DOI: 10.1590/1413-81232018238.14622016

Factors associated with falls in older adults with cataracts

Leonardo Petrus da Silva Paz [1]
Larissa de Lima Borges [2]
Vera Regina Fernandes da Silva Marães [1]
Marília Miranda Forte Gomes [3]
Maria Márcia Bachion [4]
Ruth Losada de Menezes [5]

Abstract *The aim of the present study was to evaluate factors associated with falls in community-dwelling older adults diagnosed with cataracts. An analytical, cross-sectional study was conducted with a sample of community-dwelling older adults residing in the Federal District of Brazil. Interviews and assessment tools were administered, such as the Timed Up and Go test, Short Physical Performance Battery (SPPB), Biodex Balance System, Katz Index, Lawton Scale, Minnesota Leisure Time Physical Activity Questionnaire and Mini Mental State Examination. Statistical analysis involved binary logistic regression. One hundred forty-two older adults (85 with cataracts) participated in the study (mean age: 69.39 ± 5.67 years). Falls were associated with the female sex (OR: 4.45) and sub-maximum score on the SPPB (OR: 3.53) among patients with cataracts, whereas multimorbidity (OR: 5.10) was the risk factor risk for older adults without cataracts. The data suggest different risk factors for falls among older adults diagnosed with cataracts.*

Key words *Accidental falls, Cataract, Aged, Postural balance, Physical fitness*

[1] Faculdade de Ceilândia, Universidade de Brasília (UnB). Universidade de Brasília,. QNN14 AE CEI-Sul, Guariroba. 72220-140 Brasília DF Brasil. leopetruspaz@gmail.com
[2] Secretaria do Estado de Saúde do Distrito Federal. Brasília DF Brasil.
[3] Programa de Pós-Graduação em Engenharia Biomédica, UnB. Brasília DF Brasil.
[4] Faculdade de Enfermagem, Universidade Federal de Goiás. Goiânia GO Brasil.
[5] Programa de Pós-Graduação em Ciências e Tecnologias em Saúde, UnB. Brasília DF Brasil.

Introduction

Cataract is the most common cause of blindness and one of the most prevalent degenerative diseases among older adults[1]. It is estimated that among the 20 million people affected by severe visual impairment throughout the world, one third of the cases is the result of cataract[2]. According to data from the 2013 Brazilian National Health Survey, cataract affects 28.7% of the older population in the country[3].

Cataract can exert a negative impact on postural balance, mobility and functional capacity and is related to the fear of falls, a greater number of morbidities, depressed mood and cognitive decline[4,5]. As postural balance depends on the proper integration of vestibular, proprioceptive and visual information, any impairment in one of these sensory systems can lead to deficiencies in the postural adjustments needed to maintain one's balance[6,7].

Older adults with cataracts have blurred vision, which results in a reduction in visual acuity as well as reduced sensitivity to contrast and the perception of colors[1]. When combined with poor lighting, cataracts favor the occurrence of tripping and slips on irregular surfaces on the ground of the environment (e.g., puddles, carpet edges, doorjambs, etc.)[8]. Indeed, studies report an association between visual impairment and falls in older adults[8,9].

There is a consensus in the literature regarding the significant improvement in visual acuity following cataract surgery[10,11]. However, the effect of surgery on the risk of falls is inconclusive[10]; there are reports of both a reduction[12] and an increase in such risk[11]. Other factors, such as lifestyle, the use of medication, multimorbidity and level of physical activity, can affect the risk of falls among older adults with cataracts, even after recovering their vision[11].

Besides visual impairment, other intrinsic and extrinsic factors may be related to the risk of falls among community-dwelling older adults, such as urinary incontinence, depression, fear of falls, balance abnormalities, cognitive deficiency, polypharmacy and functional limitations[13]. The literature offers numerous studies addressing the multidimensional aspects of the risk of falls in older adults living in the community[14,15] and those in nursing homes[16,17]. However, few researchers have addressed groups with specific problems, such as older adults with cataracts. Therefore, investigations are needed to examine the relationship between visual impairment and falls, as many studies do not take into consideration the influence of multiple confounding factors that may be associated with this outcome[18].

This investigation was based on the hypothesis that older adults with cataracts have different risk factors for falls than those without cataracts. Thus, the aim of the present study was to evaluate factors associated with falls in community-dwelling older adults with cataracts.

