerned) [32]. The total score ranges from 16 to 64. The higher the score, the more fearful the individual is about falling [32]. The fear of falling was also assessed when participants were asked to respond to the yes or no question, "Are you afraid of falling?" The cross-cultural adaptation of the FES-I to the Portuguese language (Brazil) in the community-dwelling elderly population demonstrated adequate internal consistency (Cronbach's alpha coefficient = .93) and good intra- and inter-rater reliability of the total score (ICC = .84 and .91, respectively) [31].

Functional tests

The TUG test measured the amount of time the participant required to stand up from an armless chair, walk 3 m, turn 180°, return to the chair and sit down again [33]. This test had concurrent validity of moderate to high when correlated with Berg Balance Scale ($r = -.81$), gait speed ($r = -.61$) and Barthel Index ($r = -.78$) and very high intra- and inter-rater reliability (both ICC = .99) [33]. The five times sit-to-stand (5-STS) test consisted of recording the time needed to rise from a chair and return to the seated position for five repetitions, as fast as possible, with their arms folded across their chest [34]. The validity of this test as a measure of functional strength was supported by the correlation of 5-STS time with knee extension force or torque ($r = -.48$ to $-.57$) [35]. Regarding the test-retest reliability of the 5-STS, a systematic review summarized the findings of 10 studies and found ICCs ranging from .64 to .96 (adjusted mean = .81) [36]. Handgrip strength in the dominant hand (mean of 3 trials) was obtained using the JAMAR® dynamometer following the guidelines of the American Society of Hand Therapists [37]. The JAMAR® dynamometer presented acceptable concurrent validity with known weights ($r = .9998$) [38] and excellent test-retest reliability over a 12-week interval in apparently healthy community-dwelling elders, with ICC of .954 and .912 for the left and right hands, respectively [39].

Gait assessment

Gait parameters were measured using a 5.74 m electronic walkway system (GAITRite®, CIR Systems, USA). Gait velocity (cm/s), cadence (steps/min), step length (cm), step time (s), swing time (s), stance time (s) and double support time (s) were collected over six trials at self-selected pace. Gait variability was assessed using the coefficient of variation (CV) of each gait parameter (CV in % = [standard deviation/mean] x 100). Participants started walking 2 m before the carpet and continued 2 m past the carpet to allow for initial acceleration and terminal deceleration. Data from all trials were combined as a single test. The GAITRite® system demonstrated high concurrent validity relative to a gold standard (three-dimensional motional analysis system) [40] and excellent test-retest reliability in older people [41].

Statistical analysis

The participants were divided in two groups: those with and those without a fear of falling. This distribution was

based on a receiver operating characteristic (ROC) curve that was constructed to determine the cutoff point of the FES-I considering the answer to the question "Are you afraid of falling?", with yes = 1 and no = 0. The optimal cutoff point was the value that maximized the sum of sensitivity and specificity. Categorical variables were presented as percentages and continuous variables as means and standard deviations. Group differences in clinical data, functional tests and gait parameters were determined using the chi-squared test for categorical variables, the independent *t* test for normally distributed continuous variables and the Mann–Whitney test for skewed continuous variables.

A binary logistic regression model was conducted to determine which variables could predict the fear of falling in elderly women with diabetes. Prior to the regression analysis, a factorial analysis with principal component and varimax rotation was performed on a set of 13 gait parameters. This was conducted to reduce the number of gait variables by forming subgroups of new variables, denominated factors, which are uncorrelated and that together explain a large portion of the variance in the data. The goal was to eliminate redundancy between strongly correlated gait parameters, which could lead to incorrect estimates in the regression analysis. The extraction of factors was based on eigenvalues greater than 1.0. The Mann–Whitney test was then conducted with the factor scores to determine which factors were different between the groups with and without the fear of falling.

Variables with a *p*-value less than .20 obtained using the univariate analysis (clinical data, functional tests and the factors extracted) were entered into the forward stepwise logistic regression analysis. The order of entrance of the variables into the model was from the most to the least significant. A significance level of .05 was adopted for permanence of the variables in the final model. Odds ratios (OR) with lower and upper 95 % confidence intervals (95 % CI) were calculated. The existence of multicollinearity among the predictor variables was tested with the Spearman's correlation test. The adequacy of the multivariate model was evaluated using the Hosmer-Lomeshow goodness-of-fit test, where a non-significant result signifies a good fit. All analyses were performed using the SPSS® software version 20.0, with the level of confidence set at 5 %.

Results

The FES-I score of the sample ranged from 16 to 64 (24.2 ± 7.7). The area under the ROC curve was .896 ($p < .05$) and the 95%CI was .835 to .956. The cutoff point was set at 23 (sensitivity = 70.1 % and specificity = 93.8 %). Participants with a score < 23 were assigned to the group without the fear of falling ($n = 50$) and those with a score ≥ 23 were assigned to the group with the fear of falling ($n = 49$).

Table 1 shows the results of the univariate analysis. The group with the fear of falling had a significantly higher prevalence of frail individuals, demonstrated more depressive symptoms and exhibited worse performance on the TUG and 5-STS tests compared to the group without the fear of falling. Additionally, participants with a fear of falling walked slower, had lower cadence, took smaller steps and exhibited higher step time and swing time variability than those without a fear of falling. Factorial analysis resulted in a Kaiser-Meyer-Olkin measure, which determines the degree of intercorrelation between variables and the adequacy of the factor analysis, of .783, indicating that the data were adequate for the analysis. Likewise, Bartlett's test was significant ($p < .001$), indicating enough correlation between the response variables to proceed with the analysis. Table 2 presents the results of the factorial analysis, with two factors accounting for 79.2 % of the variance in gait performance. The first factor accounted for 62.9 % of the variance and was heavily loaded with the variables velocity, cadence, step length, step time, swing time, stance time and double support time. This factor was labeled "spatiotemporal". The second factor accounted for 16.3 % and was loaded only with gait variability data. We labeled this factor as "variability". Only Factor 1 was significantly different between the groups (Table 3). The group with fear of falling exhibited lower Factor 1 score (–0.27 ± 1.17) compared to the group without fear of falling (0.26 ± 0.72; $p = .032$), showing that those with fear of falling had worse performance on the "spatiotemporal" domain.

Of the analyzed variables, eight had a *p*-value less than .20 in the univariate analysis. All correlation coefficients among the predictor variables were less than .50 (data not shown), indicating an absence of multicollinearity. The order of entrance of the variables into the multivariate model was as follows: GDS-15, TUG, 5-STS, frailty level, Factor 1, MLTAQ, number of comorbidities and handgrip strength. Only two variables remained statistically significant at $p < .05$ and composed the final model: GDS-15 and TUG (Table 4). The results showed that the likelihood of having a fear of falling increased 1.34 times for a one-point increase in the GDS-15 score and 1.36 times for each second of increase in the TUG performance. The Hosmer-Lomeshow goodness-of-fit test presented a *p*-value of .453, indicating that the model had a good adjust.

Discussion

The current study revealed that the fear of falling in community-dwelling older women with DM2 without neuropathic symptoms is associated with a higher frailty

Table 1 Clinical, functional and gait variables between the groups with and without a fear of falling

Variables	Fear of falling		*p*-value
	Yes ($n = 49$)	No ($n = 50$)	
Clinical Data			
Age (years)	72.6 ± 6.1	71.8 ± 4.7	.758[a]
Body mass index (kg/m^2)	29.1 ± 4.6	29.4 ± 4.2	.801[b]
Waist-to-hip ratio	1.0 ± 0.1	1.0 ± 0.1	.825[a]
Number of comorbidities	4.2 ± 1.8	3.6 ± 1.5	.069[a]
Number of medications	4.7 ± 2.0	4.5 ± 2.1	.399[a]
MLTAQ (kcal/week)	744.7 ± 905.9	1173.0 ± 1274.9	.051[a]
Fall history			.275[c]
Fallers, %	37.0	26.5	
Non-fallers, %	63.0	73.5	
Frailty level			.016[c,d]
Frail, %	19.1	4.1	
Pre-frail, %	63.8	59.2	
Non-frail, %	17.1	36.7	
MMSE (0–30)	26.6 ± 2.6	26.2 ± 2.8	.963[a]
GDS-15 (0–15)	4.4 ± 2.5	2.7 ± 2.3	.001[a,d]
Fasting glucose (mg/dL)	131.3 ± 39.6	128.1 ± 32.4	.907[a]
Disease duration (years)	9.6 ± 8.5	8.2 ± 8.1	.358[a]
Functional Tests			
TUG (s)	11.8 ± 3.7	10.2 ± 1.7	.003[a,d]
5-STS (s)	15.9 ± 5.0	13.8 ± 2.7	.012[a,d]
Handgrip strength (kgf)	19.6 ± 4.4	20.7 ± 4.0	.180[b]
Gait Parameters			
Velocity (cm/s)	108.2 ± 21.6	120.1 ± 14.7	.012[a,d]
Cadence (steps/min)	112.4 ± 11.7	117.0 ± 7.6	.023[b,d]
Step length (cm)	57.3 ± 7.9	61.5 ± 5.6	.002[b,d]
Step time (s)	0.54 ± 0.06	0.51 ± 0.03	.111[a]
Swing time (s)	0.42 ± 0.05	0.41 ± 0.03	.283[a]
Stance time (s)	0.66 ± 0.09	0.62 ± 0.05	.083[a]
Double support time (s)	0.24 ± 0.06	0.22 ± 0.03	.197[a]
Velocity CV (%)	4.6 ± 1.9	4.2 ± 2.1	.245[a]
Step length CV (%)	3.5 ± 1.3	3.3 ± 1.1	.352[a]
Step time CV (%)	3.7 ± 2.2	3.1 ± 1.5	.045[a,d]
Swing time CV (%)	4.5 ± 2.4	3.6 ± 1.2	.012[a,d]
Stance time CV (%)	3.6 ± 1.6	3.2 ± 1.8	.073[a]
Double support time CV (%)	8.6 ± 4.4	8.0 ± 3.2	.484[a]

Data are expressed as mean ± standard deviation unless otherwise specified
MLTAQ Minnesota Leisure Time Activities Questionnaire, *MMSE* Mini-Mental State Examination, *GDS-15* Geriatric Depression Scale with 15 items, *TUG* Timed Up and Go test, *5-STS* Five times sit-to-stand test, *CV* Coefficient of variation
[a]Mann-Whitney test; [b]Independent *t* test; [c]Chi-square test;
[d]Statistical significance

Table 2 Rotated component matrix with varimax rotation of the extracted gait factors

Gait parameters	Factor 1 - Spatiotemporal	Factor 2 - Variability
Velocity (cm/s)	.861	
Cadence (steps/min)	.933	
Step length (cm)	.635	
Step time (s)	−.937	
Swing time (s)	−.740	
Stance time (s)	−.956	
Double support time (s)	−.802	
Velocity CV (%)		−.877
Step length CV (%)		−.760
Step time CV (%)		−.877
Swing time CV (%)		−.745
Stance time CV (%)		−.910
Double support time CV (%)		−.762
% of variance explained	62.9	16.3

CV Coefficient of variation

level, more depressive symptoms, worse performance on functional tests (TUG and 5-STS) as well as alterations in gait parameters, including decreased velocity, cadence and step length and increased variability of step time and swing time. Factorial analysis was also able to identify one domain (spatiotemporal) with significantly worse performance in participants with fear of falling. Additionally, our results demonstrated that the GDS-15 and TUG test predicted the fear of falling in this population.

Older adults with a fear of falling often avoid mobility tasks, such as walking and reaching, which can lead to the deterioration of physical capacities and consequently result in frailty [42]. Prior study demonstrated a relationship between the fear of falling measured with the FES-I and frailty assessed with the Fried et al.'s criteria in a group of high-functioning persons aged 65 to 70 years [43]. The authors observed that vulnerable participants (1 or more frailty criteria) had a reduced fall-related self-efficacy compared with robust participants (no frailty criterion), and concluded that the fear of falling may be

Table 3 Comparison of the two factors between the groups with and without a fear of falling

Factors	Fear of falling		*p*-value
	Yes ($n = 49$)	No ($n = 50$)	
Factor 1			
Spatiotemporal	−0.27 ± 1.17	0.26 ± 0.72	.032[a,b]
Factor 2			
Variability	−0.07 ± 0.96	0.07 ± 1.04	.389[a]

Data are expressed as mean ± standard deviation
[a]Mann-Whitney test; [b]Statistical significance

Table 4 Final model of the binary logistic regression

Variables	Odds ratio	95 % Confidence interval		*p*-value
		Lower bound	Upper bound	
GDS-15	1.34	1.11	1.61	.003
TUG	1.36	1.07	1.73	.012

GDS-15 Geriatric Depression Scale with 15 items, *TUG* Timed Up and Go test

an important pathway leading to frailty [43]. As far as we know, our study is the first to show an association between the fear of falling and frailty in older adults with diabetes. We found a significantly higher percentage of frail participants in the group with the fear of falling (19.1 %) compared with the group without the fear of falling (4.1 %). It is important to point out that the frailty phenotype has five components, of which physical activity level and handgrip strength were similar between groups; thus, the presence of the other criteria such as weight loss, exhaustion and gait slowness may have contributed to the greater prevalence of frailty among elderly women with diabetes and fear of falling. This supposition seems to be plausible since we found a lower gait velocity in the elderly women with a fear of falling in comparison with those without a fear of falling when using the GAITRite® system to assess gait parameters.

The GDS-15 is a scale used to screen for depressive disorders in older adults, and a cut-off point of 5/6 (non-case/case) has been recommended [44]. Although both groups had average GDS-15 scores below six points, suggesting absence of depressive disorders, the group with the fear of falling presented a significantly higher GDS-15 score, which means more depressive symptoms. In addition, 33 % and 8 % of the participants with and without a fear of falling, respectively, had depressive disorders (GDS-15 ≥ 6 points; $p = .002$). The link between depressive issues and the fear of falling had been previously demonstrated in various studies [16, 17, 45]. For instance, Malini et al. [17] found that depressive symptoms assessed by the GDS-15 were associated with the fear of falling measured by the FES-I (OR 1.68, 95 % CI 1.07-2.63). Thus, our results support current knowledge and provide new insight regarding the existence of a relationship between symptoms of depression and the fear of falling in elderly individuals with diabetes. Importantly, Munshi et al. [46] found that depressive symptoms and the fear of falling were associated with executive dysfunction in older adults aged 70 years or older with DM2. Executive functions are mental processes that enable us to plan, focus attention, remember instructions and judge multiple tasks successfully [47]. Those are critical functions for performing day-to-day activities. Thus, it is essential to identify elderly with diabetes who are afraid of falling and with symptoms of depression and apply appropriate interventions in order to prevent executive dysfunction and, consequently, functional decline.

The present study also found an association between the fear of falling and decreased performance on functional tests. Of the tests investigated, the TUG and the 5-STS were significantly different between the groups of diabetic elderly women with and without a fear of falling. Similarly, a recent study found that both the TUG and 5-STS tests could discriminate a group of elderly women highly concerned about falls (FES-I score > 20) from an age- and body mass index-matched group of elderly women with low concerns about falls (FES-I score ≤ 20) [48]. The TUG is a quick and practical test designed to evaluate overall performance of the lower limbs, functional mobility and dynamic balance [49]. Recently, Liu [16] and Park et al. [22] also found that older adults with a fear of falling (without a specific disease) spent more time performing the TUG test compared with those without a fear of falling. According to a meta-analysis, elderly individuals aged between 70 and 79 years, which corresponds to the average age of our groups (72.6 and 71.8 years), should perform the TUG test in 9.2 seconds (normal range = 8.2–10.2) [50]. In our study, both groups performed poorly on the TUG test, with one group at the borderline of the normal range (10.2 seconds) and the other with an average time higher than the upper value of the normal range (11.8 seconds), which may be related to diabetes. Previous studies demonstrated that older adults with DM2 have performed poorly on the TUG test than control subjects [9, 51]. The TUG performance of community-dwelling older adults is influenced by a number of factors, such as lower-limb muscle strength, balance, reaction time, vision, health status and cognitive function [52]. Impairments commonly seen in individuals with diabetes may justify the lower performance on the TUG test by the diabetic elderlies. In addition, our results revealed that the presence of fear of falling could have worsened the TUG performance. The group with fear of falling showed an average TUG time of 11.8 seconds, which was 13.6 % higher in comparison with the group without a fear of falling (10.2 seconds). Therefore, fear of falling is an important variable to be considered when assessing the TUG test in older women with DM2.

Traditionally, the 5-STS test is considered a functional measure of muscle strength from the lower limbs [53]. Nonetheless, a previous study showed that older individuals with balance dysfunction had significantly longer 5-STS time than older control individuals, suggesting that the 5-STS test is also a measure of dynamic balance in older adults [54]. A cut-off score of 14.2 seconds was established to identify older adults with balance dysfunction [54]. In the present study, only the group with the fear of falling exhibited an average time of the 5-STS test

above the cut-off score cited (15.9 seconds). Thus, our results clearly demonstrate that elderly women with diabetes and fear of falling have a poor functional capacity and present lower-limb muscle strength and dynamic balance deficits, which may negatively spiral toward a loss of confidence, activity avoidance, physical frailty, falls and a loss of independence [14].

Our results also provide original and detailed information on gait performance of elderly women with diabetes who are afraid of falling. In particular, the fear of falling was associated with decreased gait velocity, cadence and step length in addition to reduced spatiotemporal gait performance (Factor 1). Conversely, in a cross-sectional study with 34 patients with diabetes (67.6 ± 9.2 years), Kelly et al. [23] found no difference in gait velocity and stride length across fear of falling levels. These seemingly conflicting findings might be related to differences in characteristics of the samples and the classification of the participants. In their study, eligible subjects were men and women aged 45 years or older with a medical diagnosis of type 1 or type 2 diabetes mellitus. In addition, their participants were classified as having a low, moderate or high concern about falling. Another likely explanation for their non-significant gait comparisons could be the limited statistical power associated with the small sample size.

The average gait velocity of the group with the fear of falling was 108.2 cm/s, which was approximately 10 % slower (difference of 11.9 cm/s) than those without the fear of falling (120.1 cm/s). According to Brach et al. [55], the clinically meaningful change for gait velocity in older adults is 4.15 cm/s for a small change and 10.38 cm/s for a substantial change. Therefore, the difference observed between our groups is substantial and merits consideration since decreased gait velocity was found to be a consistent risk factor for disability, cognitive impairment, institutionalization, falls and mortality in community-dwelling older adults [56].

Gait variability refers to the fluctuation in a gait measure from one step to the next and is thought to represent disruption in intrinsic motor or postural control during walking [57]. There is a general supposition of an inverse relationship between gait variability and gait stability [21]. Thus, high gait variability reflects an inefficient gait control and an unstable gait pattern. In our study, the fear of falling was associated with greater variability in step time and swing time. Previous research demonstrated that greater variability in step time was independently associated with poorer executive function in older adults (72.0 ± 7.0 years), after adjusting for several confounders, including gait velocity [58]. Additionally, a prospective cohort study conducted with 597 participants (80.5 ± 5.4 years) over a mean follow-up period of 20 months, found that increased swing time variability predicted fall risk and injurious falls [59]. These results indicate that an increase in step time variability and/or swing time variability is a marker of health-related adverse outcomes in older populations, including seniors with diabetes as supported by our findings. Although the Factor 2 (variability) was similar between groups, step time and swing time variability did differ between groups. It is important to emphasize that the factor is formed by the variables that present strong correlation with each other and calculated taking into account the weighted average of the items that compose the factor [60]. Therefore, it is possible to observe different results when analyzing individual variables and variable groupings (i.e. factors).

In the present study, there was no association of fall history and age with the fear of falling. Surprisingly, these associations in the literature are inconclusive, which may be partly explained by different population characteristics and methods or concepts used to define the fear of falling. Recently, an updated systematic review whose objectives were to identify additional risk factors for the fear of falling in community-dwelling older adults and analyze those previously mentioned, found a relationship not as robust as expected between the history of falls and the fear of falling [61]. Of the studies identified between 2006 and 2013, 13 presented a significant association between the history of falls and different fear of falling-related constructs, while nine studies exhibited a non-significant association [61]. On the other hand, the relationship between age and fear of falling-related constructs presented an inverse pattern, with eight and 13 studies showing significant and non-significant associations, respectively [61]. Therefore, it appears that fall history and age are not strongly associated with a fear of falling in older individuals.

According to the multivariate analysis, the variables that predicted the fear of falling in our study were the GDS-15 and TUG test. This finding is in agreement with previous studies that also demonstrated that depressive symptoms and TUG performance predicted the fear of falling in older adults [16, 62]. Our results revealed that the increase of one unit in the GDS-15 and TUG test was associated with a 34 % and 36 % higher chance of having a fear of falling, respectively. Depressive symptoms may lead the individual to a less-confident state about his/her physical ability and may become more afraid of falling [45]. On the other hand, the TUG test involves a series of motor tasks requiring integration of the motor, sensory and cognitive systems important for daily activities and independent mobility [33]. Thus, a fear of falling may arise when the individual recognizes deficits in any of these systems. This result is very relevant for clinical practice. Both the GDS-15 and TUG test are simple assessment tools that could help healthcare professionals identify older women with DM2 who are at risk for a fear of falling and, consequently, refer

them to appropriate interventions aimed at reducing fear of falling.

This study has some limitations that should be taken into consideration. First, sample selection was based on convenience; thus, the generalization of the results is limited. Second, the cross-sectional design prevents any conclusion about the chronology and the causality of the associations found. Therefore, longitudinal studies are required to clarify the actual causes and consequences of the fear of falling in older individuals with diabetes. Third, diabetes diagnosis was based on self-report. Nevertheless, this has been found to be a reliable method of determining the presence of the disease [63]. In addition, all participants reported the use of hypoglycemic medication, which could have reduced the potential bias related to the diagnosis. Fourth, this study examined the factors associated with the fear of falling solely in women. According to a recent systematic review, the female gender is strongly associated with the fear of falling in community-dwelling older adults [61]. However, it would be interesting to expand our findings to elderly men with DM2. Lastly, although we excluded the participants based on neuropathic symptoms, the peripheral nerve function test was not conducted. Thus, the exact contribution of this factor on the fear of falling in our sample could not be verified. Nevertheless, a prior study found no correlation between the level of peripheral neuropathy and the concern about falling in individuals with diabetes [23].

Despite these limitations, our study has some strong hallmarks. We have established a specific cut-off point to differentiate between those with and without a fear of falling for the community-dwelling elderly population with DM2. This is suitable since using the same cut-off point of other populations with distinct health conditions could lead to different results. Furthermore, our participants were submitted to a comprehensive assessment and various gait parameters were obtained through a gait analysis system widely used in clinical and research settings that allows the register of gait data with great precision. Therefore, several potential variables that could influence the fear of falling in seniors with diabetes were investigated.

Conclusions

As far as we are aware, this is the first study that examined the impact of the fear of falling on a number of clinical, functional and gait variables in community-dwelling older women with type 2 diabetes mellitus. Our results demonstrated that the fear of falling in this population is related to frailty, depressive symptoms and dynamic balance, functional mobility and gait problems. In addition, multivariate analysis showed that increases in GDS-15 and TUG scores are associated with a greater likelihood of having a fear of falling. Therefore, these instruments should be considered during the evaluation of older women with diabetes and fear of falling.

