How to cite this article: Silva LN, Ribeiro MDA, Oliveira SB, Silva JCA. Influência dos requisitos cinéticos funcionais e desfechos de saúde na mobilidade funcional de idosos. J Phys Res. 2018;8(4):489-496. doi: 10.17267/2238-2704rpf.v8i4.2126

Original article

Journals BAHIANA
SCHOOL OF MEDICINE AND PUBLIC HEALTH

Influence of kinetic and functional requirements of health outcomes in the functional mobility of elderly people

Influência dos requisitos cinéticos funcionais e desfechos de saúde na mobilidade funcional de idosos

Luan Nascimento da Silva[1], Mara Dayanne Alves Ribeiro[2], Sabrynna Brito Oliveira[3], Jefferson Carlos Araujo Silva[4]

[1]Corresponding author. Federal University of Pelotas. Pelotas, Rio Grande do Sul, Brazil. ORCID: 0000-0003-4435-214X. luan.nascimento2222@gmail.com
[2]Federal University of Ceará. Fortaleza, Ceará, Brazil.ORCID: 0000-0003-0756-1428. mara_dayanne2@hotmail.com
[3]Federal University of Minas Gerais. Belo Horizonte, Minas Gerais, Brazil. ORCID: 0000-0001-9303-4338. sabrynnabrito@gmail.com
[4]Brasília University. Brasília, Distrito Federal, Brazil.. ORCID: 0000-0001-9131-4360. jeffcasilva@gmail.com

RESUMO | INTRODUÇÃO: A mobilidade funcional é um fator determinante para promover a independência do idoso, com influência na saúde física e mental. Os testes para avaliar a capacidade funcional de idosos devem ser direcionados a simularem as atividades de vida diárias de locomoção. **OBJETIVO:** Verificar a influência de requisitos cinéticos funcionais e desfechos da saúde sobre a mobilidade funcional de idosos em uma unidade básica de saúde. **MATERIAIS E MÉTODOS:** O estudo foi realizado com 88 idosos, que foram submetidos a testes funcionais para avaliação da mobilidade funcional, equilíbrio estático e força muscular de membros inferiores. Além disso foi aplicada uma escala de depressão e coletada variáveis relacionadas a saúde do idoso. **RESULTADOS:** Os requisitos cinéticos funcionais e a sintomatologia depressiva também foram correlacionadas à capacidade de locomoção, todavia a força muscular (correlação de Spearman = 0,52, p=0,000) exibiu uma maior influência na mobilidade funcional. As variáveis que tiveram associação com uma pior mobilidade funcional foram: histórico de quedas (p=0,001), diabetes (p=0,008) e hipertensão (p=0,015). **CONCLUSÃO:** Nos idosos avaliados, a força muscular dos membros inferiores apresenta maior influência sobre a mobilidade funcional. Ser hipertenso, diabético e/ou já ter caído pode influenciar o desempenho funcional de locomoção.

PALAVRAS-CHAVE: Idoso. Envelhecimento. Funcionalidade. Morbidade. Fatores de risco.

ABSTRACT | INTRODUCTION: Functional mobility is a determinant factor to promote the independence of the elderly, with influence on physical and mental health. Tests to assess the functional capacity of the elderly should be aimed at simulating daily living activities of locomotion. **OBJECTIVE:** To verify the influence of functional kinetic requirements and health outcomes on the functional mobility of the elderly in a basic health unit. **MATERIALS AND METHODS:** The study was performed with 88 elderly, who underwent functional tests to evaluate functional mobility, static balance and lower limb muscle strength. In addition, a depression scale was applied and variables related to elderly health were collected. **RESULTS:** Functional kinetic requirements and depressive symptomatology were also correlated with locomotion capacity, but muscle strength (Spearman correlation = 0.52, p = 0.000) showed a greater influence on functional mobility. The variables that had an association with a worse functional mobility were: history of falls (p = 0.001), diabetes (p = 0.008) and hypertension (p = 0.015). **CONCLUSION:** In the elderly evaluated, lower limb muscle strength has a greater influence on functional mobility. Being hypertensive, diabetic and/or already having fallen can influence the functional performance of locomotion.

KEYWORDS: Aging. Elderly. Functioning. Morbidity. Risk factors.