Methods

An observational, analytical, cross-sectional study was conducted in the Federal District of Brazil. Community-dwelling older adults were recruited through active searches at healthy ageing programs in the city of Ceilândia and ophthalmology services at two public hospitals in the Federal District.

Male and female older adults aged 60 years or older with a medical diagnosis of bilateral cataract confirmed using standardized methods[1] were included in the study. The exclusion criteria were a clinical diagnosis of neurological disease or uncorrected visual impairment and a score on the Mini Mental Health Examination suggestive of cognitive impairment (cutoff point adjusted for schooling)[19]. Older adults with paralysis or orthopedic abnormalities or the inability of remain in a standing position and walk without assistance were also excluded.

This study was conducted between December 2011 and December 2012 in compliance with recommendations for research involving human beings and received approval from the Ethics Committee of the School of Education and Research in Health Sciences, Brasília, DF, Brazil (certificate number: 0153/11). The present study is part of a larger investigation denominated: "Impact of cataract surgery on the occurrence of falls and multidimensional aspects of health: A longitudinal study involving older adults in the Federal District of Brazil".

The outcome variable (falls) was defined as an unexpected event in which an individual falls to the ground or a lower level[20]. This outcome was based on self-reports from the participants using the previous 12 months as the reference.

The other variables and respective assessment methods are listed below:

- Socio-demographic variables: age, sex, marital status, reading skill, schooling, health conditions (diagnosis of cataract, having undergone cataract surgery, comorbidities, depression,

number of medications and use of psychotropic agents) and lifestyle (smoking, physical activity and alcohol intake). Multimorbidity was defined as the occurrence of five or more chronic-degenerative diseases (diabetes, arterial hypertension, kidney disease, cardiovascular disease, depression, osteoporosis, etc.). These data were collected with the aid of a structured questionnaire;

- Level of physical activity was determined using the Brazilian version of the Minnesota Leisure Time Physical Activity Questionnaire[21]. The classification as active or inactive was based on the criteria recommended by the American College of Sports Medicine: at least 150 minutes per week of moderate physical activity (3 METs) or 75 minutes of vigorous or sports activity (6 METs)[22,23];

- Physical-functional performance was evaluated at the Movement Analysis Lab of the university using the Brazilian version of the Short Physical Performance Battery (SPPB)[24] to evaluate lower limb strength, balance, gait speed and the risk of falls and the Timed Up and Go (TUG) test[25] for the evaluation of balance, functional gait capacity and the risk of falls. Cutoff points were determined using ROC analysis (not presented in this study) for the risk of falls based on the SPPB (ordinal) and TUG (numeric), which were considered binary variables. The risk of falls was also evaluated using a force plate: Biodex Balance System (BBS)[26];

- Functional independence was measured using the Brazilian version of the Katz Index of Independence in Activities of Daily Living and the Lawton Instrumental Activities of Daily Living Scale[27,28], which have been validated for the Portuguese language.

To evaluate associations between the outcome (falls) and the variables of interest in the older adults with and without cataract, binary logistic regression analysis was conducted using the SPSS program, version 20, to determine odds ratios (OR). The variables determined to be possible risk or protection factors regarding the occurrence of falls were incorporated in the model one by one (univariate regression analysis with "insert" method). Variables with a p-value < 0.20 were incorporated in blocks of variables grouped based on socio-demographic characteristics, health conditions, physical-functional performance and lifestyle to obtain a more representative model. Multivariate analysis was then performed based on the division of the sample into individuals with and without a diagnosis of cataract (models A and B, respectively). All models were adjusted for age. The "at least ten events" rule (successes or failures) was obeyed for each independent variable in the model. Differences between groups were evaluated using the Mann-Whitney test and chi-squared test (categorical variables).

Results

One hundred seventy-six older adults were invited to participate in the study, 144 of whom appeared for the evaluations. Two were excluded (one for not being able to see the target on the screen of the BBS and another was unable to report whether or not a fall had occurred in the previous year). Thus, 142 older adults participated in the study. Table 1 displays the characteristics of the sample stratified for the presence/absence of cataract. No statistically significant differences were found between the two groups regarding the variables investigated, except visual acuity and the risk of falls determined using the TUG test with a cutoff point of 7.67 seconds.