Abbreviations

TUG: timed up and go test; *r*: correlation coefficient; DM2: type 2 diabetes mellitus; MLTAQ: minnesota leisure time activities questionnaire; ICC: intraclass correlation coefficient; GDS-15: geriatric depression scale with 15 items; FES-I: falls efficacy scale-international; 5-STS: five times sit-to-stand test; CV: coefficient of variation; ROC curve: receiver operating characteristic curve; OR: odds ratio; 95 % CI: 95 % confidence interval.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

BSM, RCD and RNK were involved in conception and design of this study. BSM, DMCA and DSP were involved in acquisition, analysis and interpretation of data. RNK, RFS and LSMP provided inputs for statistical analysis and interpretation of data. BSM wrote the first draft of the manuscript and all the other authors were involved in revising it critically for important intellectual content. All authors approved the final version of the manuscript.

Authors' information

BSM is a PhD student. DMCA combines academia with clinical practice as physiotherapist. DSP, RFS, LSMP, RCD and RNK are professors.

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Author details

[1]Graduate Program in Rehabilitation Science, Universidade Federal de Minas Gerais, Minas Gerais, Belo Horizonte, Brazil. [2]Centro Universitário Estácio, Physical Therapy Course, Minas Gerais, Belo Horizonte, Brazil. [3]Nursing School, Physical Therapy Course, Universidade Federal de Alfenas, Minas Gerais, Alfenas, Brazil. [4]Department of Physical Therapy, Universidade Federal de Minas Gerais, Minas Gerais, Belo Horizonte, Brazil.

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5 ARTIGO 2

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Factors associated with fear of falling in community-dwelling older adults with and without diabetes mellitus: Findings from the Frailty in Brazilian Older People Study (FIBRA-BR)

Bruno de Souza Moreira [a,*], Rosana Ferreira Sampaio [a], Juliano Bergamaschine Mata Diz [a], Alessandra de Carvalho Bastone [b], Eduardo Ferriolli [c], Anita Liberalesso Neri [d], Roberto Alves Lourenço [e], Rosângela Corrêa Dias [a], Renata Noce Kirkwood [a]

[a] Graduate Program in Rehabilitation Science, Universidade Federal de Minas Gerais, 6627 Antônio Carlos Avenue, Belo Horizonte, MG 31270-901, Brazil
[b] Department of Physical Therapy, Universidade Federal dos Vales do Jequitinhonha e Mucuri, 5000 MGT 367 Highway, Diamantina, MG 39100-000, Brazil
[c] Department of Internal Medicine, School of Medicine of Ribeirão Preto, Universidade de São Paulo, 3900 Bandeirantes Avenue, Ribeirão Preto, SP 14049-900, Brazil
[d] Graduate Program in Gerontology, Faculty of Medical Sciences, Universidade Estadual de Campinas, 126 Tessalia Vieira de Camargo Avenue, Campinas, SP 13083-887, Brazil
[e] Department of Internal Medicine, Faculty of Medical Sciences, Universidade do Estado do Rio de Janeiro, 381 Marechal Rondon Street, 2° Floor, Rio de Janeiro, RJ 20950-000, Brazil

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ABSTRACT

Purpose: This study aimed to investigate the associated factors with fear of falling in community-dwelling older adults with and without diabetes mellitus.
Methods: Data from the Frailty in Brazilian Older People Study (FIBRA-BR), involving 4449 individuals aged 65 years or older (19.2% with diabetes), were analyzed. The potential factors associated with fear of falling included sociodemographic data, chronic diseases, health-related variables and functional capacity measures. Logistic regression analysis was performed to identify the factors associated with fear of falling.
Results: Female gender, arthritis or rheumatism, negative health self-perception, frailty, lower Lawton Scale score and reduced gait speed were independently associated with fear of falling in both groups. Factors associated with fear of falling specific to non-diabetic older adults were depression, visual impairment, falls in the previous 12 months, obesity, depressive symptoms, higher Katz Index score and decreased handgrip strength. Lower Mini-Mental State Examination score was an associated factor with fear of falling only in those with diabetes.
Conclusion: The factors associated with fear of falling did differ between non-diabetic and diabetic older adults. Health care professionals should consider such differences when planning their therapeutic approaches for a successful management of fear of falling in these older populations.

1. Introduction

Ageing is a dynamic, progressive and physiological process that naturally predisposes individuals to functional decline, morbidity, disability, poor quality of life and increased mortality (Mane et al., 2014; Sattelmair et al., 2009). It is estimated that the number of people aged 65 years or older will double as a proportion of the global population, from 7% in 2000 to 16% in 2050 (van der Cammen et al., 2016). Thus, the growing number of older adults will certainly increase the demands over the national healthcare systems.

Falling is a common problem in the older population with various harmful physical and psychosocial consequences that can impair quality of life (Hoang et al., 2016). One of the most frequent psychological consequences of falls is the fear of falling (FoF), defined as low perceived self-efficacy or confidence at avoiding falls during essential, nonhazardous activities of daily living (Tinetti et al., 1990). However, older adults with no history of previous falls may also present FoF (Hadjistavropoulos et al., 2011). The prevalence of FoF ranges from 21 to 85% among older adults living in community who had experienced falls and 33 to 46% in those who had not fallen (Kumar et al., 2014). The literature reports that, in the long term, the FoF is linked to several negative outcomes, including activity avoidance or restriction, loss of

Abbreviations: FoF, fear of falling; GDS-15, 15-item Geriatric Depression Scale; FIBRA-BR, Frailty Brazilian Older People Study; FES-I, Falls Efficacy Scale-International; MMSE, Mini-Mental State Examination; BMI, body mass index; ADL, basic activities of daily living; IADL, instrumental activities of daily living; OR, odds ratio; CI, confidence interval.

* Corresponding author.
E-mail addresses: brunosouzamoreira@gmail.com (B.S. Moreira), sampaioufmg@gmail.com (R.F. Sampaio), julianodiz@gmail.com (J.B.M. Diz), ale.bastone@gmail.com (A.C. Bastone), eferriol@fmrp.usp.br (E. Ferriolli), anitalbn@uol.com.br (A.L. Neri), roberto.lourenco@globo.com (R.A. Lourenço), rcorreadias8@gmail.com (R.C. Dias), renata.kirkwood@gmail.com (R.N. Kirkwood).

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muscle strength, deconditioning, decreased postural control, poor perceived health, depression, feelings of helplessness and social isolation (Peel, 2011; Delbaere et al., 2004).

Diabetes mellitus is a growing health condition worldwide, particularly in older adults (Moreira et al., 2016b). According to the International Diabetes Federation (2015), the number of people aged between 65 and 79 years with diabetes was 94.2 million in 2015 and is expected to reach 200.5 million by 2040. Previous studies have demonstrated that diabetes is associated with increased prevalence of FoF (Bruce et al., 2015; Roman de Mettelinge et al., 2013; Tander et al., 2015). Balance and mobility impairments, obesity, depression and diabetes-related complications have been pointed out as potential factors for increased prevalence of FoF in diabetic individuals (Bruce et al., 2015).

Several studies have investigated the factors associated with FoF in community-dwelling older adults (Chang et al., 2016; Malini et al., 2016; Liu, 2015; Oh et al., 2015; Kumar et al., 2014; Mane et al., 2014; Kim and So, 2013). Nevertheless, these studies were conducted with older populations in general, *i.e.* both diabetic and non-diabetic older adults were included. To our knowledge, only two studies have examined variables associated with FoF in older adults with diabetes, and their limitations include the small sample sizes and the selection of participants based on convenience (Moreira et al., 2016a; Tander et al., 2015). Furthermore, no prior study has investigated the factors associated with FoF in those without diabetes.

Therefore, we conducted a large-scale study to determine which sociodemographic, clinical (chronic diseases and health-related variables) and functional factors are associated with FoF in non-diabetic and diabetic older adults. Such knowledge could help health care professionals to identify earlier those who are at risk for developing FoF and, therefore, refer them to appropriate therapeutic approaches.

2. Material and methods

2.1. Study design and participants

This was a cross-sectional observational study resulting from the Frailty in Brazilian Older People Study (FIBRA-BR). The FIBRA study was a cross-sectional, multicenter, multidisciplinary and epidemiological study designed to determine the prevalence and associated factors related to the frailty syndrome among Brazilian older adults, according to the Fried et al.'s frailty scale (Fried et al., 2001). The FIBRA study included 15 cities from all five Brazilian geographical regions with diverse human development indexes. The cities were chosen by the convenience of research coordinators and the sample in each city was selected according to probabilistic sampling strategy among community-dwelling older adults stratified by sex and age. Participants with missing data on self-reported diabetes mellitus diagnosis and the Falls Efficacy Scale-International (FES-I) score were excluded from the analyses. Fig. 1 describes the flow chart of the participants through the study. Of the 4449 older adults analyzed in this study, 855 (19.2%) reported having a physician diagnosis of diabetes mellitus (Fig. 1).

The inclusion criteria were as follows: men and women aged 65 years or older, living in the community and able to ambulate with or without walking aids. The exclusion criteria were cognitive impairment defined as a score below 17 on the Mini-Mental State Examination (MMSE) (Brucki et al., 2003), motor impairments and aphasia due to stroke, severe sensory deficits that could hamper the communication, presence of Parkinson's disease in advanced stage or with unstable symptoms, being bedridden or restricted to a wheelchair and presence of terminal illness. All participants signed the informed consent form before participating in the study and the ethics committees of the four universities involved in the FIBRA study approved the research.

Fig. 1. Study flow chart.

2.2. Data collection

The older adults were recruited at home and invited to participate. Data were collected from 2009 to 2010 by extensively trained research assistants using a standard multidimensional questionnaire created by the research coordinators containing questions about sociodemographic characteristics and chronic diseases in addition to valid and reliable scales and questionnaires that had been cross-culturally adapted for use in Brazilian older adults. Moreover, anthropometric measures such as body mass and height were obtained to determine the body mass index (BMI). For assessment of body mass, it was used a portable digital scale and an inelastic tape measure was used to measure the older adults' height. The performance on functional tests was also assessed.

2.2.1. FoF

FoF was assessed by the FES-I (Camargos et al., 2010). This scale assesses participants' concern about falls when performing 16 activities, from basic to more demanding activities. Self-perceived efficacy in completing each activity is rated on a four-point Likert scale (1 = not at all concerned to 4 = very concerned) (Yardley et al., 2005). The total score ranges from 16 to 64. The higher the score, the more fearful the individual is about falling (Yardley et al., 2005). In the present study, participants with a score < 23 on the FES-I were classified as without fear of falling and those with a score ≥ 23 as with fear of falling (Delbaere et al., 2010; Moreira et al., 2016a).

2.2.2. Sociodemographic data

The sociodemographic data included sex (male and female), age group (65–74 and ≥75 years), marital status (married or living with partner, single, divorced or separated and widower or widow), educational level (illiterate, 1–5, 6–11 and ≥12 years of schooling) and living alone (yes/no).

2.2.3. Chronic diseases

The presence of chronic diseases diagnosed by a physician within the last year was based on self-report (yes/no). The following diseases were investigated: diabetes mellitus, cardiac disease (angina, myocardial infarction or heart attack), hypertension, stroke or cerebral ischemia, arthritis or rheumatism, pulmonary disease (bronchitis or emphysema), depression and osteoporosis. Moreover, the total number of diseases was registered and categorized as 0, 1–2 and ≥3 diseases for non-diabetic participants and 1–2 and ≥3 diseases for diabetic participants.

2.2.4. Health-related variables

The health-related variables included the number of medications used regularly in the last three months (0, 1–2 and ≥3 medications), hearing impairment (yes/no), visual impairment (yes/no), health self-perception (negative/positive) assessed by asking "In general, how would you say your health is?" (the responses "regular", "poor" and "very poor" composed the category "negative health self-perception", whereas the responses "excellent", "very good" and "good" composed the category "positive health self-perception"), fall history in the previous 12 months (yes/no), cognitive status assessed by the MMSE (total score) (Brucki et al., 2003), BMI categorized as underweight (BMI < 18.5 kg/m^2), eutrophic (18.5 ≤ BMI < 25 kg/m^2), overweight (25 ≤ BMI < 30 kg/m^2) and obese (BMI ≥ 30 kg/m^2) (World Health Organization, 1997), depressive symptoms assessed by the GDS-15 (Almeida and Almeida, 1999), with a cut-off point of 5/6 (non-case/case) (Herrmann et al., 1996) and frailty level operationalized by the Fried et al.'s scale composed of five criteria: unintentional weight loss, self-reported exhaustion, low physical activity level, weakness and slowness (Fried et al., 2001). In the current study, the cutoff points used to define the presence or absence of frailty in the following criteria - low physical activity level, weakness and slowness - were those described by Fried et al. (2001). Participants were classified as frail if they had three or more of these criteria, pre-frail if they had one or two criteria and non-frail if they had none of them (Fried et al., 2001).

2.2.5. Functional capacity measures

Functional capacity was assessed using self-reported questionnaires: Katz Index (Lino et al., 2008) and Lawton Scale (Lawton and Brody, 1969), and performance measures: handgrip strength and gait speed. The Katz Index assesses the independence in basic activities of daily living (ADL) (Lino et al., 2008). The total score of this instrument ranges from 0 to 6, with lower scores indicating greater independence in ADL. On the other hand, the Lawton Scale assesses independence in instrumental activities of daily living (IADL) (Lawton and Brody, 1969). The total score ranges from 7 to 21, with higher scores indicating greater independence in IADL. Handgrip strength of the dominant hand (mean of three trials) was obtained using the Jamar® dynamometer following the American Society of Hand Therapists recommendations (Fess, 1992). Gait speed was obtained by dividing the distance walked (4.6 m) by the time (in seconds) taken to cover this distance. The study protocol incorporated a distance of two meters for acceleration and deceleration purposes. The participants were asked to walk in their self-selected speed using their usual footwear and walking aid (if necessary). Each participant performed the test for three times, and the mean value was used for data analysis.

2.3. Statistical analysis

Categorical variables were presented as absolute frequency and percentage, and continuous variables as mean and standard deviation. The chi-squared test and the Mann-Whitney *U* test were used to compare the categorical and continuous variables, respectively, between the participants with and without FoF. All continuous variables presented non-normal distribution according to the Kolmogorov-Smirnov test. Non-adjusted odds ratios (OR) with 95% confidence intervals (95% CI) were also calculated. A binary logistic regression analysis was used to identify the factors associated with FoF in older adults with and without diabetes. Two distinct multivariate models were created. Due to the large number of factors assessed, the modeling was initially performed in blocks: sociodemographic data, chronic diseases, health-related variables and functional capacity measures. Variables with p-value <0.20 in the univariate analysis were included in the model of each block. It was used the backward criterion, that is, all variables were included in the model of each block, followed by the withdrawal of one by one, starting with the least significant variable (higher p-value). A significance level of 0.05 was adopted for permanence of the variables in the model of each block. Subsequently, the variables that remained in the model of each block were entered into the global model and new adjustment was conducted, again using the backward criterion, remaining in the final model, only the variables with p-value <0.05. The adjusted OR of each factor was calculated with its respective 95% CI. The adequacy of the multivariate models was assessed using the Hosmer-Lemeshow test, where a non-significant result indicates a good adjustment. All analyses were performed using SPSS® software version 20.0.

3. Results

3.1. Factors associated with FoF in non-diabetic older adults

A total of 3594 older adults without diabetes mellitus (73.5 ± 6.5 years; 66.1% women) participated in this study. Of this total, 1928 (53.6%) had FoF and 1666 (46.4%) had no FoF. Table 1 provides the characteristics of the non-diabetic population and the comparison of sociodemographic data, chronic diseases, health-related variables and functional capacity measures between the groups with and without FoF. There was a significant difference in all variables investigated, with the exception of living alone ($p = 0.918$). Factors associated with significantly higher odds of FoF on the univariate analysis were: female

Table 1
Univariate associations between fear of falling and sociodemographic data, chronic diseases, health-related variables and functional capacity measures in older adults without diabetes mellitus (n = 3594).

Variables	Total (n = 3594)	Fear of falling		OR (95% CI)	*p*-Value
		Yes (n = 1928)	No (n = 1666)		
Sociodemographic data					
Female, n (%)	2377 (66.1)	1471 (76.3)	906 (54.4)	2.70 (2.34–3.11)	<0.001
Age group, n (%)					
≥75 years	1369 (38.1)	786 (40.8)	583 (35.0)	1.28 (1.12–1.46)	<0.001
Marital status, n (%)					
Married/living with partner	1704 (47.5)	810 (42.1)	894 (53.7)	1.00	<0.001
Single	401 (11.2)	230 (11.9)	171 (10.3)	1.48 (1.19–1.85)	
Divorced/separated	239 (6.7)	114 (5.9)	125 (7.5)	1.01 (0.77–1.32)	
Widower/widow	1247 (34.7)	772 (40.1)	475 (28.5)	1.79 (1.55–2.08)	
Education level, n (%)					
Illiterate	707 (19.7)	424 (22.0)	283 (17.0)	1.79 (1.37–2.32)	<0.001
1–5 years	1825 (50.8)	991 (51.4)	834 (50.1)	1.42 (1.12–1.79)	
6–11 years	729 (20.3)	362 (18.8)	367 (22.1)	1.18 (0.91–1.53)	
≥12 years	331 (9.2)	151 (7.8)	180 (10.8)	1.00	
Living alone, n (%)	492 (13.7)	265 (13.8)	227 (13.6)	1.01 (0.83–1.22)	0.918
Chronic diseases					
Cardiac disease, n (%)	507 (14.1)	308 (16.0)	199 (12.0)	1.40 (1.16–1.70)	<0.001
Hypertension, n (%)	1869 (52.0)	1065 (55.2)	804 (48.3)	1.32 (1.16–1.51)	<0.001
Stroke, n (%)	184 (5.1)	124 (6.4)	60 (3.6)	1.84 (1.34–2.52)	<0.001
Arthritis or rheumatism, n (%)	1007 (28.1)	652 (33.9)	355 (21.4)	1.89 (1.62–2.19)	<0.001
Pulmonary disease, n (%)	248 (6.9)	150 (7.8)	98 (5.9)	1.35 (1.03–1.75)	0.026
Depression, n (%)	533 (14.8)	362 (18.8)	171 (10.3)	2.02 (1.66–2.45)	<0.001
Osteoporosis, n (%)	737 (20.6)	491 (25.6)	246 (14.8)	1.98 (1.67–2.35)	<0.001
Number of diseases, n (%)					
0	953 (26.5)	424 (22.0)	529 (31.8)	1.00	<0.001
1–2	1949 (54.2)	1026 (53.2)	923 (55.4)	1.39 (1.19–1.62)	
≥3	692 (19.3)	478 (24.8)	214 (12.8)	2.79 (2.27–3.42)	
Health-related variables					
Number of medications, n (%)					
0	605 (16.9)	260 (13.5)	345 (20.8)	1.00	<0.001
1–2	1610 (44.9)	825 (42.8)	785 (47.3)	1.39 (1.15–1.68)	
≥3	1370 (38.2)	842 (43.7)	528 (31.8)	2.12 (1.74–2.57)	
Hearing impairment, n (%)	879 (24.5)	526 (27.3)	353 (21.2)	1.40 (1.19–1.63)	<0.001
Visual impairment, n (%)	1630 (45.4)	990 (51.4)	640 (38.5)	1.69 (1.48–1.93)	<0.001
Negative health self-perception, n (%)	1686 (47.0)	1077 (56.0)	609 (36.6)	2.21 (1.93–2.53)	<0.001
Falls in the previous 12 months, n (%)	1003 (28.1)	652 (34.1)	351 (21.2)	1.92 (1.65–2.23)	<0.001
MMSE[a], mean ± SD	24.2 ± 3.4	23.8 ± 3.4	24.7 ± 3.2	0.92 (0.90–0.94)	<0.001
BMI (kg/m^2), n (%)					
Underweight (BMI < 18.5)	115 (3.2)	69 (3.6)	46 (2.8)	1.54 (1.05–2.27)	<0.001
Eutrophic (18.5 ≤ BMI < 25)	1302 (36.5)	642 (33.7)	660 (39.8)	1.00	
Overweight (25 ≤ BMI < 30)	1386 (38.9)	720 (37.8)	666 (40.2)	1.11 (0.95–1.29)	
Obese (BMI ≥ 30)	761 (21.4)	476 (25.0)	285 (17.2)	1.72 (1.43–2.06)	
Depressive symptoms[b], n (%)	3112 (86.6)	1732 (89.8)	1380 (82.8)	1.83 (1.51–2.23)	<0.001
Frailty level, n (%)					
Non-frail	1426 (39.7)	591 (30.7)	835 (50.1)	1.00	<0.001
Pre-frail	1882 (52.4)	1108 (57.5)	774 (46.5)	2.02 (1.76–2.33)	
Frail	286 (8.0)	229 (11.9)	57 (3.4)	5.68 (4.17–7.73)	
Functional capacity measures					
Katz Index[c], mean ± SD	0.2 ± 0.5	0.2 ± 0.7	0.1 ± 0.1	2.46 (2.00–3.02)	<0.001
Lawton Scale[d], mean ± SD	19.5 ± 2.4	19.0 ± 2.8	20.2 ± 1.7	0.77 (0.74–0.80)	<0.001
Handgrip strength (kgf), mean ± SD	23.5 ± 10.0	20.8 ± 8.8	26.5 ± 10.3	0.94 (0.93–0.95)	<0.001
Gait speed (m/s), mean ± SD	0.9 ± 0.3	0.8 ± 0.3	1.0 ± 0.3	0.13 (0.10–0.17)	<0.001

OR, odds ratio; CI, confidence interval; MMSE, Mini-Mental State Examination; SD, standard deviation; BMI, body mass index.
[a] Mini-Mental State Examination ranges from 0 to 30 where higher scores indicate better cognitive performance.
[b] The cutoff point of 6 on the 15-item Geriatric Depression Scale (GDS-15) was used to define the presence of depressive symptoms.
[c] Katz Index ranges from 0 to 6 where lower scores indicate higher independence in basic activities of daily living.
[d] Lawton Scale ranges from 7 to 21 where higher scores indicate higher independence in instrumental activities of daily living.

gender, age ≥ 75 years, being single and widower/widow, low educational level (illiterate and 1–5 years of schooling), cardiac disease, hypertension, stroke, arthritis or rheumatism, pulmonary disease, depression, osteoporosis, having 1–2 and ≥3 diseases, taking 1–2 and ≥3 medications, hearing and visual impairments, negative health self-perception, fall history in the previous 12 months, underweight and obesity, depressive symptoms, pre-frailty and frailty and a higher Katz Index score. On the other hand, higher MMSE and Lawton Scale scores, handgrip strength and gait speed were associated with significantly lower odds of FoF.

According to the results from the logistic regression analysis, the factors independently associated with increased odds of FoF in non-diabetic older adults were: being female, having arthritis or rheumatism and depression, presenting visual impairment and negative health self-perception, falling in the previous 12 months, being obese, having depressive symptoms, being frail and a higher Katz Index score.

Furthermore, higher Lawton Scale score, handgrip strength and gait speed were independently associated with lower odds of FoF (Table 2). The Hosmer-Lemeshow test showed a *p*-value of 0.070, indicating that the model had a good adjustment.