Submitted 09/27/2018, Accepted 11/08/2018, Published 11/23/2018
J Phys Res, Salvador, 2018 November 8(4):489-496
Doi: 10.17267/2238-2704rpf.v8i4.2126 | ISSN: 2238-2704
Responsible editors: Cristiane Maria Carvalho Costa Dias, Katia Nunes Sá

Introduction

The development of new technologies and the expansion of knowledge in the health sphere has implied a more effective assistance to the morbidities of the population. The consequence of this evolution is the increase in life expectancy that directly influences epidemiological issues[1]. In the first decade of the 21st century, the Brazilian population of the elderly corresponded to 10.8% (n = 20,590,599) of the total population. Estimates suggest that there are currently approximately 26 million elderly people in Brazil and there is a tendency to increase to 37.9 million in 2027[2,3].

The process of senescence brings about a natural diminution of the physiological functions of the systems of the organism. However, inadequate life habits and genetic propensity make them more propitious to the pathological manifestation of senility, marked by the appearance of Chronic Noncommunicable Diseases (CNCD), reduced mobility and functional limitation. In this context, many factors reduce the functional mobility of the elderly and contribute negatively to the aggravation of the inherent conditions of the natural aging process[4].

The reduction of functions in the cardiovascular, respiratory, nervous, musculoskeletal, endocrine, and other systems, which are expressed by deficits in cardiorespiratory fitness, flexibility, strength and balance, is observed in the elderly. These are called functional kinetic requirements and influence the functional independence of the elderly[5].

Health strategies to reduce the effects and/or development of senility should be increasingly implemented. However, for this to be possible, evaluation tools are needed to track the progression of each process and direct the intervention[6]. Functional mobility is a determining factor in promoting independence of the elderly, influencing physical and mental health. The tests to perform this evaluation in the elderly should be directed to simulate the daily life activities of locomotion, since they are performed more frequently and are those of greater difficulty of performance[7].

From these considerations, the objective of this study was to relate the influence of functional kinetic requirements, represented by the evaluation of lower limb muscle strength and static balance, and elderly health outcomes on the functional mobility of elderly in a basic health unit.

Materials and methods

This article is an observational study with a quantitative, transversal and exploratory approach. The sample was intentional, composed of elderly people enrolled in the Ulisses Family Health Strategy (ESF) coverage area, in the urban area of Cocal (PI). Data collection occurred from November 2014 to January 2015.

The inclusion criteria were: age ≥ 60 years, physical and mental autonomy, absence of cognitive and neurological impairment, and independent gait. The exclusion criteria were: presence of sensorimotor, auditory and/or visual impairment, incapacitating them in the performance of the tests.

With the help of the Community Health Agent (ACS) the elderly were invited to attend the Basic Health Unit (UBS), where they were informed about the risks and benefits of the study. Those who met the eligibility criteria confirmed their participation in the study by signing the Informed Consent Form (ICF) and were referred for evaluation. The volunteers responded to a semi-structured questionnaire, which compiled personal data, anthropometric characteristics (weight, height, body mass index (BMI)) and health history: CNCD such as Systemic Arterial Hypertension (SAH) and Diabetes Mellitus (DM), as well as the history of falls in the last year, and functional kinetic requirements, depression index and functional mobility were evaluated.

The functional kinetic requirements were measured from the tests: Functional Reach Test (FRT), which evaluates the static balance through the right upper limb excursion forward; and the lower limb strength test, known as "sit and lift"[8]. Depressive symptoms were assessed using the Geriatric Depression Scale with 15 items (GDS-15), where a score between 0 and 5 points is classified as normal symptoms; a score between 6 and 10 points corresponds to increasing depressive signs; and between 11 and

15 to severely depressed elderly subjects[9]. The functional mobility of the volunteers was estimated using the Timed Up and Go (TUG) test, where the individual must lift from a 3m chair and return to the initial position, while the time to perform the maneuver is performed[8].

After data recording and storage, an analysis with Stata 15.0© software was conducted. For the descriptive presentation of the data, mean and standard deviation were used. Spearman test was performed to verify the correlation of the TUG test with the other tests of functional kinetic requirements performed and linear regression model to estimate how these tests can influence the functional mobility. The association between the health outcomes of the elderly and the functional mobility was evaluated using Fisher's Exato and linear trend tests, as required by the analysis. A significance level ≤0.05 was considered.