The prevalence of falls in the previous 12 months was 40%. The prevalence of the practice of physical activity at the recommended level was high in the overall sample. Sub-maximum scores were found regarding the evaluations of physical-functional performance and independence on basic and instrumental activities of daily living. A tendency toward a greater prevalence rate of falls among the individuals without a diagnosis of cataract was found, but the difference between groups did not achieve statistical significance.

Table 2 displays the results of the univariate analysis considering the groups with and without cataract and the results of the analysis of differences between groups regarding the separate variables. Variables individually associated with falls are highlighted with one ($p < 0.05$) or two ($p < 0.20$) asterisks in each group. The cutoff points for the TUG test and SBBP were 7.67 seconds and 11 points, respectively. Multivariate regression models A and B represent the risk of falls in the groups with and without cataract, respectively, and were adjusted for both age (75 years or older) and sex. The female sex had fourfold greater odds of having suffered a fall than the male sex. Individuals with cataracts who had a score lower than 11 points on the SPPB had 3.5-fold greater odds of having suffered a fall than those with a higher score. Multimorbidity was associated with falls in the group without a diagnosis of cataract (Table 3).

Table 1. Characteristics of sample composed of community-dwelling older adults, Federal District, Brazil, 2015.

Variable	With cataract (n = 85)			Without cataract (n = 57)			
	n	%	Mean (± SD)	n	%	Mean (± SD)	p
Falls							
No	52	61.18%		24	42.11%		0.70
Yes	33	38.82%		33	57.80%		
Age							
< 75 years	67	78.82%		51	89.47%		0.97
> 75 years	18	21.18%		6	10.53%		
Sex							
Male	31	36.47%		20	35.09%		0.86
Female	54	63.53%		37	64.91%		
Marital status							
Married or lives with partner	47	55.29%		29	50.88%		0.93
Single	8	9.41%		6	10.53%		
Divorced or separated	8	9.41%		7	12.28%		
Widowed	22	25.88%		15	26.32%		
Absence of spouse							
No	47	55.29%		29	50.88%		0.60
Yes	38	44.71%		28	49.12%		
Reading and writing skills							
No	23	27.06%		10	17.54%		
Yes	62	72.94%		47	82.46%		0.19
Multimorbidity							
No	66	77.65%		43	75.44%		
Yes	19	22.35%		14	24.56%		0.378
Use of psychotropic agent							
No	66	88.00%		38	88.37%		0.95
Yes	9	12.00%		5	11.63%		
Polypharmacy (3 or more)							
No	31	36%		40	47%		0.28
Yes	24	28%		45	53%		
Deficient visual acuity							
No	53	62.40%		50	87.70%		**0.01**
Yes	32	37.60%		7	12.30%		
Katz index			0.47 (± 0.52)			0.32 (± 0.46)	0.19
Lawton scale			24.20 (± 3.29			25.26 (± 2.83)	0.60
Mini Mental State Examination			24.33 (± 3.36)			24.84 (± 3.28)	0.5
Frailty status							
Non-frail	32	37.65%		14	24.56%		0.26
Pre-frail	52	61.18%		42	73.68%		
Frail	1	1.18%		1	1.75%		

it continues

Discussion

In this study, factors associated with falls in community-dwelling older adults with a diagnosis of cataract were investigated and compared to factors found for older adults without cataracts. The female sex and a score of less than 11 points on the SPPB were associated with falls in the group with cataract, whereas having five or more chronic diseases was associated with a greater chance of falls in the group without cataract.

Few analytical studies involving older adults with cataract have been conducted in Brazil. Previous investigations report associations between

Ciência & Saúde Coletiva, 23(8):2503-2514, 2018

Table 1. Characteristics of sample composed of community-dwelling older adults, Federal District, Brazil, 2015.

Variable	With cataract (n = 85)			Without cataract (n = 57)			
	n	%	Mean (± SD)	n	%	Mean (± SD)	p
Level of physical activity							
Active	45	52.90%		31	54.40%		0.20
Non-active	40	47.10%		26	45.60%		
Risk of falls (BBS)							
Low risk	62	72.94%		44	77.20%		0.57
High risk	23	27.06%		13	22.80%		
TUG – cutoff: 7.67 seconds							
Low risk (< 7.67 seconds)	44	51.80%		39	68.40%		**0.04**
High risk	41	48.20%		18	31.60%		
SPPB – cutoff: 11 points							
Low risk (< 11 points)	39	45.90%		35	61.40%		0.07
High risk	46	54.10%		22	38.60%		

Legend: BBS= Biodex Balance System; TUG= Timed Up and Go; SPPB= Short Physical Performance Battery; * Mann-Whitney test.

cataract and postural balance, fear of falls and quality of life[29,30]. However, the studies cited did not address other dimensions of the phenomenon (falls) in the population and were limited to the description of socio-demographic characteristics[31,32]. Likewise, few multidimensional studies are found in the international literature addressing the relationship between visual impairment and falls[18].