3.2. Factors associated with FoF in diabetic older adults

In this study, 855 older adults (73.0 ± 5.9 years; 67.1% women) reported a diagnosis by a physician of diabetes mellitus. Of this total, 520 (60.8%) and 335 (39.2%) presented FoF and no FoF, respectively. The prevalence of FoF was significantly higher among diabetic older adults than non-diabetic older adults ($p < 0.001$). In addition, the diabetic group had the FES-I score significantly higher (mean = 27.5; standard deviation = 10.5; median = 25) compared to the non-diabetic group (mean = 26.3; standard deviation = 9.9; median = 23; $p < 0.001$) (Fig. 2). Table 3 displays the characteristics of the older population with diabetes and the differences between the diabetic participants with and without FoF. There was no significant difference between groups with regard to educational level, living alone, cardiac disease, stroke, pulmonary disease, number of medications, hearing impairment and BMI. Factors associated with significantly higher odds of FoF on the univariate analysis were: female gender, age ≥ 75 years, being widower/widow, hypertension, arthritis or rheumatism, depression, osteoporosis, having ≥3 diseases, visual impairment, negative health self-perception, fall history in the previous 12 months, depressive symptoms, pre-frailty and frailty and a higher Katz Index score. On the other hand, factors associated with significantly lower odds of FoF included higher MMSE and Lawton Scale scores, handgrip strength and gait speed.

The final model of the logistic regression analysis showed that the factors independently associated with increased odds of FoF in diabetic older adults were: being female, having arthritis or rheumatism, presenting negative health self-perception and being frail. Furthermore, it was demonstrated that higher MMSE and Lawton Scale scores and greater gait speed were independently associated with lower odds of FoF (Table 2). This model had a good adjustment as shown by the Hosmer-Lemeshow test ($p = 0.724$).

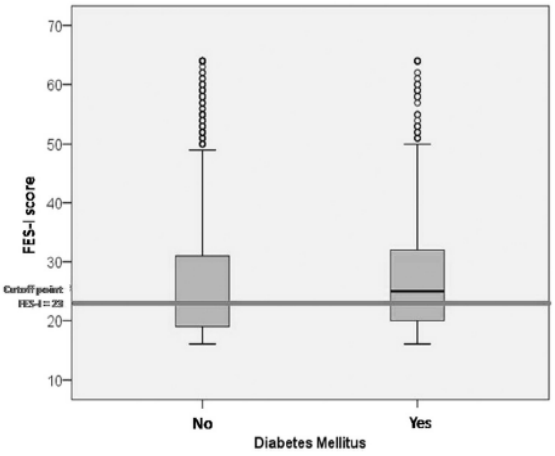

Fig. 2. Difference in FES-I score between non-diabetic and diabetic groups. The gray line represents the cutoff point in FES-I used in the present study to classify the participants as with and without fear of falling. The median FES-I score was similar to the cutoff point of 23 in the non-diabetic group and higher than 23 in the diabetic group.

4. Discussion

This is the first study investigating potential differences in factors associated with FoF among community-dwelling older adults who had or had not a self-reported diagnosis by a physician of diabetes mellitus. Of the 26 factors evaluated (sociodemographic data, chronic diseases, health-related variables and functional capacity measures), 13 and seven factors were independently associated with FoF in non-diabetic and diabetic older adults, respectively. The current results confirm the higher prevalence of FoF in diabetic older adults and the multidimensionality of FoF in addition to provide evidence that there are differences in the associated factors with FoF in relation to the presence or absence of diabetes mellitus. Therefore, health care professionals should consider such differences when developing interventions designed to lessen FoF in these distinct populations.

Among the sociodemographic data investigated, female gender was the only factor that remained independently associated with FoF in both final models. It is worth highlighting that female gender was the second risk factor with higher strength of association with FoF in both non-diabetic and diabetic older adults (OR = 1.69 and 1.93, respectively). In line with our findings, a recent systematic review demonstrated that female gender was robustly associated across all FoF-related constructs (*i.e.* FoF assessed with single questions, FoF-related activity

Table 2
Final models of the binary logistic regression assessing the factors associated with fear of falling for older adults without (n = 3145) and with (n = 751) diabetes mellitus.

		Non-diabetic participants (n = 3145)		Diabetic participants (n = 751)	
		OR (95% CI)	*p*-Value	OR (95% CI)	*p*-Value
Sociodemographic data	Female gender	1.69 (1.36–2.11)	<0.001	1.93 (1.36–2.75)	<0.001
Chronic diseases	Arthritis or rheumatism	1.33 (1.10–1.60)	0.003	1.61 (1.13–2.29)	0.009
	Depression	1.55 (1.22–1.96)	<0.001	–	–
Health-related variables	Visual impairment	1.18 (1.01–1.39)	0.041	–	–
	Negative health self-perception	1.56 (1.33–1.84)	<0.001	1.77 (1.27–2.46)	0.001
	Falls in the previous 12 months	1.35 (1.13–1.61)	0.001	–	–
	MMSE	–	–	0.95 (0.90–0.99)	0.037
	Underweight[a]	0.97 (0.61–1.57)	0.913	–	–
	Overweight[a]	1.19 (0.99–1.43)	0.057	–	–
	Obese[a]	1.28 (1.02–1.61)	0.002	–	–
	Depressive symptoms	1.28 (1.02–1.61)	0.034	–	–
	Pre-frail[b]	1.16 (0.96–1.39)	0.120	1.14 (0.79–1.64)	0.497
	Frail[b]	1.79 (1.18–2.71)	0.006	2.31 (1.14–4.67)	0.020
Functional capacity measures	Katz Index (ADL)	1.42 (1.11–1.80)	0.005	–	–
	Lawton Scale (IADL)	0.87 (0.84–0.91)	<0.001	0.85 (0.78–0.93)	<0.001
	Handgrip strength	0.97 (0.96–0.99)	<0.001	–	–
	Gait speed	0.33 (0.24–0.46)	<0.001	0.41 (0.22–0.79)	0.007

OR, odds ratio; CI, confidence interval; MMSE, Mini-Mental State Examination; ADL, basic activities of daily living; IADL, instrumental activities of daily living.
[a] Reference category: eutrophic.
[b] Reference category: non-frail.

Table 3
Univariate associations between fear of falling and sociodemographic data, chronic diseases, health-related variables and functional capacity measures in older adults with diabetes mellitus (n = 855).

Variables	Total (n = 855)	Fear of falling		OR (95% CI)	*p*-Value
		Yes (n = 520)	No (n = 335)		
Sociodemographic data					
Female, n (%)	574 (67.1)	394 (75.8)	180 (53.7)	2.69 (2.01–3.61)	<0.001
Age group, n (%)					
≥75 years	314 (36.7)	206 (39.6)	108 (32.2)	1.38 (1.03–1.84)	0.029
Marital status, n (%)					
Married/living with partner	421 (49.2)	235 (45.2)	186 (55.5)	1.00	0.003
Single	84 (9.8)	56 (10.8)	28 (8.4)	1.58 (0.97–2.59)	
Divorced/separated	64 (7.5)	34 (6.5)	30 (9.0)	0.90 (0.53–1.52)	
Widower/widow	286 (33.5)	195 (37.5)	91 (27.2)	1.70 (1.24–2.32)	
Education level, n (%)					
Illiterate	210 (24.6)	137 (26.3)	73 (21.9)	1.39 (0.73–2.65)	0.226
1–5 years	435 (50.9)	267 (51.3)	168 (50.3)	1.18 (0.64–2.17)	
6–11 years	162 (19.0)	89 (17.1)	73 (21.9)	0.90 (0.47–1.74)	
≥12 years	47 (5.5)	27 (5.2)	20 (6.0)	1.00	
Living alone, n (%)	113 (13.2)	69 (13.3)	44 (13.1)	1.01 (0.67–1.52)	0.995
Chronic diseases					
Cardiac disease, n (%)	212 (24.8)	128 (24.6)	84 (25.1)	0.97 (0.71–1.33)	0.860
Hypertension, n (%)	677 (79.3)	428 (82.3)	249 (74.6)	1.59 (1.14–2.22)	0.006
Stroke, n (%)	76 (8.9)	52 (10.0)	24 (7.2)	1.44 (0.87–2.39)	0.153
Arthritis or rheumatism, n (%)	291 (34.1)	207 (39.8)	84 (25.2)	1.96 (1.45–2.65)	<0.001
Pulmonary disease, n (%)	66 (7.7)	39 (7.5)	27 (8.1)	0.92 (0.55–1.54)	0.761
Depression, n (%)	157 (18.4)	111 (21.3)	46 (13.8)	1.70 (1.17–2.47)	0.005
Osteoporosis, n (%)	175 (20.5)	123 (23.7)	52 (15.6)	1.68 (1.17–2.40)	0.004
Number of diseases, n (%)					
≥3	509 (59.5)	340 (65.4)	169 (50.4)	1.85 (1.40–2.45)	<0.001
Health-related variables					
Number of medications, n (%)					
0	31 (3.6)	17 (3.3)	14 (4.2)	1.00	0.775
1–2	285 (33.4)	175 (33.7)	110 (32.9)	1.31 (0.62–2.76)	
≥3	538 (63.0)	328 (63.1)	210 (62.9)	1.29 (0.62–2.66)	
Hearing impairment, n (%)	222 (26.0)	143 (27.6)	79 (23.6)	1.24 (0.90–1.70)	0.191
Visual impairment, n (%)	457 (53.6)	306 (59.1)	151 (45.1)	1.76 (1.33–2.32)	<0.001
Negative health self-perception, n (%)	519 (60.7)	356 (68.5)	163 (48.7)	2.29 (1.73–3.04)	<0.001
Falls in the previous 12 months, n (%)	288 (34.0)	196 (37.9)	92 (27.9)	1.58 (1.17–2.13)	0.003
MMSE[a], mean ± SD	23.9 ± 3.5	23.3 ± 3.4	24.7 ± 3.4	0.88 (0.84–0.92)	<0.001
BMI (kg/m^2), n (%)					
Underweight (BMI < 18.5)	9 (1.1)	6 (1.2)	3 (0.9)	1.53 (0.37–6.29)	0.386
Eutrophic (18.5 ≤ BMI < 25)	228 (26.9)	129 (25.1)	99 (29.6)	1.00	
Overweight (25 ≤ BMI < 30)	327(38.6)	197 (38.4)	130 (38.9)	1.16 (0.82–1.64)	
Obese (BMI ≥ 30)	283 (33.4)	181 (35.3)	102 (30.5)	1.36 (0.95–1.95)	
Depressive symptoms[b], n (%)	771 (90.2)	482 (92.7)	289 (86.3)	2.02 (1.28–3.18)	0.002
Frailty level, n (%)					
Non-frail	257 (30.1)	124 (23.8)	133 (39.7)	1.00	<0.001
Pre-frail	496 (58.0)	310 (59.6)	186 (55.5)	1.79 (1.32–2.42)	
Frail	102 (11.9)	86 (16.5)	16 (4.8)	5.76 (3.20–10.37)	
Functional capacity measures					
Katz Index[c], mean ± SD	0.2 ± 0.6	0.3 ± 0.7	0.1 ± 0.4	1.95 (1.39–2.74)	<0.001
Lawton Scale[d], mean ± SD	19.1 ± 2.7	18.5 ± 3.1	20.0 ± 1.7	0.77 (0.71–0.83)	<0.001
Handgrip strength (kgf), mean ± SD	22.7 ± 9.2	20.7 ± 8.7	25.8 ± 9.0	0.94 (0.92–0.95)	<0.001
Gait speed (m/s), mean ± SD	0.9 ± 0.3	0.8 ± 0.3	1.0 ± 0.3	0.14 (0.08–0.24)	<0.001

OR, odds ratio; CI, confidence interval; MMSE, Mini-Mental State Examination; SD, standard deviation; BMI, body mass index.
[a] Mini-Mental State Examination ranges from 0 to 30 where higher scores indicate better cognitive performance.
[b] The cutoff point of 6 on the 15-item Geriatric Depression Scale (GDS-15) was used to define the presence of depressive symptoms.
[c] Katz Index ranges from 0 to 6 where lower scores indicate higher independence in basic activities of daily living.
[d] Lawton Scale ranges from 7 to 21 where higher scores indicate higher independence in instrumental activities of daily living.

restriction and fall-related self-efficacy) (Denkinger et al., 2015). The literature reports that older women are more likely to have FoF because they fall more often than men, and this experience could increase their FoF (Kim and So, 2013). Moreover, older women have higher morbidity and generally feel more fear over their health and body pain, which may contribute to the emergence of FoF (Kim and So, 2013).

Regarding the chronic diseases, we found that arthritis or rheumatism was associated with FoF in both non-diabetic and diabetic older adults. Likewise, a recent study conducted with 445 robust community-dwelling older adults aged 65 years or older showed that arthritis was associated with FoF (OR = 2.054; 95% CI = 1.021–4.130) (Liu, 2015). A potential mechanism to explain this association is that arthritis may trigger mobility problems that can affect the older adults' ability to perform different activities, which in turn may result in the adoption of detrimental behaviors for their functioning (*e.g.* activity restriction), leading them to become over-frightening of falling (Liu, 2015). In addition, in our study, depression was also associated with FoF in those without diabetes. Based on the current knowledge, it is reasonable to assume that there is a bidirectional relationship between FoF and depression. Older adults with FoF may avoid activity, which could lead to a reduction in social interactions and less opportunities for positive reinforcement, resulting in depression (Chu et al., 2011). Conversely,

depression may cause older adults to be less secure and confident about their physical abilities and, consequently, to become more afraid of falling (Shin et al., 2010). Therefore, early screening and management of the chronic conditions associated with FoF are necessary to prevent negative impact on older adults' general wellbeing and confidence to perform their habitual activities.

In this study, a range of health-related variables were independently associated with FoF in non-diabetic older adults, namely visual impairment, negative health self-perception, falls in the previous 12 months, obesity and depressive symptoms. These factors have been identified as having an association with FoF in prior studies conducted with older populations in general (Austin et al., 2007; Chang et al., 2016; Kim and So, 2013; Liu, 2015; Malini et al., 2016; Murphy et al., 2003; Oh et al., 2015). Negative health self-perception was also associated with FoF in older adults with diabetes. Our results showed that non-diabetic and diabetic older adults with negative health self-perception are 1.56 and 1.77 times, respectively, more likely to have FoF than non-diabetic and diabetic older adults with positive health self-perception. Health self-perception is a widely used measure as a general health indicator based on the individual's self-assessment about his/her health status (Oh et al., 2015). It has been reported that this measure is consistent with the actual health status of the respondents and is able to predict health outcome, survival, impending morbidity and death (Bora and Saikia, 2015). From now on, there is also evidence that negative health self-perception can predict FoF in older adults with and without diabetes.

A novel finding noted in the current study was the independent association between lower MMSE score and FoF in diabetic older adults. The MMSE is a screening tool for cognitive function, with lower scores suggesting a cognitive impairment. Diabetes is related to a higher risk of mild cognitive impairment in older population (Gao et al., 2016). A prior prospective cohort study demonstrated that mild cognitive impairment was independently associated with FoF development in older adults, after controlling for potential correlates of FoF, such as physical function and falls (Uemura et al., 2015). According to the authors, the anxiety that is a common neuropsychiatric symptom in those with mild cognitive impairment may decrease individuals' confidence in physical health status and make them more afraid of falling (Uemura et al., 2015). Our finding emphasizes the need for further studies with strict diagnostic criteria for cognitive impairment to better understand the underlying mechanisms involved in the relationship between cognitive function and FoF in diabetic older adults.

Frailty was another health-related variable associated with FoF in our final models. To our knowledge, few studies have investigated the association between FoF and frailty assessed with Fried et al.'s scale (Akin et al., 2015; Esbri Victor et al., 2016; Moreira et al., 2016a). In a population-based study with 906 community-dwelling Turkish older adults (71.5 ± 5.6 years; 50.6% female), frailty was not associated with FoF in the multivariate model (Akin et al., 2015). In contrast, in a group of 183 Spanish older adults with a history of falls (78.4 ± 5.6 years; 80.3% female), FoF was independently associated with frailty after adjusting for sex (Esbri Victor et al., 2016). Recently, in a study conducted with 99 Brazilian older women with type 2 diabetes (65–89 years), our research group showed that frailty did not remain significantly associated with FoF in the final model of the logistic regression (Moreira et al., 2016a). These conflicting results might be related to different cultural and clinical characteristics across populations and the type of instruments used to assess FoF. In the present study, frailty was the risk factor with the greatest strength of association with FoF in both non-diabetic and diabetic older adults (OR = 1.79 and 2.31, respectively). As frailty involves a dysregulation in multiple organ systems, such as musculoskeletal, endocrine and cardiovascular (Chen et al., 2014), it is conceivable that frailty plays an important role in the pathogenesis of FoF. Therefore, our findings strongly suggest that frailty is the most determinant factor for FoF among older adults living in the community. However, the cross-sectional design of this study prevents any causal relationship.

Considering the self-reported functional capacity measures, higher Katz Index score and lower Lawton Scale score, which correspond to a lower independence to perform ADL and IADL, respectively, were independently associated with FoF in non-diabetic older adults. The association between limitation, dependence or disability in ADL and IADL and FoF is consistent with previous studies conducted with older populations in general (Kim and So, 2013; Malini et al., 2016; Nourhashemi et al., 2001; Oh et al., 2015). According to the literature, FoF may lead to self-imposed restriction in day-to-day activities, which in turn may result in deconditioning, loss of maximal muscle strength, decreased postural control and increased risk of falling and FoF; thus creating a vicious cycle or a downward spiral of physical frailty (Delbaere et al., 2004). It is important to stress that in the present study there was no independent association of FoF with the ADL scale in diabetic older adults. Recently, in a study with 100 diabetic patients aged 60 years or older, Tander et al. (2015) found that the FES-I score was correlated with the ADL scale score. In Tander et al.'s (2015) study, ADL were assessed by the Modified Barthel Index, which contains the same activities of daily living of the Katz Index in addition to activities of grooming, climbing stairs and walking. A likely explanation for the association found in their study is due to the fact that the instrument used contains more difficult activities than those included in the ADL scale applied in our study. On the other hand, in our sample of older adults with diabetes, FoF was independently associated with the Lawton Scale score. This scale assesses the individual's performance in tasks such as cooking, housekeeping, shopping and use of transportation, which are more complex and challenging activities that require greater balance control and interaction with the environment. Thus, the IADL scale should be considered as a key tool for the assessment of elderly individuals afraid of falling since it was independently associated with FoF in both older adults with and without diabetes.

Surprisingly, our multivariate analysis showed that handgrip strength remained significantly associated with FOF in older adults without diabetes, but not in those with diabetes. A systematic review supports the value of handgrip strength as a predictor of mortality/survival, disability, complications and/or increased length of stay after hospitalization or surgery (Bohannon, 2008). Additionally, handgrip strength has been used as an indirect indicator of sarcopenia (Viana et al., 2013) and a marker of nutritional status (Norman et al., 2011). Several studies have investigated the relationship between handgrip strength and FoF in older population and controversial results have been observed (Deshpande et al., 2008; Malini et al., 2016; Park et al., 2014; Tomita et al., 2015). For example, in a study with 883 community-dwelling older adults aged 60 years or older from a rural area, Park et al. (2014) found lower handgrip strength in the participants with FoF when compared with those without FoF, regardless of the history of falls. Similarly, Tomita et al. (2015) demonstrated that older women with FoF had weaker handgrip strength than those without FoF. The authors also showed that weaker handgrip strength was significantly associated with FoF after adjusting for age, BMI, comorbidities, falls in the previous year and cataracts (Tomita et al., 2015). In contrast, a population-based study carried out with 926 participants aged 65 years or older showed that handgrip strength was not associated either with FoF or with fear-induced activity restriction (Deshpande et al., 2008). In a diabetic population, a recent study demonstrated that handgrip strength was similar between older women with type 2 diabetes with and without FoF (Moreira et al., 2016a). Potential reasons for this inconsistency in the findings across studies likely include methodological and study subject differences. Therefore, additional research should be conducted to establish more robust conclusions on the relationship between handgrip strength and FoF.

There is consistent evidence that reduced gait speed is a risk factor for disability, cognitive impairment, institutionalization, falls and mortality (Abellan van Kan et al., 2009). Our results add to existing

knowledge by showing that reduced gait speed is also a strong risk factor for FoF in non-diabetic older adults as well as in those with diabetes. In a study conducted with 742 participants aged 65 years or older, Malini et al. (2016) found that reduced gait speed was associated with FoF after adjustment for socioeconomic, demographic, clinical, functional and psychosocial variables. Moreira et al. (2016a) also showed that diabetic older women with FoF had lower gait speed in comparison with those without FoF. Previous study concluded that the generalized deficit in muscle strength of the lower limbs may explain the slower gait among older adults fearful of falling (Brouwer et al., 2004). Furthermore, our results showed that the mean difference between the groups with and without FoF for both non-diabetic and diabetic older adults was 0.20 m/s, which exceeds the value of 0.10 m/s considered as a substantial clinical change, as suggested in a study about clinically significant changes in physical performance measures in older adults (Perera et al., 2006). Thus, gait speed should be used as a functional tool to identify older adults with FoF and/or as an outcome measure to demonstrate the effectiveness of therapeutic interventions designed to FoF.

This study has certain limitations. First, the cross-sectional design prevents us from determining the temporality of our associations. In other words, it is unknown whether some of the factors that we found associated with FoF resulted from it or occurred prior to it. A longitudinal study is warranted to substantiate causal relationships. Second, the diagnosis of diabetes was based on self-report, which may have affected the prevalence of this health condition. Third, a great number of participants enrolled in the FIBRA study were excluded of the analyses due to the missing data, which could interfere in the inference ability of our study. However, the sample size still remained substantial. Finally, it was not assessed the presence of diabetes-related complications (*e.g.* peripheral neuropathy, nephropathy and retinopathy), which might be associated with FoF in older adults with diabetes. Other variables such as body pain, vitality, dizziness, use of walking aids, balance and muscle strength of lower limbs were also not investigated in this study. Therefore, future studies should include such variables to provide an additional insight into the FoF in older population with and without diabetes.

Despite these limitations, our study presents strengths that should be highlighted. This is a large study that included older adults of both sexes sampled from various cities with different human development indexes, which enhances the generalizability of our findings. Another important aspect of this study is that FoF was assessed by the FES-I, a valid and reliable tool in assessing the FoF that has as advantages the fact of being short and simple to administer in clinical practice, having easily understandable scoring categories and including both physical and social activities in and out of the home.

5. Conclusions

The present study confirmed that FoF is a multifactorial condition related to a number of sociodemographic, clinical and functional variables. Moreover, differences in the associated factors with FoF among community-dwelling older adults with and without diabetes mellitus were evidenced. Our multivariate analyses also demonstrated that being frail, according to the Fried et al.'s frailty scale, was the main risk factor of FoF for both groups followed by female gender and negative health self-perception. Knowledge of the associated factors with FoF, particularly those that are modifiable, may be useful in developing strategies to decrease this common and disabling health problem in older adults. Finally, our findings suggest that a multidisciplinary approach is necessary for a successful management of FoF and the treating team should consider the particularities of FoF in non-diabetic and diabetic older adults.

Conflict of interest

The authors declare that there is no conflict of interest.