The linear regression model and the Cartesian description of the association between the independent and dependent variables in question, using the formula below:

$$\widehat{TUG} = \hat{\beta}_0 + \hat{\beta}_1 Xi$$

The β_0 refers to the expected value for the dependent variable TUG when Xi is equal to zero. The Xi corresponds to the values of the independent variables of this study (value obtained in the tests). The angular coefficient β_1 is the expected variation in the response variable, when the independent variable modifies a unit. The values generated by this mathematical expression create a straight line from the β_0 and the angular coefficient β_1, which can offer a visual analysis of the associations between the variables.

The study was approved by the Research Ethics Committee of the Unified Teaching Center of Teresina (CEUT), under protocol n° 6,597/2014. The research followed the principles of Resolution No. 466/2012 of the National Health Council (CNS) and all procedures related to the collection and analysis of the data occurred only after approval by the ethics committee.

RESULTS

Of the 163 elderly Ulisses' ESF users10, a total of 93 attended the evaluation. The absentees included bedridden elderly and those that the ACS could not contact, as well as those that did not fit the inclusion criteria of the study. During the UBS evaluation process, 5 individuals were excluded because they presented moderate cognitive deficits (n = 2), making it difficult to perform the tests, dependent gait (n = 1) and withdrawal (n = 2). Thus, 88 elderly people composed the sample.

The anthropometric data and the measured values of the performed tests were described in Table 1. The mean TUG test time was 13.96 (± 3.08) seconds. The anthropometric variables age and height had correlation (low) with TUG values, being positive and negative, respectively. Functional kinetic requirements and depressive symptomatology were also correlated with TUG values, however, muscle strength exhibited a greater influence on functional mobility.

Table 1. Anthropometric variables, kinetic requirements and the Geriatric Depression Scale (GDS-15) of the Family Health Elderly (ESF) Ulisses, Cocal-PI.2018

		Mean	SD (±)	R^2	P	β_0	β_1
Anthropometric Variables	Age	68,39	6,33	0,22	0,035*	64,44	0,36
	Weight	57,82	10,23	-0,11	0,292	63,82	-0,41
	Stature	1,51	0,08	-0,21	0,041*	1,59	-0,00
	BMI	25,23	3,79	0,03	0,720	25,35	-0,00
Functional Kinetic Requirements	FRT	17,01	5,64	-0,28	0,007*	23,36	-0,45
	MS	17,72	4,15	0,52	0,000*	7,04	0,76
Geriatric Depression Scale		5,01	2,46	0,24	0,021*	2,14	0,19

BMI: body mass index; TAF: functional range test; FM: muscle strength of lower limbs; *statistically significant.

Figure 1 shows the trend of TUG values from the results obtained in the MS test. We can observe a positive correlation between the time spent performing the TUG (Spearman's correlation = 0.52, p = 0.000) and the time spent performing the muscle strength test.

Figure 1. Correlation between functional mobility and muscle strength (FM)