Visual impairment can cause difficulties in detecting obstacles with little contrast, judging distances, perceiving spatial relationships and processing all visual information necessary to perform adjustments in order to maintain postural control and adequate mobility, thereby hindering the adaptation to the environmental demands required for the execution of activities of daily living[9,7]. The impact of visual impairment on falls may be greater when accompanied by other sensory and balance deficiencies[33].

An impaired performance on visual tests is related to a worse performance on physical-functional tests.[34] Older adults with cataracts and a self-reported fear of falls are less confident regarding their ability to maintain their balance and avoid falls and may therefore limit their functional activities due to the fear of falling[30]. There is a gap in knowledge regarding the effects of visual impairment on the level of physical activity among older adults. Cataract surgery is known to improve visual acuity[10], but there is no certainty regarding a subsequent reduction in the risk of falls[10-12].

Cataract is considered an independent risk factor for falls[9] and can determine more accentuated impairment with regard to balance and mobility in comparison to older adults without cataract[5]. Thus, one would expect a poorer performance on balance tests and, consequently, a greater prevalence rate of falls in individuals with cataract. However, this did not occur in the present study, as no statistically significant difference was found between groups regarding the prevalence of falls. In fact, there was a tendency toward a greater prevalence rate of falls in the group without cataract, whereas those with cataract had a worse performance on the physical-functional tests. The prevalence of falls among older adults without cataract may be associated with the occurrence of multimorbidity, as having five or more comorbidities increased the odds of falling fivefold in this group. Multimorbidity may be associated with falls[35] and frailty, which can increase the risk of unfavorable outcomes over time, such as falls, hospitalizations and fractures[36].

Despite this apparent difference in the prevalence of falls between the groups studied, no significant differences were found between the individuals with and without cataract for any of the variables investigated, except visual acuity and performance on the TUG test. A previous case-control study conducted in Malaysia involving older adults who had suffered hip fracture found no differences between the cases with cataract and those without cataract (controls) with regard to the pre-morbid state, degree of inde-

Table 2. Univariate logistic regression of variables as potential risk or protection factors regarding falls, Federal District, Brazil, 2015.

Variable	Meaning	With cataract (n = 85)		Without cataract (n = 57)	
		p-value	OR	p-value	OR
Age 75 years or older	No				
	Yes	0.58	1.34	0.68	1.40
Sex	Male				
	Female	**0.02***	5.60	0.74	0.83
Absence of spouse	No				
	Yes	**0.02***	2.90	0.51	1.42
Diagnosis of cataract	No				
	Yes				
Uses psychotropic	No				
	Yes	0.08**	3.73	0.17**	4.94
Polypharmacy (3 or more)	No				
	Yes	0.05*	2.52	0.79	0.87
Multimorbidity	No				
	Yes	0.39	1.58	0.06**	3.36
Katz index	Independence on ADL	**0.02***	4.14	0.74	0.82
Lawton scale	Independence on IADL	0.06**	0.87	0.32	1.15
Risk of falls (BBS)	Low risk of falls	0.34	0.60	0.73	1.24
	High risk of falls	**0.04***	3.73	0.23	0.72
TUG	Time in seconds	0.40	1.07	0.53	1.14
Risk of falls (cutoff on TUG: 7.67 seconds)	Low risk of falls				
	High risk of falls	0.17**	1.85	0.41	1.60
SPPB (cutoff: 11 points)	Low risk of falls				
	High risk of falls	**0.02***	4.16	0.88	0.92
Level of physical activity	Active				
	Non-active	0.09**	2.11	**0.05***	3.12

Legend: OR* = adjusted odds ratio; ADL = activities of daily living; IADL = instrumental activities of daily living; BBS = Biodex Balance System; TUG= Timed Up and Go; SPPB= Short Physical Performance Battery. * significant difference ≤ 0.05; ** significant difference ≤ 0.20.

pendence for mobility, the use of gait-assistance devices or living alone[37]. On the other hand, older adults in Scotland with visual impairment at primary care services exhibited more comorbidities in comparison to those without this type of impairment[38]. The differences between studies may be related to the recruitment setting, as the sample was recruited from a hospital setting in the first study and primary care in the second.