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6 CONSIDERAÇÕES FINAIS

A escolha do medo de cair como objeto de estudo da presente tese baseou-se nas lacunas existentes no conhecimento científico sobre os fatores relacionados a este problema de saúde na população idosa com diabetes mellitus. Os dois estudos realizados são pioneiros e fornecem subsídios para o desenvolvimento de novas pesquisas na área. A seguir, estão descritos alguns aspectos importantes de cada estudo, além dos principais achados:

Estudo A

- O medo de cair em idosas da comunidade com diabetes mellitus tipo 2 sem sintomas neuropáticos está associado com maior nível de fragilidade, maior sintomatologia depressiva, déficits de equilíbrio dinâmico e mobilidade funcional e alterações na marcha.
- O grupo de idosas diabéticas com medo de cair apresentou maior tempo de execução no TUG e no teste de sentar e levantar em comparação com o grupo de idosas diabéticas sem medo de cair.
- O medo de cair em idosas diabéticas está associado com menor velocidade da marcha, cadência e comprimento do passo e maior variabilidade do tempo do passo e do tempo de oscilação.
- O grupo de idosas diabéticas com medo de cair apresentou velocidade da marcha aproximadamente 10% menor em relação ao grupo de idosas diabéticas sem medo de cair.
- Não foi observada associação da idade e história de quedas com medo de cair em idosas diabéticas da comunidade.
- Os resultados deste estudo mostraram que o aumento de uma unidade na GDS-15 e no TUG estava associado com uma chance 34% e 36% maior de ter medo de cair, respectivamente.
- Este foi o primeiro estudo a estabelecer um ponto de corte na FES-I para diferenciar entre idosos diabéticos da comunidade com e sem medo de cair.

Estudo B

- Este foi o primeiro estudo a investigar e determinar diferenças nos fatores associados com o medo de cair em idosos da comunidade com e sem diabetes mellitus.
- A prevalência do medo de cair foi significativamente maior nos idosos diabéticos (60,8%) em comparação aos idosos não diabéticos (53,6%).
- Os resultados deste estudo confirmam a multidimensionalidade do medo de cair na população idosa diabética e não diabética.
- O sexo feminino foi o único fator sociodemográfico independentemente associado com o medo de cair em ambos idosos com e sem diabetes mellitus.
- Maior escore no MEEM estava independentemente associado com menor chance de ter medo de cair apenas nos idosos diabéticos.
- A fragilidade foi o fator de risco com maior força de associação com o medo de cair tanto para idosos não diabéticos quanto para idosos diabéticos.
- Maior velocidade da marcha estava independentemente associada com menor chance de ter medo de cair em ambos idosos com e sem diabetes mellitus.
- Este estudo tem como ponto forte a inclusão de idosos de ambos os sexos amostrados de 15 cidades com diferentes IDH das cinco regiões geográficas brasileiras, aumentando o poder de generalização de nossos achados.

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ANEXOS

ANEXO A – Parecer do Comitê de Ética em Pesquisa do Estudo A

UNIVERSIDADE FEDERAL DE MINAS GERAIS
COMITÊ DE ÉTICA EM PESQUISA - COEP

Parecer nº. ETIC 0144.0.203.000-10

Interessado(a): Profa. Leani Souza Máximo Pereira
Departamento de Fisioterapia
EEFFTO - UFMG

DECISÃO

O Comitê de Ética em Pesquisa da UFMG – COEP aprovou, no dia 24 de maio de 2010, após atendidas as solicitações de diligência, o projeto de pesquisa intitulado **"Avaliação das características da marcha e a associação com os marcadores inflamatórios em idosos diabéticos classificados como frágeis, pré-frágeis e não frágeis"** bem como o Termo de Consentimento Livre e Esclarecido.

O relatório final ou parcial deverá ser encaminhado ao COEP um ano após o início do projeto.

Profa. Maria Teresa Marques Amaral
Coordenadora do COEP-UFMG

ANEXO B – Escore de Sintomas Neuropáticos

Escore de Sintomas Neuropáticos (ESN)

Original: Young MJ, Boulton AJM, Macleod AF e cols.
Tradução: Moreira RO, Castro AP, Papelbaum M e cols.

1. O senhor(a) tem experimentado dor ou desconforto nas pernas?	( ) Se NÃO, interromper a avaliação ( ) Se SIM, continuar a avaliação	
2. Que tipo de sensação mais te incomoda? (Descrever os sintomas se o paciente não citar nenhum destes)	( ) Queimação, dormência ou formigamento ( ) Fadiga, câimbras ou prurido	2 pts 1 pt
3. Qual a localização mais freqüente desse(a) (sintoma descrito)?	( ) Pés ( ) Panturrilha ( ) Outra localização	2 pts 1 pt 0 pt
4. Existe alguma hora do dia em que este(a) (sintoma descrito) aumenta de intensidade?	( ) Durante a noite ( ) Durante o dia e a noite ( ) Apenas durante o dia	2 pts 1 pt 0 pt
5. Este(a) (sintoma descrito) já o(a) acordou durante a noite?	( ) Sim ( ) Não	1 pt 0 pt
6. Alguma manobra que o(a) senhor(a) o realiza é capaz de diminuir este(a) (sintoma descrito)? (Descrever as manobras para o paciente se ele não citar nenhuma delas)	( ) Andar ( ) Ficar de pé ( ) Sentar ou deitar	2 pts 1 pt 0 pt

Escore Total:_____ Classificação: Leve / Moderado / Grave
Um escore de 3–4 implica em sintomas leves, 5–6 sintomas moderados e 7–9 sintomas graves.

ANEXO C – Parecer do Comitê de Ética em Pesquisa do Estudo B

UFMG | Universidade Federal de Minas Gerais
Comitê de Ética em Pesquisa da UFMG - COEP

Parecer nº. ETIC 187/07

Interessado(a): Profa. Rosângela Corrêa Dias
Departamento de Fisioterapia
EEFFTO- UFMG

DECISÃO

O Comitê de Ética em Pesquisa da UFMG – COEP aprovou, no dia 04 de outubro de 2007, após atendidas as solicitações de diligência, o projeto de pesquisa intitulado **"Estudo da fragilidade em idosos brasileiros"** bem como o Termo de Consentimento Livre e Esclarecido.

O relatório final ou parcial deverá ser encaminhado ao COEP um ano após o início do projeto.

Profa. Dra. Maria Elena de Lima Perez Garcia
Coordenadora do COEP-UFMG

ANEXO D – Inquérito do Estudo da Fragilidade em Idosos Brasileiros (Rede FIBRA)

ESTUDO DA FRAGILIDADE EM IDOSOS BRASILEIROS

1- DATA ENTREVISTA:___/___/_____ 2 - HORA DE INÍCIO: ___:___ 3 - HORA DE TÉRMINO:___:___
4 - CÓDIGO DO ENTREVISTADOR: _____ 5-PÓLO: _____
6 - CÓDIGO DA CIDADE:_____ 7 - SETOR CENSITÁRIO: _____

CONTROLE DE QUALIDADE

DATA _____
STATUS _____
OBSERVAÇÃO _____
_____

STATUS DO QUESTIONÁRIO:

(1) questionário completo
(2) necessário fazer outro contato com o idoso
(3) esclarecer com o entrevistador
(4) perdido

CÓDIGO DO REVISOR: ☐

8 - STATUS FINAL DO QUESTIONÁRIO: ☐

9 - CÓDIGO DO PARTICIPANTE: ☐

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10 - Nome: _____
11 - Endereço: _____ 12.Bairro: _____
13 - Telefone: _____
14 - Data de nascimento:_____/_____/ 15.Idade: _____
16 - Gênero: (1) Masc. (2) Fem. ☐
17 - Assinatura do TCLE: (1) Sim (2) Não ☐
18.Nome de familiar, amigo ou vizinho para contato:
19.Telefone: _____
20.OBS.:_____
_____
_____

I - ESTADO MENTAL

Agora vou lhe fazer algumas perguntas que exigem atenção e um pouco da sua memória. Por favor, tente se concentrar para respondê-las.

QUESTÕES	RESPOSTAS	PONTUAÇÃO	
21 - Que dia é hoje?		(1) Certo (0) Errado	21 ☐
22 - Em que mês estamos?		(1) Certo (0) Errado	22 ☐
23 - Em que ano estamos?		(1) Certo (0) Errado	23 ☐
24 - Em que dia da semana estamos?		(1) Certo (0) Errado	24 ☐
25 - Que horas são agora aproximadamente? (considere correta a variação de mais ou menos uma hora)		(1) Certo (0) Errado	25 ☐
26 - Em que local nós estamos? (dormitório, sala, apontando para o chão)		(1) Certo (0) Errado	26 ☐
27 - Que local é este aqui? (apontando ao redor num sentido mais amplo para a casa)		(1) Certo (0) Errado	27 ☐
28 - Em que bairro nós estamos ou qual o nome de uma rua próxima?		(1) Certo (0) Errado	28 ☐
29 - Em que cidade nós estamos?		(1) Certo (0) Errado	29 ☐
30 - Em que estado nós estamos?		(1) Certo (0) Errado	30 ☐
31 - Vou dizer 3 palavras e o(a) senhor(a) irá repeti-las a seguir: CARRO – VASO – TIJOLO 32. Gostaria que o(a) senhor(a) me dissesse quanto é: (se houver erro, corrija e prossiga. Considere correto se o examinado espontaneamente se corrigir)	31. a - CARRO	(1) Certo (0) Errado	31.a ☐
	31. b - VASO	(1) Certo (0) Errado	31.b ☐
	31. c - TIJOLO	(1) Certo (0) Errado	31.c ☐
32 - Gostaria que o(a) senhor(a) me dissesse quanto é: (se houver erro, corrija e prossiga. Considere correto se o examinado espontaneamente se corrigir)	32. a - 100 - 7 _____	(1) Certo (0) Errado	32.a ☐
	32. b - 93 - 7 _____	(1) Certo (0) Errado	32.b ☐
	32. c - 86 - 7 _____	(1) Certo (0) Errado	32.c ☐
	32. d - 79 - 7 _____	(1) Certo (0) Errado	32.d ☐
	32. e - 72 - 7 _____	(1) Certo (0) Errado	32.e ☐

QUESTÕES	RESPOSTAS	PONTUAÇÃO
33 - O(a) senhor(a) consegue se lembrar das 3 palavras que lhe pedi que repetisse agora há pouco?	33. a - CARRO 33. b - VASO 33. c - TIJOLO	(1) Certo (0) Errado 33.a ☐ (1) Certo (0) Errado 33.a ☐ (1) Certo (0) Errado 33.a ☐
34 - Mostre um relógio e peça ao entrevistado que diga o nome.		(1) Certo (0) Errado 34 ☐
35 - Mostre uma caneta e peça ao entrevistado que diga o nome.		(1) Certo (0) Errado 35 ☐
36 - Preste atenção: vou lhe dizer uma frase e quero que repita depois de mim: NEM AQUI, NEM ALI, NEM LÁ. (Considere somente se a repetição for perfeita)		(1) Certo (0) Errado 36 ☐
37 - Agora pegue este papel com a mão direita. Dobre-o ao meio e coloque-o no chão. (Falar todos os comandos de uma vez só)	37.a - Pega a folha com a mão correta 37.b - Dobra corretamente 37.c - Coloca no chão	(1) Certo (0) Errado 37.a ☐ (1) Certo (0) Errado 37.b ☐ (1) Certo (0) Errado 37.c ☐
38. Vou lhe mostrar uma folha onde está escrito uma frase. Gostaria que fizesse o que está escrito: FECHE OS OLHOS		(1) Certo (0) Errado 38 ☐
39. Gostaria que o(a) senhor(a) escrevesse uma frase de sua escolha, qualquer uma, não precisa ser grande		(1) Certo (0) Errado 39 ☐
40. Vou lhe mostrar um desenho e gostaria que o(a) senhor(a) copiasse, tentando fazer o melhor possível. Desenhar no verso da folha. (Considere apenas se houver 2 pentágonos interseccionados, 10 ângulos, formando uma figura com 4 lados ou com 2 ângulos)		(1) Certo (0) Errado 40 ☐
Escore Total	41 ☐	

II – CARACTERÍSTICAS SÓCIO-DEMOGRÁFICAS

42 - Qual é o seu estado civil?

(1) Casado (a) ou vive com companheiro(a) (2) Solteiro(a) 42 ☐

(3) Divorciado(a) / Separado(a) (4) Viúvo(a) (97) NS (98) NA

(99) NR

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43 - Qual sua cor ou raça?

(1) Branca (2) Preta/negra (3) Mulata/cabocla/parda (4) Indígena 43 ☐

(5) Amarela/oriental (97) NS (98) NA (99) NR

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44 - Trabalha atualmente? (se não, vá para questão 45)

(1) Sim (2) Não (97) NS (98) NA (99) NR

44.a.O que o(a) senhor(a) faz (perguntar informações precisas sobre o tipo de ocupação) 44 ☐

_____

_____

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45 - O(a) senhor(a) é aposentado(a)? 45 ☐

(1) Sim (2) Não (97) NS (98) NA (99) NR

---

46 - O(a) senhor(a) é pensionista? 46 ☐

(1) Sim (2) Não (97) NS (98) NA (99) NR

---

47 - O(a) senhor(a) é capaz de ler e escrever um bilhete simples? (se a pessoa responder que aprendeu a ler e escrever, mas esqueceu, ou que só é capaz de assinar o próprio nome, marcar NÃO) 47 ☐

(1) Sim (2) Não (97) NS (98) NA (99) NR

---

48 - Até que ano da escola o(a) Sr (a) estudou?

(1) Nunca foi à escola (nunca chegou a concluir a 1ª série primária ou o curso de alfabetização de adultos)

(2) Curso de alfabetização de adultos

(3) Primário (atual nível fundamental, 1ª a 4ª série)

(4) Ginásio (atual nível fundamental, 5ª a 8ª série) 48 ☐

(5) Científico, clássico (atuais curso colegial ou normal, curso de magistério, curso técnico)

(6) Curso superior

(7) Pós-graduação, com obtenção do título de Mestre ou Doutor

(97) NS (98) NA (99) NR

49 - Total de anos de escolaridade: 49 ☐

50 - Quantos filhos o(a) Sr/Sra tem? 50 ☐

51.O(a) Sr/Sra mora só? (Se sim, vá para 52) 50 ☐
(1) Sim (2) Não

51.a - Quem mora com o(a) senhor(a)?

(1) Sozinho	( ) sim	( ) não	51.a ☐
(2) Marido/ mulher/ companheiro (a)	( ) sim	( ) não	
(3) Filhos ou enteados	( ) sim	( ) não	
(4) Netos	( ) sim	( ) não	
(5) Bisnetos	( ) sim	( ) não	
(6) Outros parentes	( ) sim	( ) não	
(7) Pessoas fora da família (amigos, pessoas contratadas, acompanhantes, cuidadores e empregada doméstica)	( )sim	( )não	

52 - O(a) Sr/Sra é proprietário(a) de sua residência? 52 ☐
(1) Sim (2) Não (97) NS (98) NA (99) NR

53 - O(a) Sr/Sra é o principal responsável pelo sustento da família? (Se sim, vá para 54) 53 ☐
(1) Sim (2) Não (97) NS (98) NA (99) NR

53.a - O(a) Sr/Sra ajuda nas despesas da casa? 53.a ☐
(1) Sim (2) Não (97) NS (98) NA (99) NR

54 - Qual a sua renda mensal, proveniente do seu trabalho, da sua aposentadoria ou pensão? 54 ☐

55 - O(a) Sr/Sra tem algum parente, amigo ou vizinho que poderia cuidar de você por alguns dias, caso necessário? 55 ☐
(1) Sim (2) Não (97) NS (98) NA (99) NR

56 - Qual a renda mensal da sua família, ou seja, das pessoas que moram em sua casa, incluindo o(a) senhor(a)? 56 ☐

57. O(a) senhor(a) e sua (seu) companheira(o) consideram que têm dinheiro suficiente para cobrir suas necessidades da vida diária? 57 ☐
(1) Sim (2) Não

58. Agora verificaremos sua pressão arterial
BRAÇO DIREITO - PA1 sentado

58.a ☐ 58.b ☐

III – SAÚDE FÍSICA PERCEBIDA

Doenças crônicas auto-relatadas diagnosticadas por médico no último ano.
No último ano, algum médico já disse que o(a) senhor(a) tem os seguintes problemas de saúde?

PATOLOGIAS

59 - Doença do coração como angina, infarto do miocárdio ou ataque cardíaco? 59 ☐
(1) Sim (2) Não (97) NS (99) NR

60 - Pressão alta – hipertensão? 60 ☐
(1) Sim (2) Não (97) NS (99) NR

61 - Derrame/AVC/Isquemia Cerebral 61 ☐
(1) Sim (2) Não (97) NS (99) NR

62 - Diabetes Mellitus? 62 ☐
(1) Sim (2) Não (97) NS (99) NR

63 - Tumor maligno/câncer? 63 ☐
(1) Sim (2) Não (97) NS (99) NR

64 - Artrite ou reumatismo? 64 ☐
(1) Sim (2) Não (97) NS (99) NR

65 - Doença do pulmão (bronquite e enfisema)? 65 ☐
(1) Sim (2) Não (97) NS (99) NR

66 - Depressão? 66 ☐
(1) Sim (2) Não (97) NS (99) NR

67 - Osteoporose? 67 ☐
(1) Sim (2) Não (97) NS (99) NR

Saúde auto-relatada: Nos últimos 12 meses, o(a) senhor(a) teve algum destes problemas?

PROBLEMAS

68. Incontinência urinária (ou perda involuntária da urina)? 68 ☐
(1) Sim (2) Não (97) NS (99) NR

69 - Incontinência fecal (ou perda involuntária das fezes)? 69 ☐
(1) Sim (2) Não (97) NS (99) NR

70 - Nos últimos 12 meses, tem se sentido triste ou deprimido? 70 ☐
(1) Sim (2) Não (97) NS (99) NR

71 - Esteve acamado em casa por motivo de doença ou cirurgia? 71 ☐
(1) Sim (2) Não (97) NS (99) NR

71.a - Se sim, por quantos dias permaneceu acamado? 71.a ☐
(1) Sim (2) Não (97) NS (99) NR

72 - Nos últimos 12 meses, teve dificuldade de memória, de lembrar-se de fatos recentes? 72 ☐
(1) Sim (2) Não (97) NS (99) NR

73 - O(a) senhor(a) tem problemas para dormir? 73 ☐
(1) Sim (2) Não (97) NS (99) NR

Alterações no peso

PROBLEMAS

74. O(a) senhor(a) ganhou peso? 74 ☐
(1) Sim (2) Não (97) NS (99) NR

74.a. Se sim, quantos quilos aproximadamente? ☐

75. O(a) senhor(a) perdeu peso involuntariamente? 75 ☐
(1) Sim (2) Não (97) NS (99) NR

75.a. Se sim, quantos quilos aproximadamente? ☐
(1) Sim (2) Não (97) NS (99) NR

76. Teve perda de apetite? 76 ☐
(1) Sim (2) Não (97) NS (99) NR

Quedas

PROBLEMAS

77 - O(a) senhor(a) sofreu quedas nos últimos 12 meses? (Se não, vá para 81)
(1) Sim (2) Não (97) NS (99) NR

77.a - Se sim, quantas vezes? Uma vez ☐ Duas ou mais ☐

78 - Devido às quedas, o(a) senhor(a) teve que procurar o serviço de saúde ou teve que consultar o médico? 78 ☐
(1) Sim (2) Não (97) NS (99) NR

79 - Sofreu alguma fratura? (Se não, vá para 81) 79 ☐
(1) Sim (2) Não (97) NS (99) NR

79.a - Se sim, onde? 79.a ☐
(1) punho (2) quadril (3) vértebra (4) combinações (5) outros

80 - Teve que ser hospitalizado por causa dessa fratura? 80 ☐
(1) Sim (2) Não (97) NS (99) NR

Uso de medicamentos

81 - Quantos medicamentos o(a) senhor(a) tem usado de forma regular nos últimos 3 meses, receitados pelo médico ou por conta própria? 81 ☐

82 - Para os que tomam medicamentos, perguntar:
"Como tem acesso aos medicamentos"? 82 ☐
(1) Compra com o seu dinheiro
(2) Compra com os recursos da família
(3) Obtém no posto de saúde
(4) Qualquer outra composição (1+2), (1+3), (2+3), (1+2+3) ou doação

83 - O(a) senhor(a) deixa de tomar algum medicamento prescrito por dificuldade financeira para comprá-lo? 83 ☐
(1) Sim (2) Não (97) NS (98) NA (99) NR

Déficit de Audição e de Visão

84 - O(a) senhor(a) ouve bem? 84 ☐
(1) Sim (2) Não (98) NA (99) NR

85 - O(a) senhor(a) usa aparelho auditivo? 85 ☐
(1) Sim (2) Não (97) NS (98) NA (99) NR

86 - O(a) senhor enxerga bem? 86 ☐
(1) Sim (2) Não (97) NS (98) NA (99) NR

87 - O(a) senhor(a) usa óculos ou lentes de contato? 87 ☐
(1) Sim (2) Não (97) NS (98) NA (99) NR

Hábitos de vida: tabagismo e alcoolismo

Agora eu gostaria de saber sobre alguns de seus hábitos de vida.

88 - O (a) Sr (a) fuma atualmente? (Se não, vá para 88.b)

(1) Sim (2) Não (97) NS (98) NA (99) NR — 88 ☐

88.a. Para aqueles que responderam SIM, perguntar:

"Há quanto tempo o(a) senhor(a) é fumante? — 88.a ☐

88.b - Para aqueles que responderam NÃO, perguntar:

(1) Nunca fumou (2) Já fumou e largou (97) NS (98) NA (99) NR — 88.b ☐

AUDIT

89 - Com que freqüência o senhor(a) consome bebidas alcoólicas?

(0) Nunca (1) Uma vez por mês ou menos (2) 2-4 vezes por mês
(3) 2-3 vezes por semana (4) 4 ou mais vezes por semana — 89 ☐

90 - Quantas doses de álcool o senhor(a) consome num dia normal?

(0) 0 ou 1 (1) 2 ou 3 (2) 4 ou 5 (3) 6 ou 7 (4) 8 ou mais — 90 ☐

91 - Com que freqüência o senhor(a) consome cinco ou mais doses em uma única ocasião?

(0) Nunca (1) Menos que uma vez por mês (2) Uma vez por mês
(3) Uma vez por semana (4) Quase todos os dias — 91 ☐

Avaliação subjetiva da saúde (saúde percebida)

92 - Em geral, o(a) senhor(a) diria que a sua saúde é:

(1) Muito boa (2) Boa (3) Regular (4) Ruim (5) Muito ruim
(99) NR — 92 ☐

93 - Quando o(a) senhor(a) compara a sua saúde com a de outras pessoas da sua idade, como o(a) senhor(a) avalia a sua saúde no momento atual?

(1) Igual (2) Melhor (3) Pior (99) NR — 93 ☐

94 - Em comparação há 1 ano atrás, o(a) senhor(a) considera a sua saúde hoje:

(1) Igual (2) Melhor (3) Pior (99) NR — 94 ☐

95 - Em relação ao cuidado com a sua saúde, o(a) senhor(a) diria que ele é, de uma forma geral:

(1) Muito bom (2) Bom (3) Regular (4) Ruim (5) Muito ruim
(99) NR — 95 ☐

96 - Em comparação há 1 ano atrás, como o(a) senhor(a) diria que está o seu nível de atividade?