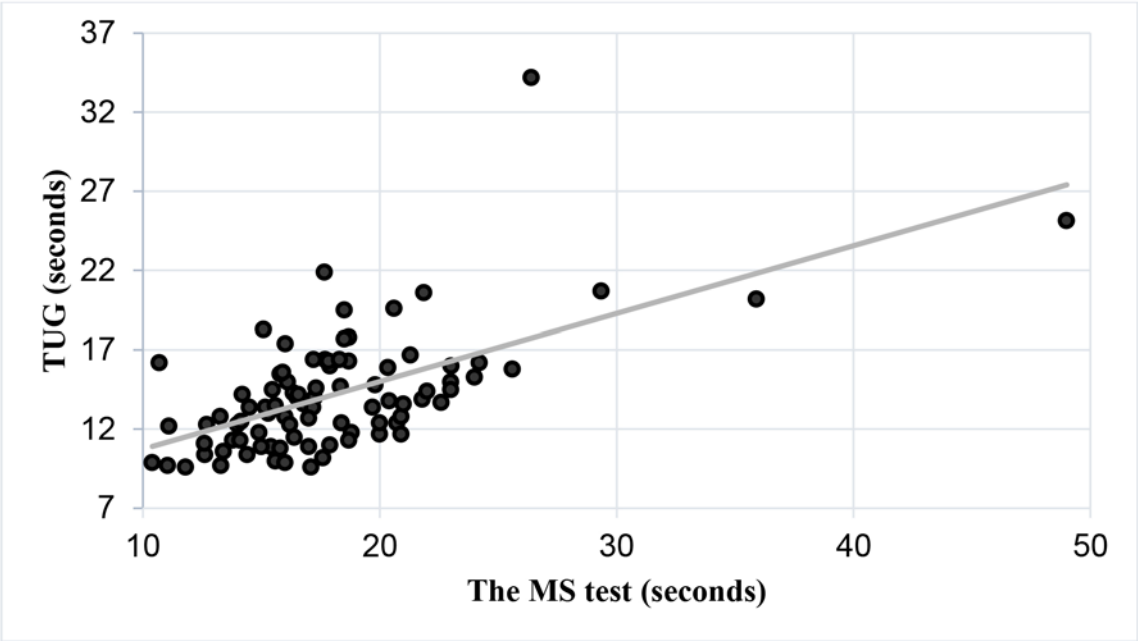

Figure 2 shows the trend of TUG values from the results obtained in the static equilibrium test. We can observe a negative correlation between the time spent to perform the TUG (Spearman's correlation = -0.28, p = 0.007) and the distance reached in the FRT.

Figure 2. Correlation between functional mobility and functional range test (FRT)

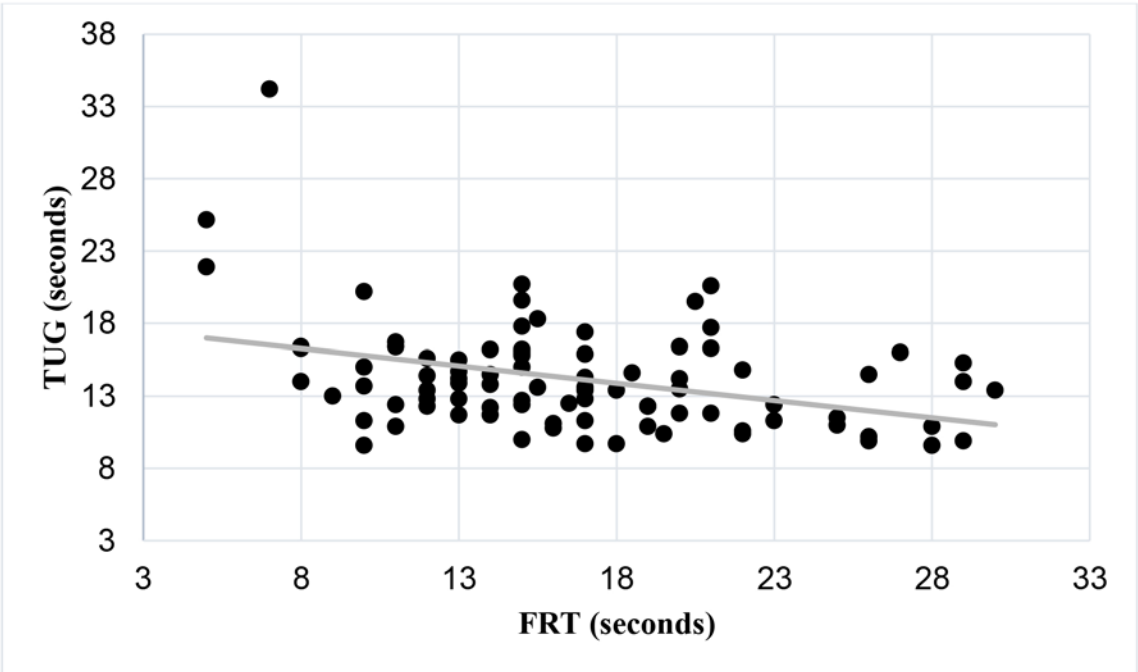

Table 2 shows the functional outcomes of elderly health. The variables that had association with the TUG values were: History of falls, DM and SAH.