An interesting finding of the present investigation was the high prevalence of falls in community-dwelling older adults with high levels of functioning, as demonstrated by the high levels of physical activity and sub-maximum scores for physical-functional performance and independence in terms of basic and instrumental activities of daily living.

A poor performance on a balance test, such as the TUG test, is associated with a history of falls[39]. Therefore, this test has been used to screen for older adults at risk of suffering a fall, although there is no consensus on the ideal cutoff point for the identification of this population[40]. Indeed, the use of the TUG test has been questioned with regard to its predictive capacity for falls among older adults[41]. Since older adults with higher levels of physical activity obtain better scores on postural balance tests[42], there may be a ceiling effect for scores on balance tests[40,43].

The participants in the present investigation had high scores on the physical-functional performance tests (TUG, SPPB and BBS). It should be stressed that the adequacy of cutoff points on balance tests for the profile of the population

Table 3. Regression models representing falls and associated factors among older adults with and without cataract, Federal District, Brazil, 2015.

Model	With cataract	Variable	B	Standard error	Wald	p	OR
		Age 75 years or older	0.76	1.06	0.52	0.47	2.15
		Sex	-0.35	0.79	0.2	0.66	0.71
A	No	Multimorbidity (5 or more)	1.63	0.81	4.08	**0.04***	5.1
		Psychotropic agent	1.61	1.23	1.71	0.19	5.01
		Constant	-0.46	0.74	0.39	0.54	0.63
		Age 75 years or older	0.24	0.7	0.12	0.73	1.28
		Sex	1.49	0.65	5.22	**0.02***	4.45
		Absence of spouse	0.62	0.53	1.36	0.24	1.85
B	Yes	Polypharmacy (3 or more)	0.85	0.54	2.47	0.12	2.34
		Physical performance (< 11 on SPPB)	1.26	0.6	4.48	**0.03***	3.53
		Recommended level of physical activity	-0.08	0.58	0.02	0.89	0.92
		Constant	-3.04	0.73	17.13	0.01	0.05

Legend: OR* = adjusted odds ratio; SPPB = Short Physical Performance Battery. * significant difference ≤ 0.05.

studied is fundamental. However, even with the establishment of adequate cutoff points on the physical-functional tests to improve sensitivity and specificity[42], the measures for the evaluation of postural balance (TUG and BBS) were not associated with falls in the groups investigated in the present study. Moreover, the physical-functional tests employed do not include an evaluation of the sensory components of postural balance[43].

Taken together, the present findings and those described in the literature suggest that a higher score on physical-functional tests does not necessarily imply an absence of a risk of falls. Individuals with high levels of functioning and no postural balance deficiencies continue to perform their habitual activities and could expose themselves to situations of risk[44]. Therefore, the high prevalence of physical activity among the individuals may explain the high prevalence of falls in the present sample, as 41% reported practicing physical activity at the recommended levels[19] and this percentage was even higher (52%) among the individuals with cataract. These figures are higher than the rate described in the 2013 National Health Survey, in which the proportion of older adults who practiced physical activity at the recommended level in Brazil was 13.6%[45].

Although practicing physical activity can reduce the risk of falls[46], practicing such activity in an outdoor environment may expose older adults to environmental barriers[47]. Moreover, Okubo *et al*. (2015) found that the habit of walking did not increase the risk of falls among older adults with a low risk of falls, but was strongly associated with this outcome among those with two or more risk factors for falls[48].

In the present study, the regression models revealed different risk factors for falls between older adults with and without cataract. In the group with cataract, the female sex and a poorer physical performance remained in the final model as factors associated with falls.

Women with cataracts were fivefold more likely to fall than men with cataracts. This may have occurred because women undergo sensory, motor and cognitive decline earlier than men[49] and are closer to the limit at which reduced muscle power could compromise their functional status[50]. Another factor to consider is the greater use of healthcare services by older women, including medical appointments, which increases the chances of a greater number of diagnoses of cataracts[51]. Women also have greater longevity and a consequent accumulation of age-related disease and also seek cataract surgery more[52]. Similar differences between women and men regarding the functional impact of cataract have been reported[53]. In general, women have more fear of falling than men and this fear is believed to play a protective role against falls[54]. The divergence between men and women may be linked to cultural

factors, as women (even those who have suffered falls) continue playing their social roles, exercising activities in the home environment[52].