(1) Igual (2) Melhor (3) Pior (99) NR — 96 ☐

97- Agora verificaremos sua pressão arterial mais uma vez

BRAÇO DIREITO - PA2 sentado **97.a** ☐ **97.b** ☐

BRAÇO DIREITO

PA3 em pé
(Aguardar 2 minutos antes de medir a PA3 em pé) **97.c** ☐ **97.d** ☐

Uso de serviços de saúde

Agora vamos falar sobre o uso que o(a) senhor(a) tem feito de serviços médicos nos <u>últimos 12 meses</u>

98 - O(a) senhor(a) tem plano de saúde? **98** ☐
(1) Sim (2) Não (97) NS (98) NA (99) NR

99 - Precisou ser internado no hospital pelo menos por uma noite? **99** ☐
(1) Sim (2) Não (97) NS (98) NA (99) NR

99.a - Para aqueles que responderam SIM, perguntar:
Qual foi o maior tempo de permanência no hospital? **99.a** ☐

100 - O(a) senhor(a) recebeu em sua casa a visita de algum profissional da área da saúde? (psicólogo, fisioterapeuta, médico, fonoaudiólogo). **100** ☐
(1) Sim (2) Não (97) NS (98) NA (99) NR

101 - Quantas vezes o(a) senhor(a) foi à uma consulta médica (qualquer especialidade)? **101** ☐

101.a - Para aqueles que responderam NENHUMA na questão anterior, perguntar:
Qual o principal motivo de não ter ido ao médico nos últimos 12 meses?
(1) Não precisou
(2) Precisou, mas não quis ir
(3) Precisou, mas teve dificuldade de conseguir consulta
(4) A consulta foi marcada, mas teve dificuldade para ir
(5) A consulta foi marcada, mas não quis ir
(97) NS (98) NA (99) NR **101.a** ☐

Aspectos Funcionais da Alimentação

Agora eu gostaria de saber sobre possíveis mudanças ou dificuldades para se alimentar que o(a) senhor(a) tem sentido nos últimos 12 meses

PROBLEMAS

102 - Mudança no paladar ou dificuldade para perceber e diferenciar os sabores? **102** ☐
(1) Sim (2) Não (97) NS (99) NR

103 - Dificuldade ou dor para mastigar comida dura? **103** ☐
(1) Sim (2) Não (97) NS (99) NR

104 - Dificuldade ou dor para engolir? **104** ☐
(1) Sim (2) Não (97) NS (99) NR

105 - Sensação de alimento parado ou entalado?
(1) Sim (2) Não (97) NS (99) NR — 105 ☐

106 - Retorno do alimento da garganta para a boca ou para o nariz?
(1) Sim (2) Não (97) NS (99) NR — 106 ☐

107 - Pigarro depois de comer alguma coisa?
(1) Sim (2) Não (97) NS (99) NR — 107 ☐

108 - Engasgos ao se alimentar ou ingerir líquidos?
(1) Sim (2) Não (97) NS (99) NR — 108 ☐

109 - Necessidade de tomar líquido para ajudar a engolir o alimento?
(1) Sim (2) Não (97) NS (99) NR — 109 ☐

Capacidade Funcional para AAVD, AIVD e ABVD

Atividades Avançadas de Vida Diária
Eu gostaria de saber qual é a sua relação com as seguintes atividades:

ATIVIDADES

NUNCA (1)
PAROU DE FAZER(2)
AINDA FAZ (3)

110 - Fazer visitas na casa de outras pessoas — 110 ☐

111 - Receber visitas em sua casa — 111 ☐

112 - Ir à igreja ou templo para rituais religiosos ou atividades sociais ligadas à religião — 112 ☐

113 - Participar de centro de convivência, universidade da terceira idade ou algum curso — 113 ☐

114 - Participar de reuniões sociais, festas ou bailes — 114 ☐

115 - Participar de eventos culturais, tais como concertos, espetáculos, exposições, peças de teatro ou filmes no cinema — 115 ☐

116 - Dirigir automóveis — 116 ☐

117 - Fazer viagens de 1 dia para fora da cidade — 117 ☐

118 - Fazer viagens de duração mais longa para fora da cidade ou país — 118 ☐

119 - Fazer trabalho voluntário — 119 ☐

120 - Fazer trabalho remunerado — 120 ☐

121. Participar de diretorias ou conselhos de associações, clubes, escolas, sindicatos, cooperativas, centros de convivência, ou desenvolver atividades políticas? — 121 ☐

Atividades Instrumentais de Vida Diária

Agora eu vou perguntar sobre a sua independência para fazer coisas do dia-a-dia. Gostaria que me dissesse se é totalmente independente, se precisa de alguma ajuda ou se precisa de ajuda total para fazer cada uma das seguintes coisas:

122 - Usar o telefone
I = É capaz de discar os números e atender sem ajuda?
A = É capaz de responder às chamadas, mas precisa de alguma ajuda para discar os números?
D = É incapaz de usar o telefone? (não consegue nem atender e nem discar)
122 ☐

123 - Uso de transporte
I = É capaz de tomar transporte coletivo ou táxi sem ajuda?
A = É capaz de usar transporte coletivo ou táxi, porém não sozinho?
D = É incapaz de usar transporte coletivo ou táxi?
123 ☐

124 - Fazer compras
I = É capaz de fazer todas as compras sem ajuda?
A = É capaz de fazer compras, porém com algum tipo de ajuda?
D = É incapaz de fazer compras?
124 ☐

125 - Preparo de alimentos
I = Planeja, prepara e serve os alimentos sem ajuda?
A = É capaz de preparar refeições leves, porém tem dificuldade de preparar refeições maiores sem ajuda?
D = É incapaz de preparar qualquer refeição?
125 ☐

126 - Tarefas domésticas
I = É capaz de realizar qualquer tarefa doméstica sem ajuda?
A = É capaz de executar somente tarefas domésticas mais leves?
D = É incapaz de executar qualquer trabalho doméstico?
126 ☐

127 - Uso de medicação
I = É capaz de usar a medicação de maneira correta sem ajuda?
A = É capaz de usar a medicação, mas precisa de algum tipo de ajuda?
D = É incapaz de tomar a medicação sem ajuda?
127 ☐

128 - Manejo do dinheiro
I = É capaz de pagar contas, aluguel e preencher cheques, de controlar as necessidades diárias de compras sem ajuda?
A = Necessita de algum tipo de ajuda para realizar estas atividades?
D = É incapaz de realizar estas atividades?
128 ☐

Atividades Básicas de Vida Diária (Katz)

Vou continuar lhe perguntando sobre a sua independência para fazer coisas do dia-a-dia. Gostaria que me dissesse se é totalmente independente, se precisa de alguma ajuda ou se precisa de ajuda total para fazer cada uma das seguintes coisas:

129 - Tomar banho (leito, banheira ou chuveiro)
I = Não recebe ajuda (entra e sai da banheira sozinho, se este for o modo habitual de tomar banho
I = Recebe ajuda para lavar apenas uma parte do corpo (como, por exemplo, as costas ou uma perna)
D = Recebe ajuda para lavar mais de uma parte do corpo, ou não toma banho sozinho
129 ☐

130 - Vestir-se (pega roupas, inclusive, peças íntimas, nos armários e gavetas, e manuseia fechos, inclusive os de órteses e próteses, quando forem utilizadas)

I = Pega as roupas e veste-se completamente, sem ajuda
I = Pegas as roupas e veste-se sem ajuda, exceto para amarrar os sapatos
D = Recebe ajuda para pegar as roupas ou vestir-se, ou permanece parcial ou completamente sem roupa

130 ☐

131 - Uso do vaso sanitário (ida ao banheiro ou local equivalente para evacuar e urinar, higiene íntima e arrumação das roupas)

I = Vai ao banheiro ou local equivalente, limpa-se e ajeita as roupas sem ajuda (pode usar objetos para apoio como bengala, andador ou cadeira)
D = Recebe ajuda para ir ao banheiro ou local equivalente, ou para limpar-se, ou para ajeitar as roupas após evacuação ou micção, ou para usar a comadre ou urinol à noite)
D = Não vai ao banheiro ou equivalente para eliminações fisiológicas

131 ☐

132 - Transferência

I = Deita-se e sai da cama, senta-se e levanta-se da cadeira sem ajuda (pode estar usando objeto para apoio, como bengala ou andador)
D = Deita-se e sai da cama e/ou senta-se e levanta-se da cadeira com ajuda
D = Não sai da cama

132 ☐

133 - Continência

I = Controla inteiramente a micção e a evacuação
D = Tem "acidentes" ocasionais
D = Necessita de ajuda para manter o controle da micção e evacuação; usa cateter ou é incontinente

133 ☐

134 - Alimentação

I = Alimenta-se sem ajuda
I = Alimenta-se sozinho, mas recebe ajuda para cortar carne ou passar manteiga no pão
D = Recebe ajuda para alimentar-se, ou é alimentado parcialmente ou completamente pelo uso de cateteres ou fluidos intravenosos

134 ☐

Expectativa de Cuidado em AAVD, AIVD e ABVD

135 - Caso precise ou venha a precisar de ajuda para realizar qualquer uma dessas atividades, o(a) senhor(a) tem com quem contar?
(Se não, vá para 136)

(1) Sim (2) Não (97) NS (98) NA (99) NR

135 ☐

135.a - Para aqueles que responderam SIM, perguntar: "Quem é essa pessoa?"

(1) Cônjuge ou companheiro(a)
(2) Filha ou nora
(3) Filho ou genro
(4) Outro parente
(5) Um(a) vizinho(a) ou amigo(a
(6) Um profissional pago
(97) NS
(98) NA
(99) NR

135.a ☐

Medidas de Atividades Físicas e Antropométricas
Questionário Minnesota

Solicitarei ao(à) Sr(a) que responda quais das atividades abaixo foi realizada nas últimas duas semanas. Para cada uma destas atividades, gostaria que me dissesse em quais dias você as realiza, o número de vezes por semana e o tempo que você gastou com a atividade cada vez que o(a) Sr(a) a realizou.

ATIVIDADE	O(a) Sr(a) praticou, nas últimas duas semanas... SIM (1) NÃO(2)	1ª SEMANA NA (98)	2ª SEMANA NA (98)	MÉDIA DE VEZES POR SEMANA NA (98)	TEMPO POR OCASIÃO	
					HORAS NA (98)	MINUTOS NA (98)

Sessão A: Caminhada

136 - Caminhada recreativa?	136.a	136.b	136.c	136.d	136.e	136.f
137 - Caminhada para o trabalho?	137.a	137.b	137.c	137.d	137.e	137.f
138 - Uso de escadas quando o elevador está disponível?	138.a	138.b	138.c	138.d	138.e	138.f
139 - Caminhada ecológica?	139.a	139.b	139.c	139.d	139.e	139.f
140 - Caminhada com mochila?	140.a	140.b	140.c	140.d	140.e	140.f
141 - Ciclismo recreativo/pedalando por prazer?	141.a	141.b	141.c	141.d	141.e	141.f
142 - Dança – salão, quadrilha, e/ou discoteca, danças regionais?	142.a	142.b	142.c	142.d	142.e	142.f
143 - Dança – aeróbia, balé?	143.a	143.b	143.c	143.d	143.e	143.f

ATIVIDADE	O(a) Sr(a) praticou, nas últimas duas semanas... SIM (1) NÃO(2)	1 ª SEMANA NA (98)	2ª SEMANA NA (98)	MÉDIA DE VEZES POR SEMANA NA (98)	TEMPO POR OCASIÃO	
					HORAS NA (98)	MINUTOS NA (98)

Seção B: Exercício de Condicionamento

144 - Exercícios domiciliares?	144.a	144.b	144.c	144.d	144.e	144.f
145 - Exercícios em clube/academia?	145.a	145.b	145.c	145.d	145.e	145.f
146 - Combinação de caminhada/ corrida leve?	146.a	146.b	146.c	146.d	146.e	146.f
147 - Corrida?	147.a	147.b	147.c	147.d	147.e	147.f
148 - Musculação?	148.a	148.b	148.c	148.d	148.e	148.f
149 - Canoagem em viagem de acampamento?	149.a	149.b	149.c	149.d	149.e	149.f
150 - Natação em piscina (pelo menos de 15 metros)?	150.a	150.b	150.c	150.d	150.e	150.f
151 Natação na praia?	151.a	151.b	151.c	151.d	151.e	151.f

Seção C: Esportes

152 - Boliche?	152.a	152.b	152.c	152.d	152.e	152.f
153 - Voleibol?	153.a	153.b	153.c	153.d	153.e	153.f
154 - Tênis de mesa?	154.a	154.b	154.c	154.d	154.e	154.f
155 - Tênis individual?	155.a	155.b	155.c	155.d	155.e	155.f

156 - Tênis de duplas?	156.a	156.b	156.c	156.d	156.e	156.f
157 - Basquete, sem jogo (bola ao cesto)?	157.a	157.b	157.c	157.d	157.e	157.f
158 - Jogo de basquete?	158.a	158.b	158.c	158.d	158.e	158.f
159 - Basquete, como juiz?	159.a	159.b	159.c	159.d	159.e	159.f
160 - Futebol?	160.a	160.b	160.c	160.d	160.e	160.f

ATIVIDADE	O(a) Sr(a) praticou, nas últimas duas semanas... SIM (1) NÃO(2)	1 ª SEMANA NA (98)	2ª SEMANA NA (98)	MÉDIA DE VEZES POR SEMANA NA (98)	TEMPO POR OCASIÃO	
					HORAS NA (98)	MINUTOS NA (98)

Seção D: Atividades no jardim e horta

161 - Cortar a grama dirigindo um carro de cortar grama?	161.a	161.b	161.c	161.d	161.e	161.f
162 - Cortar a grama andando atrás do cortador de grama motorizado?	162.a	162.b	162.c	162.d	162.e	162.f
163 - Cortar a grama empurrando o cortador de grama manual?	163.a	163.b	163.c	163.d	163.e	163.f
164 - Tirando o mato e cultivando o jardim e a horta?	164.a	164.b	164.c	164.d	164.e	164.f
165 - Afofar, cavando e cultivando a terra no jardim e horta?	165.a	165.b	165.c	165.d	165.e	165.f
166 - Trabalho com ancinho na grama?	166.a	166.b	166.c	166.d	166.e	166.f

Seção E: Atividades de reparos domésticos

167 - Carpintaria e oficina?	167.a ☐	167.b ☐	167.c ☐	167.d ☐	167.e ☐	167.f ☐
168 - Pintura interna de casa ou colocação de papel de parede?	168.a ☐	168.b ☐	168.c ☐	168.d ☐	168.e ☐	168.f ☐
169 - Carpintaria do lado de fora da casa?	169.a ☐	169.b ☐	169.c ☐	169.d ☐	169.e ☐	169.f ☐
170 - Pintura do exterior da casa?	170.a ☐	170.b ☐	170.c ☐	170.d ☐	170.e ☐	170.f ☐

Seção F: Caça e Pesca

171 - Pesca na margem do rio?	171.a ☐	171.b ☐	171.c ☐	171.d ☐	171.e ☐	171.f ☐
172 - Caça a animais de pequeno porte?	172.a ☐	172.b ☐	172.c ☐	172.d ☐	172.e ☐	172.f ☐
173 - Caça a animais de grande porte?	173.a ☐	173.b ☐	173.c ☐	173.d ☐	173.e ☐	173.f ☐

Seção G: Outras atividades

174 - Caminhar como exercício?	174.a ☐	174.b ☐	174.c ☐	174.d ☐	174.e ☐	174.f ☐
175 - Tarefas domésticas de moderadas a intensas?	175.a ☐	175.b ☐	175.c ☐	175.d ☐	175.e ☐	175.f ☐
176 - Exercícios em bicicleta ergométrica?	176.a ☐	176.b ☐	176.c ☐	176.d ☐	176.e ☐	176.f ☐
177 - Exercícios calistênicos?	177.a ☐	177.b ☐	177.c ☐	177.d ☐	177.e ☐	177.f ☐
178 - Outra? _____	178.a ☐	178.b ☐	178.c ☐	178.d ☐	178.e ☐	178.f ☐
179 - Outra? _____	179.a ☐	179.b ☐	179.c ☐	179.d ☐	179.e ☐	179.f ☐

Agora faremos algumas medidas:

180 - Peso: ☐ **181 - Altura:** ☐ **182 - Circunferência braquial:** ☐

183 - Circunferência da cintura: ☐ **184 - Circunferência do quadril:** ☐

Avaliação da Força Muscular

Solicitarei ao (à) Sr/Sra que aperte bem forte a alça que o(a) senhor(a) está segurando.

185.a - 1ª medida de força de preensão ☐

185.b - 2ª medida de força de preensão ☐

185.c - 3ª medida de força de preensão ☐

Avaliação da Velocidade de Marcha

186.a - O(a) Sr/Sra habitualmente usa algum auxiliar de marcha, como bengala ou andador?

(0) Não usa (1) Andador (2) Bengala (3) Outro **186.a** ☐

Agora eu pedirei que o(a) Sr/Sra ande no seu ritmo normal até a última marca no chão, ou seja, como se estivesse andando na rua para fazer uma compra na padaria.

186.b - 1ª medida de velocidade da marcha ☐

186.c - 2ª medida de velocidade de marcha ☐

186.d - 3ª medida de velocidade da marcha ☐

Auto-eficácia para quedas

Eu vou fazer algumas perguntas sobre qual é sua preocupação a respeito da possibilidade de cair, enquanto realiza algumas atividades. Se o(a) Sr/Sra atualmente não faz a atividade citada (por ex. alguém vai às compras para o(a) Sr/Sra, responda de maneira a mostrar como se sentiria em relação a quedas caso fizesse tal atividade).

Atenção: marcar a alternativa que mais se aproxima da opinião do idoso sobre o quão preo cupado fica com a possibilidade de cair fazendo cada uma das seguintes atividades:

ATIVIDADES	NEM UM POUCO	UM POUCO PREOCUPADO	MUITO PREOCUPADO	EXTREMAMENTE PREOCUPADO
187 - Limpando a casa passar pano, aspirar o pó ou tirar a poeira) 187 ☐	(1)	(2)	(3)	(4)
188 - Vestindo ou tirando a roupa 188 ☐	(1)	(2)	(3)	(4)

ATIVIDADES	NEM UM POUCO	UM POUCO PREOCUPADO	MUITO PREOCUPADO	EXTREMAMENTE PREOCUPADO
187 - Limpando a casa (passar pano, aspirar o pó ou tirar a poeira) 187 ☐	(1)	(2)	(3)	(4)
188 - Vestindo ou tirando a roupa 188 ☐	(1)	(2)	(3)	(4)
189 - Preparando refeições simples 189 ☐	(1)	(2)	(3)	(4)
190 - Tomando banho 190 ☐	(1)	(2)	(3)	(4)
191 - Indo às compras 191 ☐	(1)	(2)	(3)	(4)
192 - Sentando ou levantando de uma cadeira 192 ☐	(1)	(2)	(3)	(4)
193 - Subindo ou descendo escadas 193 ☐	(1)	(2)	(3)	(4)
194 - Caminhando pela vizinhança 194 ☐	(1)	(2)	(3)	(4)
195 - Pegando algo acima de sua cabeça ou do chão 195 ☐	(1)	(2)	(3)	(4)
196 - Ir atender ao telefone antes que pare de tocar 196 ☐	(1)	(2)	(3)	(4)

ATIVIDADES	NEM UM POUCO	UM POUCO PREOCUPADO	MUITO PREOCUPADO	EXTREMAMENTE PREOCUPADO
197 - Andando sobre superfície escorregadia (ex.: chão molhado) 197	(1)	(2)	(3)	(4)
198 - Visitando um amigo ou parente 198	(1)	(2)	(3)	(4)
199 - Andando em lugares cheios de gente 199	(1)	(2)	(3)	(4)
200 - Caminhando sobre superfície irregular (com pedras, esburacada) 200	(1)	(2)	(3)	(4)
201 - Subindo ou descendo uma ladeira 201	(1)	(2)	(3)	(4)
202 - Indo a uma atividade social (ex.: ato religioso, reunião de família ou encontro no clube) 202	(1)	(2)	(3)	(4)

Depressão

Vou lhe fazer algumas perguntas para saber como o(a) Sr/Sra vem se sentindo na última semana. Por favor, me responda apenas SIM ou NÃO

QUESTÕES	SIM	NÃO
203 - O(a) Sr/Sra está basicamente satisfeito com sua vida? 203	(1)	(2)
204 - O(a) Sr/Sra deixou muitos de seus interesses e atividades? 204	(1)	(2)
205 - O(a) Sr/Sra sente que sua vida está vazia? 205	(1)	(2)

QUESTÕES	SIM	NÃO
206 - O(a) Sr/Sra se aborrece com freqüência? 206 ☐	(1)	(2)
207 - O(a) Sr/Sra se sente de bom humor a maior parte do tempo? 207 ☐	(1)	(2)
208 - O(a) Sr/Sra tem medo que algum mal vá lhe acontecer? 208 ☐	(1)	(2)
209 - O(a) Sr/Sra se sente feliz a maior parte do tempo? 209 ☐	(1)	(2)
210 - O(a) Sr/Sra sente que sua situação não tem saída? 210 ☐	(1)	(2)
211 - O(a) Sr/Sra prefere ficar em casa a sair e fazer coisas novas? 211 ☐	(1)	(2)
212 - O(a) Sr/Sra se sente com mais problemas de memória do que a maioria? 212 ☐	(1)	(2)
213 - O(a) Sr/Sra acha maravilhoso estar vivo? 213 ☐	(1)	(2)
214 - O(a) Sr/Sra se sente um inútil nas atuais circunstâncias? 214 ☐	(1)	(2)
215 - O(a) Sr/Sra se sente cheio de energia? 215 ☐	(1)	(2)
216 - O(a) Sr/Sra acha que sua situação é sem esperança? 216 ☐	(1)	(2)
217 - O(a) Sr/Sra sente que a maioria das pessoas está melhor que o(a) Sr/Sra? 217 ☐	(1)	(2)

Total: 218 ☐

Fadiga

Pensando na última semana, diga com que freqüência as seguintes coisas aconteceram com o(a) senhor(a):

QUESTÕES	NUNCA/ RARAMENTE	POUCAS VEZES	NA MAIORIA DAS VEZES	SEMPRE
219.Sentiu que teve que fazer esforço para dar conta das suas tarefas habituais? 219 ☐	(1)	(2)	(3)	(4)
220.Não conseguiu levar adiante suascoisas? 220 ☐	(1)	(2)	(3)	(4)

Satisfação Global com a Vida e Referenciada a Domínios

QUESTÕES	POUCO	MAIS OU MENOS	MUITO
221. O(a) Sr/Sra está satisfeito(a) com a sua vida hoje? 221 ☐	(1)	(2)	(3)
222. Comparando-se com outras pessoas que tem a sua idade, o(a) Sr/Sra diria que está satisfeito(a) com a sua vida hoje? 222 ☐	(1)	(2)	(3)
223. O(a) Sr/Sra está satisfeito(a) com a sua memória para fazer e lembrar as coisas de todo dia? 223 ☐	(1)	(2)	(3)
224. O(a) Sr/Sra está satisfeito(a) com a sua capacidade para fazer e resolver as coisas de todo dia? 224 ☐	(1)	(2)	(3)
225. O(a) Sr/Sra está satisfeito(a) com as suas amizades e relações familiares? 225 ☐	(1)	(2)	(3)
226. O(a) Sr/Sra está satisfeito(a) com o ambiente (clima, barulho, poluição, atrativos e segurança) em que vive? 226 ☐	(1)	(2)	(3)
227. O(a) Sr/Sra está satisfeito(a) com seu acesso aos serviços de saúde? 227 ☐	(1)	(2)	(3)
228. O(a) Sr/Sra está satisfeito(a) com os meios de transporte de que dispõe? 227 ☐	(1)	(2)	(3)