Table 2. Functional outcomes of the elderly health of the Family Health Strategy (ESF) Ulisses, Cocal-PI

		N (%)	P
History of falls	None	47 (53,41)	0,001*
	1 fall	34 (38,64)	
	2 falls	5 (5,68)	
	3 falls or more	2 (2,27)	
SAH	Yes	42 (46,86)	0,015*
	Not	46 (51,14)	
DM	Yes	75 (85,23)	0,008*
	Not	13 (14,77)	
BMI	Low weight	43 (49,41)	0,517
	Normal	37 (42,35)	
	Obesity (Grade I)	8 (8,24)	
Income	Less than a salary	2 (2,27)	0,190
	One salary	83 (94,32)	
	More than a salary	3 (3,41)	
Education	Illiterate	59 (67,05)	0,180
	Fundamental Incomplete	28 (31,82)	
	Fundamental Complete	1 (1,14)	

DM: diabetes mellitus; SAH: systemic arterial hypertension; BMI: body mass index; *statistically significant.

Discussion

This study investigated the relationship between functional kinetic requirements, represented by the evaluation of lower limb muscle strength and static balance, and elderly health outcomes on the functional mobility of elderly in a primary healthcare unit. It was observed that the functional kinetic requirements of lower limb muscle strength have a greater influence on functional mobility when compared to static equilibrium; it was also observed that in relation to depressive symptomatology and health outcomes, the variables history of falls, diagnosis of hypertension and DM were associated with a lower capacity for locomotion in functional activities.

Elderly individuals may present deficits in the balance due to the sensory alterations that are due to the natural aging process. This characteristic compromises the Central Nervous System (CNS) in adequately processing the vestibular, visual and proprioceptive signals[11]. The impairment of balance in elderly presented a close relation with the risk of falls and fractures[12]. In the present study, the balance of the elderly was estimated by applying the FRT, the volunteers presented an average of 17.01 (± 5.64) cm, implying that the volunteers presented low risk of falling.

The choice of TUG was based on its ability to integrate functional kinetic requirements such as power, speed, agility and dynamic balance[13]. This evaluation instrument is widely used in the scientific scenario with the purpose of evaluating functional mobility, for representing activities that include getting up, walking, going back and sitting, as reflected in many activities performed by the elderly in the home or social environment.

The association of FRT and TUG showed a negative correlation between the time spent to perform TUG and the distance reached in FRT, that is to say that the more time spent in TUG execution the less

distance traveled in FRT. Both tests are commonly used in the measurement of these parameters and are reliable for the purpose. For example, a survey[15] conducted in a public hospital used a Proprioceptive Neuromuscular Facilitation (PNF) protocol in the elderly and observed its effects on the volunteers' balance. The analyzes were performed by means of a baropodometer, in addition to the TUG and FRT tests, the baropodometer analysis revealed no differences after the PNF protocol, but there was a decrease in TUG execution and an increase in FRT excursion, reducing the risk fall of the elderly.

In another study[16] performed with 36 elderly women, the functional mobility was evaluated through TUG, static balance using FRT, lower limb strength through the maximal repetition test (1-RM), and the Berg Equilibrium Scale (BES), aiming to verify the influence of the maximum force on the balance of the volunteers. BES was more sensitive to identifying the balance deficits, the 1-RM test identified that muscle strength had direct interference in the TUG results. The authors concluded that lower limb muscle strength is an important predictor of the functional mobility of the elderly.

The present study also investigated the type of relationship between anthropometric characteristics and the patient's history with functional mobility. Weight and BMI had no correlation with functional mobility, in contrast, age was a factor that contributed to a decrease in performance during the TUG test. This may show that age is a conditioning factor for progressive functional impairment, in association with other factors that arise during the aging process [17,18,19].

A survey conducted in Barbacena-MG[19] evaluated 206 elderly people through questionnaires to identify risk factors, incidence and consequence of falls in the elderly. The majority (54.37%) of the elderly in our study were concentrated in the age range between 70-98 years and the percentage fracture of the lower limbs as a consequence of the fall in this age group was 15.56%, this fact demonstrates the implication of advancing age in reducing the functionality of older people and the consequences it brings. The variables income and schooling had no relation to the outcome, but the history of falls, SAH and DM were associated with worse functional mobility. The previous history of falls generates fear of falling in the elderly and, therefore, restricts and limits them to performing their daily activities[18].