Agradecemos sua participação!!!
Não se esqueça de preencher o horário de término desta entrevista na primeira folha

APÊNDICES

APÊNDICE A – Artigo Relacionado ao Tema Principal da Tese

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CLINICAL FUNCTIONAL TESTS HELP IDENTIFY ELDERLY WOMEN HIGHLY CONCERNED ABOUT FALLS

Bruno de Souza Moreira, Cristiano Mourão Barroso, Sheyla Rossana Cavalcanti Furtado, and Rosana Ferreira Sampaio

Department of Physical Therapy, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil

Márcia Luciane Drumond das Chagas e Vallone

Biological Science and Health Institute, Pontifícia Universidade Católica de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil

Renata Noce Kirkwood

Department of Physical Therapy, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil

Background/Study Context: *Limited research exists on functional tests in the discrimination of elderly individuals with high concern about falls from individuals with low concern about falls. The purpose of this study was to determine which functional test best discriminates between elderly women with low and high concern about falls.*

Methods: *One hundred thirty-five elderly women (72.6 ± 4.8 years) were divided into two groups based on their Falls Efficacy Scale—International score: low concern (*n *= 56) and high concern (*n *= 79) about falls. Five functional tests were applied: Timed Up and Go test (TUG), unipodal stance test, five-repetition sit-to-stand test (5-STS), gait velocity, and grip strength. Factorial analysis and discriminant analysis were used.*

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Address correspondence to Renata Noce Kirkwood, PhD, Department of Physical Therapy, Universidade Federal de Minas Gerais, Antonio Carlos Avenue, 6627 Belo Horizonte, Minas Gerais, Brazil 31270-901. E-mail: renata.kirkwood@gmail.com

Results: *Factorial analysis resulted in three factors that explained 83.8% of the total variance. Factor 1, with 49.5% of total variance explanation, was represented by the TUG, 5-STS, and gait velocity tests and was the only factor to discriminate between the groups, classifying correctly 68.9% of the observations. Among the original variables of Factor 1, the Fisher linear coefficient showed that the TUG was the most discriminant of the tests.*

Conclusion: *The TUG test best discriminates elderly women with low and high concern about falls; therefore, it is an important test that should be performed during the assessment of elderly individuals afraid of falling.*

Fear of falling might be defined as a great distress that someone feels when facing the vulnerability to a fall (Lopes, Costa, Santos, Castro, & Bastone, 2009). The prevalence of fear of falling is significantly higher in women with advanced age and with history of falls (Alcalde, 2010). However, elderly subjects with no history of previous falls may also present fear of falling (Zijlstra et al., 2007). Individuals afraid of falling adopt some cautious strategies to prevent them from falling; however, some of these strategies may work the other way around and instead of preventing falls might increase the risk of falling. For example, recently, Kirkwood et al. (2011) showed that elderly women highly concerned about falls reduce their step length up to 3 cm during gait when compared with a paired group with low concern about falls. The literature supports that reduced step length increases head and pelvis instability during gait (Latt, Menz, Fung, & Lord, 2008). In addition, fear of falling associated with cautious strategies restricts the individual's physical activity favoring functional decline, decreased muscle strength, and postural control (Friedman, Munoz, West, Rubin, & Fried, 2002; Reelick, van Iersel, Kessels, & Rikkert, 2009). Fear of falling has also been linked to decreased quality of life, increased risk of institutionalization, depression, loss of social connectivity, and physical frailty (Scheffer, Schuurmans, van Dijk, van der Hooft, & de Rooij, 2008; Zijlstra et al., 2007).

Many studies fail to identify important factors associated with the progress of fear falling due to its multifactorial nature (Legters, 2002). Consequently, the assessment of fear of falling in elderly individuals is multifaceted and should take in account physical, behavioral, and functional components (Camargos, Dias, Dias, & Freire, 2010). Evidences from a longitudinal study (Austin, Devine, Dick, Prince, & Bruce, 2007) suggest that impairment of functional parameters such as mobility and balance may be important determinants to the onset of fear of falling. This finding emphasizes the importance of functional tests in the evaluation of elderly subjects afraid of falling. Moreover, these tests are advantageous

when compared with indirect assessments (perception) in terms of validity, reproducibility, less cultural and educational influences, as well in the ability to provide information about health status (Rodrigues-Barbosa, de Miranda, Vieira-Guimarães, Xavier-Corseuil, & Weber-Corseuil, 2011).

Among the reliable and feasible functional tests routinely applied in the clinical settings are the Timed Up and Go (TUG), unipodal stance, five-repetition sit-to-stand (5-STS), gait velocity, and grip strength tests. These tests assess functional mobility (Herman, Giladi, & Hausdorff, 2011), static equilibrium (Springer, Marin, Cyhan, Roberts, & Gill, 2007), lower limb muscle strength (Bohannon, 2006a), aerobic fitness and functional ability (Tiedemann, Sherrington, & Lord, 2005), and upper limb muscular strength (Bohannon, Peolsson, Massy-Westropp, Desrosiers, & Bear-Lehman, 2006), respectively.

However, it is not clear which of these tests could best discriminate elderly individuals with high concern about falls from individuals with low concern about falls. Therefore, our objective was to determine which of these clinical tests could best discriminate elderly females highly concerned about falls from elderly females with low concern about falls. The motivation for this study relies on the lack of clinical functional tests that could help identify, in an everyday clinical setting, elderly women highly concerned about falls.

METHODS

Subjects

A convenience sample of 140 community-dwelling elderly women was recruited between December 2009 and June 2010 from waiting lists of senior citizen physical activity groups and at senior citizen centers in the metropolitan area of Belo Horizonte, Minas Gerais, Brazil. The purpose of the study was explained to the participants in person or by telephone, and those who gave verbal consent were invited for an evaluation at our laboratory. The inclusion criteria were women aged 65 years or older, living in the community, able to walk independently without gait assistance device (cane, crutch or walker), and sufficient cognitive level to understand any command. Exclusion criteria comprised a Mini-Mental State Examination (MMSE) score lower than 18 (out of 30), vestibular symptoms such as dizziness, tinnitus, or postural instability at time of testing, motor sequel due to rheumatic, orthopedic, and/or neurological diseases, pain in the spine or lower limbs at time of testing, accentuated postural deviation, visual impairment not corrected by lenses, and auditory impairment not corrected by hearing aids. Four elderly women were excluded due to

orthopedic problems during our in-person assessment and one elderly woman because of cognitive impairment as assessed by the MMSE. Thus, a total of 135 participants aged 65 to 86 years were included in the analysis. This study was approved by the Ethics Committee of Universidade Federal de Minas Gerais (no. ETIC 442/08), and all participants provided written consent prior to data collection.

Measurements

Fear of Falling

The Falls Efficacy Scale—International (FES-I) is a self-report questionnaire that evaluates fear of falling when the individual performs a range of activities (Ruggiero et al., 2009). The FES-I contains 16 items scored on a 4-point scale (1 = not at all concerned to 4 = very concerned), with a range of scores from 16 to 64 (Ruggiero et al., 2009). The cross-cultural adaptation of the FES-I to the Portuguese language (Brazil) demonstrated good intrarater and interrater reliability (.836 and .912, respectively) (Camargos et al., 2010). Fear of falling was also assessed through a simple question (Are you afraid of falling?), with a yes/no answer.

Falls

At assessment, participants were asked how many times they had fallen in the previous year. A fall was defined as an unexpected event in which the individual comes to rest on the ground, floor, or lower level (Swanenburg, de Bruin, Uebelhart, & Mulder, 2010). The following events—loss of consciousness resulting in fall, high-trauma falls, or falling as a consequence of sustaining a violent blow—were not considered as falls (Swanenburg et al., 2010).

Timed Up and Go Test

The TUG test is an effective method for assessing mobility and quantifying locomotor performance (Herman et al., 2011). We measured the time that the subject required to rise from an armless chair, walk to a cone on floor 3 m away, turn, return, and sit down again. The subjects walked as quickly and safely as possible. A trial run was first performed for the subjects to become familiarized with the test. The participants then performed the test twice, and the final result was calculated as the mean of the two executions.

Unipodal Stance Test

The unipodal stance test evaluates the static equilibrium by measuring the time that an individual can stand with only one foot on the ground (Springer et al., 2007). The participants were asked to maintain the

unipodal static position for as long as possible, with their eyes opened. The test leg used was according to the answer to the following question: Which leg would you kick a ball? The participants performed the test twice, and the maximum time obtained was used in the analyses.

Five-Repetition Sit-to-Stand Test
The 5-STS test is traditionally used as a muscular strength measure from the lower limbs (Bohannon, 2006a). The test consisted of rising and sitting from an armless chair for 5 times, as fast as possible, with the arms folded across the chest. The participants performed the test twice, first to get familiarized with it, and then to obtain the measurement for analysis.

Gait Velocity
Performance in gait velocity test is an indicator of aerobic fitness and functional ability in older people (Tiedemann et al., 2005; Fritz & Lusardi, 2009). Gait velocity was obtained as the subjects walked on a 4.6 m long corridor, with a 2 m distance before and after, for acceleration and deceleration purposes. The participants were asked to walk in their self-selected speed. Each participant walked for three times, and the average of the times spent to perform the task was saved for data analysis. Gait velocity was obtained dividing the distance by the time and it was reported in meters per second (m/s).

Grip Strength
Grip strength measurement is used not only to describe the status of the hand but also to characterize upper extremity strength (Bohannon et al., 2006). It has also been used as a measurement of overall body muscle strength (Sallinen et al., 2010). In the present study, the grip strength was obtained using the Jamar hydraulic hand dynamometer (model SH5001; Saehan, Masan, Korea) and following the American Society of Hand Therapists recommendations (Fess, 1992). All measurements were taken with the test arm held at the side of the body, elbow flexed at 90°, forearm in a neutral position, and the wrist between 0° and 30° of extension (Fess, 1992). The participants were instructed to grip the handle of the dynamometer with maximum strength with their dominant hand for about 10 s. Three trials were collected with a 60-s rest between trials, and the average value was used for analysis. The force measurements obtained were reported in kilograms (kg).

Statistical Analysis

To divide the groups into high and low concern about falls, a receiver operating characteristic (ROC) curve was constructed to determine the cutoff

point of the FES-I considering the binary variables fear (yes = 1) or no fear (no = 0) of falls. The optimal cutoff point was the value that maximized the sum of sensitivity and specificity. Sociodemographic, anthropometric, and clinical data were analyzed using the mean difference between groups with 95% confidence interval (95% CI) and the self-reported fall history in the previous year using the chi-square test (χ^2).

The functional tests were analyzed using factorial analysis that applied a principal component model with varimax rotation to derive orthogonally statistical independent factors (eigenvalues $\geq$1.0), which were used as predictors in the discriminant analysis. Once a predictor was identified, the original variables that composed the factor were submitted to further discriminant analysis to determine the contribution of each variable to the discriminant function. All the data were analyzed with a significance level of .05.

RESULTS

The FES-I score from the study sample ranged from 16 to 39. The ROC curve value was 0.905 ($p < .05$) and the 95% confidence interval (CI) was 0.857 to 0.953. The ROC curve allocated subjects with a FES-I score $\leq$20 in the low concern group ($n = 56$) and those with scores >20 in the high concern group ($n = 79$). Means and standard deviations of the participants' characteristics with the 95% CIs of the mean differences between the groups and history of falls in the previous year are shown on Table 1. No significant differences between groups were found with regard to sociodemographic, anthropometric, and clinical data. There was also no statistically significant difference in the self-report of falls in the previous year between the groups of elderly women with low and high concern about falls ($\chi^2 = 0.506$; $p = .776$). Table 2 presents the result values of the clinical functional tests for total sample and both groups.

Factorial analysis resulted in a sample adequacy measure (Kaiser-Meyer-Olkin), which determines the degree of intercorrelation between variables and the adequacy of the factor analysis, of .704, indicating that the data were adequate for the analysis. Likewise, the Bartlett sphericity test was significant ($p < .001$), indicating sufficient correlation between the variables to proceed with the analysis.

Three factors explaining 83.8% of the variance were extracted from the data (Table 3). Factor 1, which explained 49.5% of the variance of the data, was related to the following tests: TUG, 5-STS, and gait velocity, therefore representing the time dimension. Factor 2 explained 20.1% of the variance and was composed by the unipodal stance test, thereby representing the

Table 1. Descriptive characteristics of the total sample and of the groups and mean differences between the groups (95% confidence intervals) at the beginning of the study ($N = 135$)

Characteristic	Total sample ($N = 135$)	Group: High concern about falls ($n = 79$)	Group: Low concern about falls ($n = 56$)	Difference between groups: High concern minus Low concern (95% CI)
Age (years)	72.6 (4.8)	72.4 (4.6)	73.0 (5.2)	−0.6 (–2.3 to 1.1)
Height (cm)	154.1 (5.8)	153.7 (5.7)	154.7 (6.1)	−1.0 (–3.0 to 1.0)
Weight (kg)	64.9 (11.2)	65.5 (11.0)	64.0 (11.5)	1.5 (–2.4 to 5.4)
BMI (kg/m^2)	27.3 (4.5)	27.7 (4.5)	26.7 (4.5)	1.0 (–0.6 to 2.6)
Education (years)	6.2 (4.6)	5.7 (4.6)	7.0 (4.6)	−1.3 (–2.9 to 0.3)
Comorbidities (*n*)	3.1 (1.8)	3.0 (1.7)	3.2 (2.0)	−0.2 (–0.8 to 0.4)
Medications (*n*)	3.5 (2.5)	3.3 (2.2)	3.7 (2.8)	−0.4 (–1.3 to 0.5)
MMSE (score)	26.6 (2.6)	26.3 (2.8)	27.1 (2.4)	−0.8 (–1.7 to 0.1)
Fall history, *n* (%)*				
0 fall	93 (68.9%)	53 (67.1%)	40 (71.4%)	
1 fall	27 (20.0%)	16 (20.2%)	11 (19.6%)	
≥2 falls	15 (11.1%)	10 (12.7%)	5 (9.0%)	

Note. BMI = body mass index; MMSE = Mini-Mental State Examination (range: 0–30).
*Chi-square test; $p = .776$.

Table 2. Means (standard deviations) of the performance on the functional tests of all participants and for the groups of elderly women with high and low concern about falls ($N = 135$)

Functional test	Total sample ($N = 135$)	Group: High concern about falls ($n = 79$)	Group: Low concern about falls ($n = 56$)
TUG (s)	8.5 (1.0)	8.6 (1.1)	8.2 (0.9)
5-STS (s)	12.4 (1.8)	12.6 (1.9)	12.1 (1.5)
Gait velocity (m/s)	1.18 (0.2)	1.15 (0.2)	1.21 (0.2)
Unipodal stance (s)	23.4 (22.2)	20.9 (19.7)	26.9 (25.1)
Grip strength (kg)	20.8 (4.7)	20.3 (4.4)	21.6 (5.1)

Note. TUG = Timed Up and Go test; 5-STS = five-repetition sit-to-stand test.

Table 3. Principal components with varimax rotation factor matrix ($N = 135$)

Functional test	Factor 1 Time	Factor 2 Equilibrium	Factor 3 Strength	Communality
TUG (s)	**0.878**	−0.244	−0.098	0.840
5-STS (s)	**0.825**	−0.081	−0.014	0.687
Gait velocity (m/s)	**−0.803**	0.159	0.008	0.670
Unipodal stance (s)	−0.233	**0.967**	0.083	0.995
Grip strength (kg)	−0.045	0.076	**0.996**	0.999

Note. TUG = Timed Up and Go test; 5-STS = five-repetition sit-to-stand test.
Bolded coefficients are interpreted as significant contributors to the identified factor.

dimension equilibrium. Factor 3 (grip strength) explained 14.2% of the variance and represented the strength dimension.

Discriminant analysis was then conducted to determine what factors could discriminate the groups of elderly women with low and high concern about falls. Box's M covariance test indicated equality between the matrices of both groups ($p = .077$). Wilks' lambda was significant ($p = .031$), thereby rejecting the null hypothesis that the value of the discriminant function was the same for both groups. The results showed that only Factor 1 (time dimension) remained in the model, with 68.9% (93/135) of the observations correctly classified by the discriminant function.

In order to determine the importance of each variable of Factor 1 in the discriminant function, Fisher's linear coefficient values for the TUG, 5-STS, and gait velocity tests were obtained through discriminant analysis. The variables were first standardized by dividing by the global standard deviation, thereby conserving the original mean of the variables for the discrimination process. The linear coefficients were then transformed into a normalized interval spanning from −1 to 1. The results showed that the TUG test was the clinical test that best discriminated the two groups of elderly women with low and high concern about falls (Table 4).

Table 4. Normalized discriminant functions of the original variables from Factor 1

Functional test	Normalized discriminant function
TUG (s)	−0.974*
5-STS (s)	−0.225
Gait velocity (m/s)	0.295

Note. TUG = Timed Up and Go test; 5-STS = five-repetition sit-to-stand test.
*Functional test with higher discriminant value between groups.

DISCUSSION

This study aimed to determine among five functional tests widely used in clinical settings, which test could best discriminate a group of elderly females highly concerned about falls from a paired group of elderly females with low concern about falls. Since women have a longer life expectancy than men and present cumulative disadvantages in access to education, income, food, and health care across the life course, they are more likely to be poor and to suffer health problems and disabilities in older age (World Health Organization, 2005). Thus, appropriate care and support for this vulnerable population is essential.

Functional tests are easy to be executed in clinical settings, since they normally require a short administration time and minimal equipment (Viccaro, Perera, & Studenski, 2011; Tiedemann, Shimada, Sherrington, Murray, & Lord, 2008). Therefore, these tests should be considered and incorporated as clinical tools to assist in the identification of older persons with different intensities of fear of falling. The findings of the present study suggest that the tests gait velocity, 5-STS, and TUG could discriminate elderly females with high concern about falls from elderly females with low concern about falls nearly 70% of the time. Falls and fear of falling are strongly correlated; consequently, it is unknown which one comes first. An individual who has one of these outcomes is at high risk for developing the other (Friedman et al., 2002). Therefore, considering the multifactorial nature of falls and fear of falling, we believe that a misclassification of 30% is acceptable and these tests will complement other tools in the identification of elderly females prone to falls.

Of the discriminant tests investigated, the TUG showed higher discriminant function compared with gait velocity and the 5-STS. Our results are similar to a recent study that found that gait velocity and the TUG test could discriminate elderly females with high and low concern about falls (Kirkwood et al., 2011). The TUG is a very quick, practical, and reliable test in evaluating function of the lower limb, mobility, and dynamic equilibrium (Herman et al., 2011). Additionally, it has been recommended as a key test for fall risk screening in older people (Beauchet et al., 2011), with evidence supporting its ability to predict fear of falling in community-dwelling elderly females (Austin et al., 2007). Recently, Garber et al. (2010) determined that elderly individuals who performed the TUG test in 8.23 s or less had normal physical function and those who performed in 14 s or more had physical functional limitation. Scores between 8.23 and 14 s indicate an elderly individual with a preclinical limitation, which, according to the authors, are individuals approaching disability and loss of ability to live independently (Garber et al., 2010). In the present study, the groups with high and low concern about falls performed the TUG test with

average times of 8.6 and 8.2 s, respectively. Therefore, based on the cut-off points established by Garber et al. (2010), the low concern group has normal physical function and the group with high concern about falls is in the range of the preclinical physical functional limitation. Consequently, our result fosters another important clinical aspect that elderly females highly concerned about falls will experience deterioration of their physical function faster than elderly females with low concern about falls. Complications such as decreased lower limb strength, eye contrast sensitivity, and cognition and increased body pain, postural sway, reaction time, and number of morbidities affect the performance of the TUG test (Kwan, Lin, Chen, Close, & Lord, 2011). Among these limitations, decreased strength of the knee extensors has been pointed out as the most important variable affecting performance of the TUG among community-living elderly (Kwan et al., 2011). Therefore, identifying this group and applying interventions targeted to slow or even reverse the progression of functional decline are imperative.

It has been determined that elderly individuals, including those afraid of falls, search for more stability during walking by reducing gait velocity (Chamberlin, Fulwider, Sanders, & Medeiros, 2005). Brouwer, Musselman, and Culham (2004) consider that generalized muscular weakness of the lower limbs is responsible for the slowness in gait in elderly concerned about falls. A more recent study found that increased reaction time and decreased quadriceps muscle strength are strongly associated with slower gait velocity in elderly people (Callisaya et al., 2009). In addition, reduced gait velocity is an indication of subclinical impairment in the health status (Abellan van Kan et al., 2009) and it has previously been associated with an increased risk of falls (Verghese, Holtzer, Lipton, & Wang, 2009). In the present study, both groups had gait velocity above the value considered normal (1.0 m/s) (Studenski, 2009). However, the high concern group walked slower, with a mean difference from the low concern group of 0.06 m/s, which exceeds the 0.05 m/s threshold determined as clinically meaningful (Perera, Mody, Woodman, & Studenski, 2006). Thus, our result reinforces the importance of gait velocity test as a screening tool for elderly highly concerned about falls. In addition, this functional test would help identify elderly with lower gait velocity and more likely to become impaired.

The sit-to-stand test is a complex and challenging task that requires adequate control of the body's center of mass over a small base of support. This task includes the forward movement of the center of the mass while the subject is still seated on the chair, followed by acceleration of the center of mass both in the anterior-posterior and vertical plane, push-off, and stabilization once standing is achieved (Janssen, Bussmann, & Stam, 2002). Previous study found that the 5-STS test performance depends on

multiple physiological and psychological parameters, suggesting that this functional test is not simply a measure of lower limb strength, but it also evaluates a range of factors related to mobility and balance (Lord, Murray, Chapman, Munro, & Tiedemann, 2002). It has been also demonstrated that the 5-STS test performance is strongly associated with fear of falling in older adults, even after adjusting for age, body mass index, sex, social support, and fall history (Deshpande et al., 2008). Therefore, our result supports existing knowledge and indicates that the 5-STS test is also an important discriminant tool for elderly women highly concerned about falls.

Although the unipodal stance and grip strength tests are commonly used clinically, these two functional tests failed to discriminate elderly females highly concerned about falls. The results from the factorial analysis showed both tests isolated in separate factors, which demonstrate that these clinical tests do not correlate with one another and with the other tests, since grouping into factors is achieved by correlation. The fact that grip strength could not discriminate elderly highly concerned about falls is unexpected. Lower grip strength has been correlated to aging and frailty (Fried et al., 2001). However, recently, a longitudinal study failed to demonstrate association between fear of falling and grip strength (Deshpande et al., 2008).