The association between the risk of falls and the diagnosis of hypertension has not yet been fully elucidated in the scientific literature[20]. The literature evidences a frequency of falls in the elderly with a diagnosis of elevated DM. This fact may be related to the fact that diabetic elderly exhibit impaired balance and mobility due to old age, reduced proprioceptive sensitivity, and lack of balance strategy[21].

The reduction of functionality implies a greater propensity for the fall event and the consequences that this entails. It is necessary a multiprofessional action capable of detecting the risk of falls in the elderly, since this has a multifactorial cause, such as, drug control, health education, incentive to practice regular physical activity, among others[22]. Basic care is a field of activities of health education for the elderly, in order to stimulate the functional independence of these individuals and to provide the adoption of healthy habits[23].

Depression is one of the most prevalent disorders in the elderly, often under-diagnosed and not adequately treated[9]. In this study the evaluation of the depression index in the elderly through GDS-15 showed normal signs and its association as the TUG was statistically significant, this is due to the low risk of the event being found in volunteers. Depression is often related to social isolation and, consequently, functional decline, more markedly in the elderly, because it associates with the specific impairments of the natural aging process[24].

The research had as limitation the application of the GDS-15 in the form of an interview, the low level of schooling that made it difficult for the command to execute the tests and the reduced sample. The generalizations of this study should be done with attention, because the inferential analysis was performed in a small sample. We suggest future analyzes with representative samples and with prospective evaluations to show the evolutions of the possible functional mobility impairments.

Conclusion

The study allowed us to infer that of the functional kinetic requirements, the muscular strength of the lower limbs presents greater influence on the functional mobility, in a lower magnitude to the static balance. The depressive symptomatology and the health outcomes: history of falls, diagnosis of SAH and DM were associated with less ability to move in functional activities.

Author contributions

Silva LN participated in the study design conception and performed the statistical analysis. Silva JCA managed the data collection and submitted the project for consideration of the ethics committee. Ribeiro MDA participated in the data analysis. Oliveira SB guided the research. All authors participated in writing and critical assessment and review of the article.

Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

References

1. Barreto MS, Carreira L, Marcon SS. Envelhecimento populacional e doenças crônicas: reflexões sobre desafios para o sistema de saúde pública. Rev Kairós Gerontologia. 2015;18(1):325-339.

2. Ministério da Saúde (BR). DATASUS. Indicadores demográficos. Proporção de idosos na população [Internet]. 2012 [acesso em 2018 mar 17]. Disponível em: http://tabnet.datasus.gov.br/cgi/idb2012/a12.htm

3. IBGE – Instituto Brasileiro de Geografia e Estatística. Perfil dos idosos responsáveis pelos domicílios no Brasil [Internet]. [Acesso em 2018 mar 17]. Disponível em: http://www.ibge.gov.br/home/estatistica/populacao/perfilidoso/

4. Carvalho DA, Brito AF, Santos MAP, Nogueira FRS, Sá GGM, Oliveira Neto JG, Martins MCC, Santos EP. Prevalência da prática de exercícios físicos em idosos e sua relação com as dificuldades e a falta de aconselhamento profissional específico. Rev bras Ciênc e Mov. 2017;25(1):29-40.

5. Fechine BRA, Trompieri N. O processo de envelhecimento: as principais alterações que acontecem com o idoso com o passar dos anos. Rev Científica Internacional. 2012;20(1):106-194.

6. Hernandes NA, Probst VS, Silva Jr RA, Januário RSB, Pitta F, Teixeira DC. Physical activity in daily life in physically independent elderly participating in community-based exercise program. Braz J Phys Ther. 2013;17(1):57-63. doi: 10.1590/S1413-35552012005000055

7. Agner VFC, Gomes ARS, Paz LP, Correa CL. Identificação do perfil físico-funcional de idosos de uma instituição de longa permanência. Rev Pesq Fisio. 2013;3(2):152-167. doi: 10.17267/2238-2704rpf.v3i2.159

8. Silva JCA, Hazime FA, Campelo GO, Silva LN, Ribeiro MDA, Oliveira SB. Capacidade de manutenção postural em diferentes atividades funcionais de idosos hipertensos e não hipertensos. Rev Bras Promoç Saúde. 2017;30(1):22-29. doi: 10.5020/18061230.2017.p22

9. Nascimento DC, Brito MAC, Santos AD. Depressão em idosos residentes em uma instituição asilar na cidade de Juazeiro do Norte, Ceará, Brasil. J Manag Prim Health Care. 2013;4(3):146-150.