Normative data by age have been obtained from meta-analysis for all functional tests applied in the present study (Bohannon, 2006a, 2006b, 2006c; Bohannon et al., 2006; Bohannon & Williams Andrews, 2011). According to these meta-analyses, elderly individuals, regardless of sex, aged between 70 and 79 years, which corresponds to the mean age of our sample (72.6 years), should perform the TUG test in 9.2 s (95% CI = 8.2 to 10.2) (Bohannon, 2006b), the 5-STS test in 12.6 s (95% CI = 12.6 to 12.6) (Bohannon, 2006a), and the unipodal stance test in 17.2 s (95% CI = 11.6 to 22.8) (Bohannon, 2006c). For gait velocity test, the normal performance for elderly women aged 70 to 79 years is 1.13 m/s (95% CI = 1.07 to 1.19) (Bohannon & Williams Andrews, 2011), and for grip strength test assessed with the Jamar dynamometer, the reference values described for elderly women aged 70 to 74 years are 22.5 kg (95% CI = 19.1 to 25.8) for left hand and 24.2 kg (95% CI = 20.7 to 27.8) for right hand (Bohannon et al., 2006). The average scores of the functional tests found in our sample were 8.5 s in the TUG test, 12.4 s in the 5-STS test, 23.4 s in the unipodal stance test, 1.18 m/s in the gait velocity test, and 20.8 kg in the grip strength test (Table 2). Therefore, based on the reference parameters aforementioned, our sample exhibits comparable performance within the age group in all functional tests.

It has been suggested that sociodemographic, clinical, and anthropometric variables as well as fall history may influence the relationship between fear of falling and performance on the functional tests (Donoghue, Cronin,

Savva, O'Regan, & Kenny, 2013; Rochat et al., 2010). In the present study, the groups of elderly women were similar regarding all subject characteristics such as age, education, number of comorbidities and medications, cognitive function, height, weight, body mass index, and number of falls in the previous year. Thus, the intensity of the fear of falling likely accounted for the differences found between our groups. The observational nature of this study, nevertheless, prevents any conclusion about chronology and causality and further investigations are needed to clarify this issue.

Our study has other limitations that need to be clarified. First, the study was limited to subjects who were willing to volunteer. Individuals with higher level of fear of falling are less likely to participate in a research (Chamberlin et al., 2005). Thus, caution must be exercised in attempting to generalize the findings, since the subject population was not randomly selected. Second, elderly females with mobility restriction were not included in the study; therefore, the results are only applied to individuals who could perform the tests. Third, the fall history was assessed retrospectively with a self-report method, which is known to be less accurate than prospective measurement. This may have led to an underreporting of falls in the study sample. Finally, only women were included in our study. We adopted this inclusion criterion in order to avoid a gender bias, as gait, muscle strength, and fear of falling differ between sexes. Thus, it would be interesting to investigate the results of functional tests with elderly males with fear of falling.

An important aspect of this study was the statistical analysis used. Factorial analysis was performed to reduce the number of variables by forming subgroups of new variables, denominated factors, or latent variables (Everitt & Dunn, 2001). These latent variables are not correlated and explain a large portion of the variance in the data. When correlated variables are compared using univariate tests, we run the risk of not identifying their independent effects (Everitt & Dunn, 2001). To address this issue, multivariate techniques such as factorial analysis should be applied (Verghese et al., 2009). Therefore, we are confident that our results are adequate to our sample of female elderly individuals studied.

CONCLUSIONS

The present study contributes to the literature, since it identified functional tests that could discriminate elderly females highly concerned about falls from a paired group with low concern about falls. The TUG, 5-STS, and gait velocity tests are routinely used to evaluate mobility, balance, and strength of elderly individuals and from now on could be expanded to identify elderly females highly afraid of falls. In addition, where there is the need to apply a singular functional test, once time is a crucial aspect

in clinical settings, our results showed that the TUG test should be the preferred one.

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APÊNDICE B – Artigo Relacionado à População de Interesse da Tese

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Current Diabetes Reviews, 2016, *12*, 240-251

BENTHAM SCIENCE

The Relationship Between Diabetes Mellitus, Geriatric Syndromes, Physical Function, and Gait: A Review of the Literature

Bruno de Souza Moreira[1,*], Rosana Ferreira Sampaio[1,2], Sheyla Rossana Cavalcanti Furtado[1,2], Rosângela Corrêa Dias[1] and Renata Noce Kirkwood[1]

[1]*Graduate Program in Rehabilitation Science, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil;* [2]*Department of Physical Therapy, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil*

Bruno de Souza Moreira

Abstract: Diabetes mellitus is a common and growing problem worldwide, especially in the elderly population imposing a huge economic burden for individuals and healthcare services. The purpose of this narrative review was to summarize the current state of knowledge about the relationship between diabetes and important geriatric syndromes, physical function measures, and gait variables. Studies pertaining to the topics were identified through on-line search of databases. Seniors with diabetes are more likely to experience falls, depression, and frailty. Furthermore, in older patients, diabetes has been associated with disability, including basic and instrumental activities of daily living, and with poorer performance on objective measures of physical function, such as sit-to-stand test, handgrip strength, Timed Up and Go (TUG) test, and Short Physical Performance Battery (SPPB). Diabetic seniors also have an altered gait pattern characterized by lower velocity and stride length, and higher step width, stance time, double support time, and stride length variability compared to non-diabetic seniors. Little is known about fear of falling in older adults with diabetes. The relationship between these outcomes and diabetes in older people is still outstanding and merits further investigation.

Keywords: Diabetes mellitus, elderly, geriatric syndromes, fear of falling, physical function, gait.

APÊNDICE C – Outras Produções Relevantes Durante o Período do Doutorado

Parâmetros espaço-temporais da marcha e quedas em idosos

As quedas em idosos representam um sério problema de saúde pública devido à alta incidência, altos índices de morbimortalidade e elevados custos assistenciais. Dados nacionais e internacionais revelam que 30 a 60% dos idosos comunitários caem anualmente e que 10% das quedas resultam em lesões graves, das quais 5% correspondem a fraturas. As quedas também podem gerar sérias consequências psicossociais, como medo de cair, restrição de atividades e isolamento social. Neste contexto, é essencial identificar precocemente indivíduos em risco de cair. Os parâmetros espaço-temporais da marcha parecem ser ferramentas úteis para predição de quedas. Contudo, ainda não há consenso na literatura se esses parâmetros podem predizer quedas recorrentes. Entre os fatores que podem contribuir para a falta de consenso estão os métodos estatísticos que não levam em consideração a alta correlação entre as variáveis da marcha. Neste caso, as técnicas multivariadas são mais apropriadas. Portanto, o objetivo desse estudo foi determinar, por meio da análise de componentes principais e análise discriminante, se parâmetros espaço-temporais da marcha poderiam predizer quedas recorrentes em idosas comunitárias.

Bruno de Souza Moreira. Fisioterapeuta. Mestre em Ciências da Reabilitação pela Universidade Federal de Minas Gerais. Renata Noce Kirkwood. Fisioterapeuta. Doutora em Anatomia e Biologia Celular pela Queen's University, Canadá. Rosana Ferreira Sampaio. Fisioterapeuta. Doutora em Saúde Pública pela Universidad Autonoma de Barcelona.

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Bruno Moreira · Renata Kirkwood · Rosana Sampaio

Parâmetros espaço-temporais da marcha e quedas em idosos

Estudo longitudinal com aplicação da análise de componentes principais

Novas Edições Acadêmicas

MARCHA E QUEDAS NO IDOSO

RENATA NOCE KIRKWOOD
BRUNO DE SOUZA MOREIRA
RENAN ALVES RESENDE

INTRODUÇÃO

O andar é uma das tarefas sensório-motoras mais frequentemente executadas no dia a dia e envolve a interação complexa e simultânea entre os sistemas motor, sensorial e cognitivo. Uma criança saudável demora meses para aprender a andar, e apresenta maturação da marcha somente aos 7 anos de idade.

Em razão das inúmeras alterações que ocorrem com o envelhecimento, entre elas a perda de massa e de força muscular, a redução da amplitude de movimento (ADM) articular e a piora do sistema perceptual, andar pode se tornar um desafio para o idoso.

Geriatrics Gerontology International Medline Indexed

Geriatr Gerontol Int 2017; **17:** *5–16*

REVIEW ARTICLE

Prevalence of sarcopenia in older Brazilians: A systematic review and meta-analysis

Juliano Bergamaschine Mata Diz,[1] Amanda Aparecida Oliveira Leopoldino,[1,2] Bruno de Souza Moreira,[1] Nicholas Henschke,[3] Rosangela Correa Dias,[1] Leani Souza Máximo Pereira[1] and Vinicius Cunha Oliveira[1]

[1]Postgraduate Program in Rehabilitation Sciences, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil; [2]The George Institute for Global Health, Sydney Medical School, University of Sydney, Sydney, New South Wales, Australia; and [3]Institute of Public Health, University of Heidelberg, Heidelberg, Germany

Aim: Sarcopenia is the age-related loss of muscle mass and function that evolves into disability, loss of independence and death. In Brazil the number of older people is rapidly growing, resulting in an increased prevalence of chronic conditions associated with old age. As prevalence estimates provide essential information to policymakers when developing healthcare strategies, this systematic review and meta-analysis aimed to estimate the prevalence of sarcopenia in older Brazilians.

Methods: Electronic database searches and hand-searching in relevant journals and reference lists were carried out without language restriction. Studies that reported the prevalence of sarcopenia in Brazilians aged 60 years or older were considered for inclusion. Sarcopenia was defined as low muscle mass, low muscle function or low muscle mass and function. Meta-analysis was carried out using a random-effects model.

Results: A total of 31 studies were included pooling 9416 participants. The overall prevalence of sarcopenia in older Brazilians was 17.0% (95% CI 13.0–22.0). Sensitivity analysis showed rates of 20.0% (95% CI 11.0–32.0) in women and 12.0% (95% CI 9.0–16.0) in men. Prevalence was 16.0% (95% CI 12.0–23.0) based on low muscle mass and function; and 17.0% (95% CI 9.0–31.0) based only on low muscle mass. The difference between these two criteria was not significant ($P = 0.96$).

Conclusions: Sarcopenia is an emerging public health issue in Brazil. Attention should be paid to changes in prevalence rates over the next years because of the increase in the older population. **Geriatr Gerontol Int 2017; 17: 5–16.**

Key words: age-related muscle loss, epidemiology, meta-analysis, prevalence, public health.

Introduction

In a time where the world's population is aging at an unprecedented rate, one of the most important challenges in the healthcare field is to slow the decline of the musculoskeletal system.[1,2] In this regard, age-related loss of muscle mass and function (i.e. strength and physical performance), or sarcopenia, is an intrinsic manifestation of the aging process, which can have severe implications on the functionality of older people.[2] Sarcopenia is the essential component of frailty syndrome, and has been strongly associated with poor health outcomes, such as disability, morbidity and mortality.[3–5]

The burden of this condition is extensive, and is increasing rapidly as a result of the fast increase in older populations.[6,7] After 50 years-of-age, following the process of fat accumulation as a substitution to lean body mass, it is estimated that muscle mass decreases consistently at a rate of approximately 1.0% per year, whereas gait speed and grip strength decrease at a rate of 2.0–2.2% and 1.9–5.0% per year, respectively.[8,9] In the USA, estimates calculated from national prevalence data showed that in the year 2000, 45.0% of the older population had sarcopenia, and their risk of disability was

Accepted for publication 26 November 2015.

Correspondence: Mr Juliano Bergamaschine Mata Diz MSc, Departamento de Fisioterapia, Escola de Educação Física, Fisioterapia e Terapia Ocupacional, Universidade Federal de Minas Gerais (UFMG), Av. Antônio Carlos, 6627, Pampulha, Belo Horizonte, Minas Gerais 31270-901, Brasil. Email: julianodiz@gmail.com

original article

BJPT Brazilian Journal of Physical Therapy

Effects of a progressive resistance exercise program with high-speed component on the physical function of older women with sarcopenic obesity: a randomized controlled trial

Karina S. S. Vasconcelos[1], João M. D. Dias[1], Marília C. Araújo[1], Ana C. Pinheiro[1], Bruno S. Moreira[1], Rosângela C. Dias[1]

ABSTRACT | **Background**: Sarcopenic obesity is associated with disability in older people, especially in women. Resistance exercises are recommended for this population, but their efficacy is not clear. **Objective**: To evaluate the effects of a progressive resistance exercise program with high-speed component on the physical function of older women with sarcopenic obesity. **Method**: Twenty-eight women 65 to 80 years old, with a body mass index ≥30kg/m² and handgrip strength ≤21kg were randomly allocated to two groups. The experimental group underwent a 10-week resistance exercise program designed to improve strength, power, and endurance of lower-limb muscles, with open chain and closed chain exercises. The control group had their health status monitored through telephone calls. The primary outcomes were lower limb muscle performance measured by knee extensor strength, power and fatigue by isokinetic dynamometry, and mobility measured by the Short Physical Performance Battery and by gait velocity. The secondary outcome was health-related quality of life assessed by the SF-36 Questionnaire. **Results**: The average rate of adherence was 85%, with few mild adverse effects. There were no significant between-group differences for any of the outcomes. **Conclusion**: In this study, a progressive resistance exercise program with high-speed component was not effective for improving the physical function of older women with sarcopenic obesity.

Keywords: physical therapy; obesity; sarcopenia; resistance training; aging; mobility.

Clinical Trials Identifier: Brazilian Registry of Clinical Trials (ReBEC): RBR-9p5q67. http://www.ensaiosclinicos.gov.br/rg/RBR-9p5q67/

BULLET POINTS

- Sarcopenic obesity (SO) is a disabling condition among older women.
- Resistance exercises are recommended for older people, but its effects for SO are not known.
- We proposed a progressive resistance exercise program with high-speed component for SO.
- This program was not effective for improving the physical function of older women with SO.

HOW TO CITE THIS ARTICLE

Vasconcelos KSS, Dias JMD, Araújo MC, Pinheiro AC, Moreira BS, Dias RC. Effects of a progressive resistance exercise program with high-speed component on the physical function of older women with sarcopenic obesity: a randomized controlled trial. Braz J Phys Ther. 2016 Sept-Oct; 20(5):432-440. http://dx.doi.org/10.1590/bjpt-rbf.2014.0174

Introduction

In clinical practice, physical therapists are often faced with challenging cases of elderly patients with excess body weight, a condition that has been associated with impairments in muscle performance and functional limitations. Finding the best intervention for these patients can be even more challenging.

The combination of excess body fat and reduced muscle mass or strength is called sarcopenic obesity (SO)[1,2]. Older people are at greater risk of SO due to physiological changes during aging. The hormonal decline associated with aging leads to muscle fiber atrophy and accumulation of abdominal and intra-muscular fat, predisposing the patient to SO[1]. A pro-inflammatory state is intrinsically related to this condition and other factors can exacerbate this process such as physical inactivity, comorbidities, and dietary deficiencies[3]. This condition is highly

[1]Departamento de Fisioterapia, Escola de Educação Física, Fisioterapia e Terapia Ocupacional, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, MG, Brazil
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QUASI-EXPERIMENTAL STUDY

Effects of aerobic exercise on functional capacity, anthropometric measurements and inflammatory markers in diabetic elderly women

Daniela Maria da Cruz dos Anjos, PhD, PT [a],
Bruno de Souza Moreira, MSc, PT [b],
Renata Noce Kirkwood, PhD, PT [b],
Rosângela Corrêa Dias, PhD, PT [b],
Daniele Sirineu Pereira, PhD, PT [c],
Leani Souza Máximo Pereira, PhD, PT [b,*]

[a] *Centro Universitário Estácio, Physical Therapy Course, Minas Gerais, Belo Horizonte, Brazil*
[b] *Graduate Program in Rehabilitation Science, Universidade Federal de Minas Gerais, Minas Gerais, Belo Horizonte, Brazil*
[c] *Nursing School, Physical Therapy Course, Universidade Federal de Alfenas, Minas Gerais, Alfenas, Brazil*

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KEYWORDS
Type 2 diabetes mellitus;
Elderly;
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Functional capacity;
Inflammatory markers

Summary This study investigated the effects of an aerobic training program on functional capacity [Timed Up and Go test (TUG), timed 10-m walk test (10MWT), five-repetition sit-to-stand test (5-STS), handgrip strength test (HGS) and one-legged stance test (OLS)], anthropometric measurements [body mass, body mass index (BMI), waist and hip circumferences and waist-to-hip ratio] and plasma levels of inflammatory markers [soluble tumor necrosis factor receptors 1 and 2, and interleukins 6 and 10] in 43 elderly women with type 2 diabetes mellitus. After the training, a significant improvement was observed in the performance of the participants on the TUG, 10MWT, 5-STS and HGS and in the anthropometric measures of body

* Corresponding author. Department of Physical Therapy, Universidade Federal de Minas Gerais, Presidente Antônio Carlos Avenue 6627, Campus Pampulha, Belo Horizonte, Minas Gerais 31270-901, Brazil.
E-mail addresses: danielacruzanjos@gmail.com (D.M.C. dos Anjos), brunosouzamoreira@gmail.com (B.S. Moreira), renata.kirkwood@gmail.com (R.N. Kirkwood), rcorreadias8@gmail.com (R.C. Dias), daniele.sirineu@gmail.com (D.S. Pereira), leanismp.bh@terra.com.br (L.S.M. Pereira).

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original article

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Spatiotemporal and variability gait data in community-dwelling elderly women from Brazil

Renata N. Kirkwood[1], Henrique A. Gomes[1], Rosana F. Sampaio[1], Sheyla R. C. Furtado[1], Bruno S. Moreira[1]

ABSTRACT | **Background:** Gait is an extremely complex motor task; therefore, gait data should encompass as many gait parameters as possible. **Objective:** To provide reference values for gait measurements obtained from a Brazilian group of community-dwelling elderly females between the ages of 65 and 89 years and to apply the PCA-biplot to yield insight into different walking strategies that might occur during the aging process. **Method:** 305 elderly community-dwelling females living in Brazil were stratified into four age groups: 65-69 years (N=103); 70-74 years (N=95); 75-79 years (N=77); and ≥80 years (N=30). Age, height, and BMI were assessed to describe the characteristics of the groups. Gait spatiotemporal and variability data were obtained using the GAITRite® system. Principal component analysis, followed by MANOVA and the PCA-biplot approach were used to analyze the data. **Results:** 95% CI showed that only three components – rhythm, variability, and support - together explained 74.2% of the total variance in gait that were different among the groups. The older groups (75-79 and ≥80 years) walked with lower than average velocity, cadence, and step length and were above average for the variables stance, step, swing, and double support time and the ≥80 year old group presented the highest gait variability compared to the other groups. **Conclusion:** Aging is associated with decreased gait velocity and cadence and increased stance, step time, and variability, but not associated with changes in base of support. In addition, the PCA-biplot indicates a decline towards decreased rhythm and increased variability with aging.

Keywords: gait; elderly; principal component analysis; biplot; variability; physical therapy.

BULLET POINTS

- This study provides extended gait parameters for Brazilian elderly women.
- The components (rhythm, variability, and support) were different among age groups.
- Aging is associated with decreased gait rhythm and increased gait variability.
- Aging is not related to changes in base of support.

HOW TO CITE THIS ARTICLE

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Introduction

The normal aging process is associated with changes to the nervous, muscular, and skeletal systems that affect the ability of a person to walk efficiently[1]. These changes, specifically in the elderly population, have been associated with greater immobility, risk of falls, dementia, and mortality[2-5]. One approach to understanding gait dysfunction is to assess and compare the results with reference values[6-9]. Traditionally, gait velocity is the elected variable used to assess gait due to the link of lower gait velocity to adverse outcomes in the elderly[10,11]. However, gait is an extremely complex motor task that can be expressed from parameters other than velocity such as cadence, base of support, step length, swing, stance, and double support times. In addition, gait variability, defined as a fluctuation in gait parameters during a stride, is an important indicator of impaired mobility in the elderly[12,13]. Most studies focus on gait velocity, neglecting the other gait parameters[14,15], however gait should also be recognized in other facets. To our knowledge, there is a lack of gait studies conducted in community-dwelling older adults living in Brazil.

The problem that arise from gathering many gait parameters is the data dimensionality, temporal dependence, and the high variability among these variables[16]. Therefore, the need for reduction and

[1]Programa de Pós-graduação em Ciências da Reabilitação, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, MG, Brazil
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Research Report

Is the Veterans Specific Activity Questionnaire Valid to Assess Older Adults Aerobic Fitness?

Alessandra de Carvalho Bastone, PT, PhD[1]; Bruno de Souza Moreira, PT, MSc[2]; Claudine Patrícia Teixeira, PT Graduation Student[1]; João Marcos Domingues Dias, PT, PhD[2]; Rosângela Corrêa Dias, PT, PhD[2]

ABSTRACT

Background: Aerobic fitness in older adults is related to health status, incident disability, nursing home admission, and all-cause mortality. The most accurate quantification of aerobic fitness, expressed as peak oxygen consumption in $mL \cdot kg^{-1} \cdot min^{-1}$, is the cardiorespiratory exercise test; however, it is not feasible in all settings and might offer risk to patients. The Veterans Specific Activity Questionnaire (VSAQ) is a 13-item self-administered symptom questionnaire that estimates aerobic fitness expressed in metabolic equivalents (METs) and has been validated to cardiovascular patients.

Purpose: The purpose of this study was to assess the validity and reliability of the VSAQ in older adults without specific health conditions.

Methods: A methodological study with a cross-sectional design was conducted with 28 older adults (66-86 years). The VSAQ was administered on 3 occasions by 2 evaluators. Aerobic capacity in METs as measured by the VSAQ was compared with the METs found in an incremental shuttle walk test (ISWT) performed with a portable metabolic measurement system and with accelerometer data.

Results: The validity of the VSAQ was found to be moderate-to-good when compared with the METs and distance measured by the ISWT and with the moderate activity per day and steps per day obtained by accelerometry. The Bland-Altman graph analysis showed no values outside the limits of agreement, suggesting good precision between the METs estimated by questionnaire and the METs measured by the ISWT. Also, the intrarater and interrater reliabilities of the instrument were good.

Conclusions: The results showed that the VSAQ is a valuable tool to assess the aerobic fitness of older adults.

Key Words: aging, physical fitness, reliability and validity, VSAQ

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INTRODUCTION

Among all the physiological changes that occur during the aging process, the declines in muscle mass and aerobic fitness, indexed as peak oxygen consumption (VO_2 peak), are the most associated with declines in functional independence and quality of life.[1,2] Moreover, aerobic fitness in older adults is related to health status,[2,3] incident disability, nursing home admission,[4] and all-cause mortality[2,5] and has been considered an important public health research topic.[2] The decline in VO_2 peak with age is not linear and is shown to be influenced by body mass index, smoking habits, and physical activity behavior.[2] Even with advanced age, VO_2 peak can be modified through exercise training[6] and is, therefore, a potential target for interventions aimed at maintaining or promoting independence in older adults,[4] avoiding institutionalization.[6]

The most accurate quantification of aerobic fitness, expressed as VO_2 peak in $mL \cdot kg^{-1} \cdot min^{-1}$, is the cardiorespiratory exercise test, which incorporates ventilatory expired gas analysis with traditional exercise testing,[7] because it indicates the rate at which energy can be supplied aerobically during physical activity.[4] It is performed clinically to obtain an objective assessment of a patient's functional status, to evaluate symptoms, to assess the efficacy

[1]*Department of Physical Therapy—Universidade Federal dos Vales do Jequitinhonha e Mucuri/UFVJM, Diamantina, Minas Gerais, Brazil.*

[2]*Postgraduate Program in Rehabilitation Sciences—Universidade Federal de Minas Gerais/UFMG, Belo Horizonte, Minas Gerais, Brazil.*

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The data from this work have been partially presented (poster) at the XIX Congresso de Geriatria e Gerontologia de Minas Gerais, 2013, Caxambú, MG, Brasil and at the XIX Congresso Brasileiro de Geriatria e Gerontologia, 2014, Belém, PA—Brasil.