10. Secretaria Municipal de Saúde de Cocal (Piauí – BR). Equipes de saúde do município de Cocal-PI. [acesso em 2018 mar 21]. Disponível em: cocal.pi.gov.br.

11. Howe TE, Rochester L, Neil F, Skelton DA, Ballinger C. Exercise for improving balance in older people. Cochrane Database of Syst Rev. 2011;(11). doi: 10.1002/14651858.CD004963.pub3

12. Daniachi D, Netto AS, Ono NK, Guimarães RP, Polesello GC, Honda EK. Epidemiologia das fraturas do terço proximal do fêmur em pacientes idosos. Rev Bras Ortop. 2015;50(4):371-377. doi: 10.1016/j.rbo.2014.07.014

13. Oliveira PP, Fachin SM, Tozatti J, Ferreira MC, Marinheiro LPF. Análise comparativa do risco de quedas entre pacientes com e sem diabetes mellitus tipo 2. Rev Assoc Med Bras. 2012;58(2):234-239. doi: 10.1590/S0104-42302012000200021

14. Karuka AH, Silva JAMG, Navega MT. Análise da concordância entre instrumentos de avaliação do equilíbrio corporal em idosos. Rev Bras Fisioter. 2011;15(6):460-466. doi: 10.1590/S1413-35552011000600006

15. Silva IA, Amorim JR, Carvalho FT, Mesquita LSA. Efeito de um protocolo de facilitação neuromuscular proprioceptiva (FNP) no equilíbrio postural de idosas. Fisioter Pesqui. 2017;24(1):62-67. doi: 10.1590/1809-2950/16636724012017

16. Neto JP, Raso W, Brito CAF. Mobilidade funcional em função da força muscular em mulheres idosas fisicamente ativas. Rev Bras Med Esporte. 2015;21(5):369-371. doi: 10.1590/1517-869220152105112756

17. Daniel FNR, Vale RGS, Giani TS, Bacellar S, Escobar T, Stoutenberg M, Dantas EHM. Correlation between static balance and functional autonomy in elderly women. Arch Gerontol Geriatr. 2011;52(1):111-114. doi: 10.1016/j.archger.2010.02.011

18. Fairhall N, Sherrington C, Cameron ID, Kurrle SE, Lord SR, Lockwood K, Herbert RD. A multifactorial intervention for frail older people is more than twice as effective among those who are compliant: complier average causal effect analysis of a randomised trial. J Physiother. 2017;63(1):40-44. doi: 10.1016/j.jphys.2016.11.007

19. Alves RLT, Silva CFM, Pimentel LN, Costa IA, Souza ACS, Coelho LAF. Avaliação dos fatores de risco que contribuem para queda em idosos. Rev bras geriatr gerontol. 2017;20(1):59-69. doi: 10.1590/1981-22562017020.160022

20. Lima DA, Cezario VOB. Quedas em idosos e comorbidades clínicas. Revista HUPE. 2014;13(2):30-37. doi: 10.12957/rhupe.2014.10130

21. Moura SRB, Marques Júnior MASS, Oliveira TA, Nascimento LDS, Mesquita GV, Brito JNPO. Fatores associados à queda de idosos que podem resultar em fratura de fêmur. Rev Enferm UFPE. 2016;10(Supl 2):720-6.

22. Gasparotto LPR, Falsarella GR, Coimbra AMV. As quedas no cenário da velhice: conceitos básicos e atualidades da pesquisa em saúde. Rev bras geriatr gerontol, 2014;17(1):201-209. doi: 10.1590/S1809-98232014000100019

23. Mallmann DG, Galindo Neto NM, Sousa JC, Vasconcelos EMR. Educação em saúde como principal alternativa para promover a saúde do idoso. Ciênc Saúde Coletiva. 2015;20(6):1763-1772. doi: 10.1590/1413-81232015206.02382014

24. Verhaak PF, Dekker JH, de Waal MW, van Marwijk HW, Comijs HC. Depression, disability and somatic diseases among elderly. J Affect Disord, 2014;167:187-91. doi: 10.1016/j.jad.2014.05.057