Address correspondence to: Alessandra de Carvalho Bastone, PT, PhD, Department of Physical Therapy—Universidade Federal dos Vales do Jequitinhonha e Mucuri/UFVJM, Campus JK, Rodovia MGT 367, Km 583, N° 5000, Bairro Alto da Jacuba, Diamantina, MG - CEP 39100-000, Brazil (ale.bastone@gmail.com).

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RESEARCH ARTICLE

Impact of Type-2 Diabetes Time Since Diagnosis on Elderly Women Gait and Functional Status

Daniela Maria da Cruz Anjos[1,2]*, Bruno de Souza Moreira[1], Daniele Sirineu Pereira[3], Alexandra Miranda Assumpção Picorelli[1], Danielle Aparecida Gomes Pereira[1,4], Renata Noce Kirkwood[1,5], Rosângela Corrêa Dias[1] & Leani Souza Máximo Pereira[1,4]

[1]Graduate Programme in Rehabilitation Sciences, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil
[2]Physical Therapy Course, Faculdade Estácio de Sá, Belo Horizonte, Minas Gerais, Brazil
[3]Physical Therapy Course, Nursing School, Universidade Federal de Alfenas, Alfenas, Minas Gerais, Brazil
[4]Department of Physical Therapy, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil
[5]Department of Kinesiology and Physical Education, Wilfrid Laurier University, Waterloo, Ontario, Canada

Abstract

Background and Purpose. The gait, mobility and lower-limb strength alterations of diabetic elderly women without symptoms of diabetic neuropathy in different periods of the chronic disease can contribute to an early functional diagnosis, allowing prevention of adverse outcomes like falls and disability. This could also contribute to the development of interventions, cures and physiotherapy practice for this population. The aim of this study was to verify the impact of type-2 diabetes mellitus time since diagnosis on gait and functional status of elderly women. **Methods.** Eighty-two diabetic elderly women without neuropathic symptoms participated and divided in two groups: 1) 49 elderly (71.4 ± 4.8 years) with less than 10 years of type-2 diabetes mellitus diagnosis, and 2) 33 elderly (70 ± 4.5 years) with 10 or more years of type-2 diabetes mellitus diagnosis. Outcomes were spatiotemporal gait parameters (speed, cadence, step length, base of support, stance time, swing time, and double support time) assessed through GAITRite® system, and functional status assessed using the Timed Up and Go test and five times sit-to-stand test. To compare spatiotemporal gait variables and performance on functional tests between groups, multivariate analysis of variance and Mann–Whitney test were performed, respectively. **Results.** The group with 10 or more years of diagnosis showed lower gait speed and smaller step length (112.3 cm/s; 59.2 cm) compared with the group with less than 10 years of diagnosis (122.9 cm/s; 62.4 cm). In relation to Timed Up and Go test and five times sit-to-stand test, there were no statistically significant differences between the groups. **Conclusion.** Type-2 diabetes mellitus time since diagnosis has a negative impact on gait speed and step length, but not on functional status of the elderly women.

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Keywords
diabetes mellitus; elderly; frail elderly; functional status; gait

***Correspondence**
Daniela Maria da Cruz dos Anjos, PhD. Department of Physical Therapy, Universidade Federal de Minas Gerais. Presidente Antônio Carlos Avenue 6627, Campus Pampulha – Belo Horizonte, MG 31270-901, Brazil.
E-mail: danielacruzanjos@gmail.com

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Spatiotemporal gait parameters and recurrent falls in community-dwelling elderly women: a prospective study

Bruno S. Moreira, Rosana F. Sampaio, Renata N. Kirkwood

ABSTRACT | **Background:** Falling is a common but devastating and costly problem of aging. There is no consensus in the literature on whether the spatial and temporal gait parameters could identify elderly people at risk of recurrent falls. **Objective:** To determine whether spatiotemporal gait parameters could predict recurrent falls in elderly women. **Method:** One hundred and forty-eight elderly women (65-85 years) participated in this study. Seven spatiotemporal gait parameters were collected with the GAITRite® system. Falls were recorded prospectively during 12 months through biweekly phone contacts. Elderly women who reported two or more falls throughout the follow-up period were considered as recurrent fallers. Principal component analysis (PCA) and discriminant analysis followed by biplot graph interpretation were applied to the gait parameters. **Results:** After 12 months, 23 elderly women fell twice or more and comprised the recurrent fallers group and 110 with one or no falls comprised the non-recurrent fallers group. PCA resulted in three components that explained 88.3% of data variance. Discriminant analysis showed that none of the components could significantly discriminate the groups. However, visual inspection of the biplot showed a trend towards group separation in relation to gait velocity and stance time. PC1 represented gait rhythm and showed that recurrent fallers tend to walk with lower velocity and cadence and increased stance time in relation to non-recurrent fallers. **Conclusions:** The analyzed spatiotemporal gait parameters failed to predict recurrent falls in this sample. The PCA-biplot technique highlighted important trends or red flags that should be considered when evaluating recurrent falls in elderly females.

Keywords: falls; elderly; gait; principal component analysis; biplot; physical therapy.

HOW TO CITE THIS ARTICLE

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Introduction

Falls among older adults are a major public health concern due to their high incidence, substantial morbimortality rate, and high associated healthcare costs[1]. It is estimated that 30 to 60% of community-dwelling elderly people fall each year, with approximately half of them experiencing multiple falls[2], and that 10 to 20% of these falls result in injury, hospitalization, and/or death[3]. Falls also generate serious psychological and social consequences. Individuals may experience fear of falling, activity restriction, and loss of confidence, which may consequently facilitate further functional decline, depression, and social isolation[4]. Considering these adverse outcomes, it is imperative to proactively identify individuals at risk for falling.

During the last decade, gait velocity has been repeatedly reported as an appealing, quick, inexpensive, and highly reliable tool in research and clinical practice to assess elderly people at a high risk of negative outcomes[5], such as falls and recurrent falls. However, its capacity to predict recurrent falls has not been consistently observed. Some previous prospective studies have shown that slow gait velocity is associated with recurrent falls in the elderly population[6-8]. For example, in a community-based prospective study with a 2-year follow-up conducted in 1,016 participants aged 70 years and older, Luukinen et al.[9] found that slow walking velocity (<0.77m/s) was an independent risk factor for recurrent falls (age- and sex-adjusted odds ratio=1.79, 95%CI=1.06-3.00). Conversely, other prospective studies failed to observe a significant association between gait velocity and future recurrent falls in older adults[10-12].

Gait is a complex motor activity with many measurable facets besides velocity that could help to identify individuals with recurrent falls. In a study involving 96 community-dwelling elderly women (72.8±6.2 years), Lord et al.[11] demonstrated that elderly women who fell on two or more occasions in a one-year prospective period had significantly reduced cadence and increased stance time than those

Departamento de Fisioterapia, Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, MG, Brazil
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ORIGINAL RESEARCH

Validation of the Human Activity Profile Questionnaire as a Measure of Physical Activity Levels in Older Community-Dwelling Women

Alessandra de Carvalho Bastone, Bruno de Souza Moreira, Renata Alvarenga Vieira, Renata Noce Kirkwood, João Marcos Domingues Dias, and Rosângela Corrêa Dias

The purpose of this study was to assess the validity of the Human Activity Profile (HAP) by comparing scores with accelerometer data and by objectively testing its cutoff points. This study included 120 older women (age 60–90 years). Average daily time spent in sedentary, moderate, and hard activity; counts; number of steps; and energy expenditure were measured using an accelerometer. Spearman rank order correlations were used to evaluate the correlation between the HAP scores and accelerometer variables. Significant relationships were detected (rho = .47–.75, $p < .001$), indicating that the HAP estimates physical activity at a group level well; however, scatterplots showed individual errors. Receiver operating characteristic curves were constructed to determine HAP cutoff points on the basis of physical activity level recommendations, and the cutoff points found were similar to the original HAP cutoff points. The HAP is a useful indicator of physical activity levels in older women.

Keywords: older women, physical activity measurement, self-reported physical activity, accelerometer

Regular physical activity is essential for healthy aging (Tomioka, Iwamoto, Saeki, & Okamoto, 2011). It can prevent or delay the development of common diseases such as cardiovascular disease, Type 2 diabetes, and obesity and can also decrease the risk of dementia, functional limitation, and disability (Gill, Jones, Zou, & Speechley, 2012; Neilson, Robson, Friedenreich, & Csizmadi, 2008). Despite these previous studies, the specific details of these associations, including the intensity, type, volume, and frequency of the physical activity, are not entirely clear (Colbert, Matthews, Havighurst, Kim, & Schoeller, 2011; Neilson et al., 2008). Furthermore, the measurement of physical activity remains difficult, particularly in older adults (Siebeling, Wiebers, Beem, Puhan, & Ter, 2012), many of whom exhibit reduced levels of physical activity with advancing age (Davis & Fox, 2007).

Routine physical activity can be assessed using objective measures based on motion sensors (e.g., pedometers, accelerometers, and global positioning systems), double-labeled water, and subjective measures based on daily physical activity records and self-report questionnaires (Gill et al., 2012; Neilson et al., 2008). Most of the objective measures available have been validated and have been successfully used to assess the physical activity of older individuals (Colbert et al., 2011; Davis & Fox, 2007). For example, accelerometers have previously been well validated (Colbert et al., 2011; Plasqui & Westerterp, 2007) and can capture light-intensity activity (Copeland & Esliger, 2009), a characteristic that is often poorly reported in physical activities questionnaires (Forsén et al., 2010). However, objective methods are rarely applicable in large-scale epidemiological studies because of cost constraints and the burdens that are imposed on the participants and researchers (Tomioka et al., 2011). Notably, problems with memory, lack of visual and manual dexterity required to wear the devices properly, and confusion with unfamiliar technology may hamper the proper use of these modalities in older adults (Kowalski, Rhodes, Naylor, Tuokko, & Macdonald, 2012).

Physical activity questionnaires have a clear weakness considering reporting bias (Svege, Kolle, & Risberg, 2012). The responses of older adults to questionnaire items might be influenced by fluctuations in health status, medical conditions and medications, fatigue, distractibility, changes in mood, social desirability, and cognitive problems that lead to misinterpretation and inaccurate recall (Kowalski et al., 2012). Nevertheless, questionnaires provide detailed information regarding the type of activity (Colbert et al., 2011; Hawkins et al., 2009) and represent a practical, widely used approach for assessing physical activity when resources are limited, when physical activity is not the primary focus of a study (Gill et al., 2012), and when epidemiological research requires an understanding of the demographics of physical activity at a more global level (Forsén et al., 2010; Manini, 2011; Washburn, 2000). A variety of physical activity questionnaires are available, but the vast majority have shown limited reliability and validity (Neilson et al., 2008; Svege et al., 2012).

The Human Activity Profile (HAP) is a questionnaire designed to measure the functional and physical activity levels of healthy and disabled individuals of all ages (Fix & Daughton, 1998). At face value, the HAP appears to be a promising instrument for measuring physical activity in the older adult population. The HAP focuses on common human activities that include mobility, personal care, household and instrumental activities of daily living, and leisure

Bastone is with the Dept. of Physical Therapy, Federal University of Vales do Jequitinhonha e Mucuri, Diamantina, MG, Brazil. Moreira, Kirkwood, Dias, and Dias are with the Postgraduate Program in Rehabilitation Sciences, Federal University of Minas Gerais, Bela Horizonte, MG, Brazi. Vieira is with the School of Physical Therapy, Federal University of Juiz de Fora, São Pedro, MG, Brazil. Address author correspondence to Alessandra de Carvalho Bastone at ale.bastone@gmail.com

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Searching for Stability as we Age: The PCA-Biplot Approach

Renata Noce Kirkwood[a,b,*], Scott C.E. Brandon[b,c], Bruno de Souza Moreira[a] and Kevin J. Deluzio[b,c]

[a]*Graduate Program in Rehabilitation Science, Universidade Federal de Minas Gerais, 6627 Antônio Carlos Avenue, Belo Horizonte, Minas Gerais, 31270-901, Brazil*

[b]*Department of Mechanical and Materials Engineering, Queen's University, McLaughlin Hall, 130 Stuart Street, Kingston, Ontario, K7L 3N6, Canada*

[c]*Human Mobility Research Centre, Syl & Molly Apps Medical Research Centre, Kingston, General Hospital & Queen's University, Kingston, Ontario, K7L 2V7, Canada*

Abstract: Principal component analysis (PCA) has been successfully applied to gait data; however, interpretation of the components is challenging. An alternative is to use a graphical display called biplot that gives insights into relationships and trends of data sets. Our goal was to demonstrate the sensitivity of gait variables to aging in elderly women with PCA-biplot. One hundred fifty-one elderly females (71.6±5.0 yrs), 152 adults (44.7±5.4 yrs) and 150 young (21.7±4.1 yrs) participated in the study. Gait spatial and temporal parameters were collected using a computerized carpet. PCA-biplot, discriminant analysis and MANOVA were used in the analysis. PCA-biplot revealed that elderly females walked with lower velocity, shorter step length, reduced swing time, higher cadence, and increased double support time compared to the other two groups. The greatest distances between the groups were along the variable step length with the elderly group showing a decrease of 8.4 cm in relation to the younger group. The discriminant function confirmed the importance of principal component 2 for group separation. Because principal component 2 was heavily weighted by step length and swing time, it represents a measure of stability. As women age they seek a more stable gait by decreasing step length, swing time, and velocity. PCA-biplot highlighted the importance of the variable step length in distinguishing between women of different age groups. It is well-known that as we age we seek a more stable gait. The PCA-biplot emphasized that premise and gave further important insights into relationships and trends of this complex data set.

Keywords: Gait, Principal Components Analysis, Biplot, Elderly, Balance, Step Length.

1. INTRODUCTION

An efficient gait pattern is characterized by stable and adaptable forward progression throughout both stance and swing phases [1]. Humans first learn how to control balance after the onset of independent walking, and progressively develop a refined locomotor pattern that becomes similar to an adult's gait by the age of 7 [2-4]. From the time gait matures in childhood it remains stable until the age of 55-60 years, when gait adaptations begin in response to the aging process [5-7].

Summary statistics such as mean, variance and correlations are normally used for gait comparisons with respect to temporal and distance parameters such as velocity, step length, cadence, base of support, and duration of the gait phases [8]. Inferential statistical tests are important in defining statistical significance difference (e.g. p-values), but provide limited additional information in how the variables are related to each other, and how the groups and subjects behave among themselves. In addition, gait variables are highly correlated [9], have a temporal dependence [10], interact in a complex linear fashion, and also demonstrate higher variability as age increases [11, 12]. For example, velocity is a function of step length and cadence; in addition, as we increase our velocity the ratio changes between stance and swing, with stance time becoming shorter than swing time. As a result, new statistical approaches to analyse quantitative gait data have been proposed [10, 13, 14]. Among them, principal component analysis (PCA) has been recognized as a powerful tool to extract useful information from highly correlated data [15]. The purpose of PCA is to reduce the original, correlated data to a smaller set of uncorrelated variables called principal components (PCs). This reduction is accomplished with minimal loss of clinical information because the principal components are ranked such that the first few components capture most of the variation present in the original data, and subsequent components can be discarded [16]. Each retained principal component represents a weighted linear combination of the original variables; the larger the loading of a specific variable, the more influential this variable will be in the structure of that PC. However, it may be challenging for researchers to extract clinically relevant information based solely on the relative weighting of each original variable within a given principal component.

*Address correspondence to this author at the Department of Kinesiology and Physical Education, Wilfrid Laurier University, 75 University Avenue West, Waterloo, Ontario, N2L 3C5, Canada; Tel: 519 884-0710 x4156;
E-mails: renata.kirkwood@gmail.com, rkirkwood@wlu.ca

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INFLUENCE OF PASSIVE JOINT STIFFNESS ON PROPRIOCEPTIVE ACUITY IN INDIVIDUALS WITH FUNCTIONAL ANKLE INSTABILITY

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Manuscript Draft

Manuscript Number: AGG-D-16-00517

Title: Brain-Derived Neurotrophic Factor Plasma Levels Are Increased in Older Women after an Acute Episode of Low Back Pain

Article Type: Full Length Article

Keywords: brain-derived neurotrophic factor; pain modulation; low back pain; depressive symptoms; older adults.

Corresponding Author: Mr. Juliano Bergamaschine Mata Diz, MSc

Corresponding Author's Institution: Universidade Federal de Minas Gerais

First Author: Juliano Bergamaschine Mata Diz, MSc

Order of Authors: Juliano Bergamaschine Mata Diz, MSc; Bruno S Moreira, MSc; Diogo C Felicio, PhD; Luiza F Teixeira, PhD; Fabianna R Jesus-Moraleida, PhD; Barbara Z Queiroz, PhD; Daniele S Pereira, PhD; Leani S Pereira, PhD

Abstract: Background: Low back pain (LBP) is a growing public health problem in old age, and it is associated with disabling pain and depressive disorders. We compared brain-derived neurotrophic factor (BDNF) plasma levels, a key neurotrophin in pain modulation, between older women after an acute episode of LBP and age-matched pain-free controls, and investigated potential differences in BDNF levels between controls and LBP subgroups based on pain severity, presence of depressive symptoms and use of analgesic and antidepressant drugs. Methods: A total of 221 participants (154 with LBP and 67 pain-free) were studied. A comprehensive assessment of sociodemographic and clinical variables was conducted including pain severity (11-point NRS), depressive symptoms (GDS-15), age, body mass index, physical activity and total number of comorbidities and medications. Results: BDNF levels in LBP group were significantly higher than controls (7515.9 ± 3021.2; Md = 7116.0 vs 6331.8 ± 3364.0; Md = 5897.5 pg/mL, P = .005). LBP subgroups exhibited higher BDNF levels than controls, regardless of pain severity, presence of depressive symptoms and use of analgesic drugs. BDNF levels were significantly higher in LBP subgroup without the use of antidepressant drugs compared to both controls and LBP subgroup with the use of antidepressant drugs. Discussion: This study provides evidence that older women with acute low back pain exhibit higher BDNF plasma levels in comparison with pain-free controls. Subgroup comparisons suggest that the use of pain-relief drugs may influence BDNF levels. The study results offer a novel target for research on mechanisms of low back pain.

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Title: Myofascial force transmission among lower limb joints: An in vivo experiment

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Corresponding Author: Professor Hellen Veloso Rocha Marinho, Ph.D.

Corresponding Author's Institution: Universidade Estadual de Montes Claros

First Author: Hellen Veloso Rocha Marinho, Ph.D.

Order of Authors: Hellen Veloso Rocha Marinho, Ph.D.; Thales R Souza , Ph.D.; Bruno S Moreira , M.Sc.; Thiago R Santos , Ph.D.; Fabrício A Magalhães , Ph.D.; Giovanna M Amaral , Ph.D.; Sérgio T Fonseca , Ph.D.

Abstract: Anatomical studies have shown structural continuity between the lumbopelvic region and the lower limb. The present study aimed to verify if changes on knee and hip positions could modify the ankle's resting position and passive torque. Thirty-seven subjects underwent an assessment of ankle passive torque by means of an isokinetic dynamometer. The relationship between the absolute values of ankle passive resistance torque and the ankle angular position was used to calculate the following dependent variables: ankle resting position (position in which the passive resistance torque is zero); and ankle passive torque at 0° (torque at the neutral position of the ankle in the sagittal plane). These measures were carried out under three test conditions: 0° at knee and 0° at hip (0°/0°); 90° at knee and 90° at hip (90°/90°); and, 135° at knee and 120° at hip (135°/120°). The results demonstrated that the ankle resting position shifted towards dorsiflexion when knee/hip position changed from 0°/0° to 90°/90° and shifted towards plantar flexion when knee/hip position changed from 90°/90° to 135°/120°, achieving values close to the ones at the position 0°/0°. Similarly, passive torque reduced when knee/hip position changed from 0°/0° to 90°/90°, but it increased when knee/hip position changed from 90°/90° to 135°/120°. The changes on knee and hip position demonstrated the existence of tissue continuity between hip and ankle in physiological conditions, which is compatible with the concept of myofascial force transmission within the lower limb.

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Energy expenditure in frail older adults: a doubly labeled water study

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Corresponding Author:	Alessandra Bastone, PT, Ph.D. Universidade Federal dos Vales do Jequitinhonha e Mucuri Diamantina, MG BRAZIL
Corresponding Author Secondary Information:	
Corresponding Author's Institution:	Universidade Federal dos Vales do Jequitinhonha e Mucuri
Corresponding Author's Secondary Institution:	
First Author:	Alessandra Bastone, PT, Ph.D.
First Author Secondary Information:	
Order of Authors:	Alessandra Bastone, PT, Ph.D.
	Eduardo Ferriolli, MD - PhD
	Karina Pfrimer, N - PhD
	Bruno de Souza Moreira, PT - MSc
	Juliano Bergamaschine Mata Diz, PT - MSc
	João Marcos Domingues Dias, PT - PhD
	Rosângela Corrêa Dias, PT - PhD
Order of Authors Secondary Information:	
Manuscript Region of Origin:	BRAZIL
Abstract:	Background and purpose: Frailty is a common and important geriatric syndrome characterized by age-associated declines in physiologic reserve and function across multiorgan systems, culminating in a vicious cycle of dysregulated energetic. Thus, to investigate the energy expenditure of frail older adults is essential for a better understanding of the syndrome. To address this issue we compared the resting metabolic rate (RMR), the physical activity energy expenditure (PAEE), the physical activity level (PAL), and the total energy expenditure (TEE) of frail and nonfrail older adults. Methods: A cross-sectional study was conducted with 26 community-dwelling older adults (66 to 86 years), randomly selected. The groups (frail/nonfrail) were age and sex paired. RMR was measured by indirect calorimetry, using a COSMED K4 portable metabolic measurement system. TEE was obtained by the multipoint doubly labeled water method. PAEE was calculated by the equation PAEE (kcal/day) = (0.90 X TEE) - RMR and PAL was calculated as PAL = TEE/RMR. Results: The frail group showed significantly lower PAEE (796.2 ± 436.6 vs 347.0 ± 372.8 kcal/day, $p < 0.01$), PAL (1.9 ± 0.6 vs 1.4 ± 0.3, $p = 0.04$), and TEE (2492.2 ± 512.7 vs 1890.0 ± 513.6 kcal/day, $p < 0.01$) compared to the nonfrail group. Nevertheless, RMR did not differ between the groups (1446.8 ± 451.5 vs 1354.0 ± 374.5 kcal/day, $p = 0.57$). Conclusion: This study showed that low energy expenditure in physical activity is a main component of frailty, determining also low total energy expenditure, despite of no difference in resting metabolic rate. These results emphasize the importance of studies designed to investigate therapies, especially focused on physical activity, to maintain or regulate the energetics homeostasis of older adults, in order to prevent or treat