In the group with cataract, a score of less than 11 points on the SPPB was considered a risk factor for falls. Balance is affected more when visual impairment is greater. Therefore, these factors tend to result in a greater incidence of falls, as reported in two previous studies involving the use of the Berg balance scale[4,55]. In the present investigation, the SPPB was the only measure of physical-functional performance associated with falls in individuals with cataract, perhaps because of its broader scope, as this battery involves muscle strength, balance and gait speed tests. Therefore, among the measures employed, the SPPB is suggested to be the most adequate for the evaluation of older adults with different levels of functioning, as it can differentiate active individuals from sedentary individuals[56] and detect differences in performance between frail and non-frail individuals[57]. In a population-based study, a statistically significant difference on the SPPB was found between recurring fallers and non-recurring fallers[58].

The present findings and the lack of evidence favoring cataract correction surgery as the only strategy for reducing the risk of falls[59,60] underscore the importance of multidisciplinary follow up of older adults with a diagnosis of cataract to orientate these individuals and implement interventions directed at modifiable risk factors, as multidimensional strategies are effective at reducing the risk and occurrence of falls[59]. Indeed, a multidisciplinary evaluation of falls is fundamental. Certain adverse health conditions can affect one's postural control, such as those that impair the vision (e.g., cataract) or cause sensory deficiencies, as occurs in diabetes mellitus[61], thereby increasing the risk of falls. In the context of a multidimensional evaluation, it is also important to note that variables related to the use of medications were factors associated with falls in both groups in the present sample, although not achieving statistical significance.

The limitations of the present study regard the cross-sectional design and the impossibility of performing probabilistic sampling. The strengths of this study reside in the stratified analyses to determine the existence of confounding factors and the choice of regression models based on adherence statistics of the models to the data.

The present results suggest that older adults with high levels of functioning may achieve sub-maximum scores on balance tests and still have a high prevalence rate of falls. These findings can contribute to the develop of new ideas regarding the evaluation of active community-dwelling older adults, including the use of multidimensional measures for screening in primary care services[62]. Simple measures in primary care, such as the distribution of glasses and screening with visual acuity tests in the community, could assist in the management of individuals with cataracts[63]. It is also necessary to provide education and training for health professionals that include the promotion of functional health for older adults in their integrality, breaking away from the fragmentation of work by professionals in the field[64].

Conclusion

The present data suggest that sex and physical performance exert an influence on the risk of falls among community-dwelling older adults with cataract, whereas multimorbidity was associated with falls among those without cataract.

Physical performance tests, including tests addressing postural balance, should not be used as the only means for the identification of older adults at risk for falls, even when the cutoff points are adjusted.

Longitudinal studies are needed to confirm these findings and contribute to the development of multidisciplinary strategies for the evaluation of the risk of falls among community-dwelling older adults with a diagnosis of cataract.

Collaborations

LL Borges, LPS Paz and RL Menezes performed the field work and the latter author served as the adviser of the study. LPS Paz, LL Borges, VRFS Marães, MMF Gomes, MM Bachion and RL Menezes participated in the final draft of the manuscript.

Acknowledgments

To CNPq for the financing.

References

1. Thompson J, Lakhani N. Cataracts. *Prim Care Clin Off Pract* 2015; 42(3):409-423.
2. Brian G, Taylor H. Cataract blindness--challenges for the 21st century. *Bull World Health Organ* 2001; 79(3):249-256.
3. Instituto Brasileiro de Geografia e Estatística (IBGE), Barbosa N, Menezes AP, Carlos A, Nardi F. Pesquisa Nacional De Saude 2013 - Ciclos De Vida. Rio de Janeiro: IBGE; 2013.
4. Aartolahti E, Häkkinen A, Lönnroos E, Kautiainen H, Sulkava R, Hartikainen S. Relationship between functional vision and balance and mobility performance in community-dwelling older adults. *Aging Clin Exp Res* 2013; 25(5):545-552.
5. Borges LDL, Santos FPV, Pagotto V, Menezes RL. Functional disability in community-dwelling elderly: the role of cataracts and contextual factors. *Fisioter em Mov* 2014; 27(2):189-200.
6. Pasma JH, Engelhart D, Maier AB, Schouten AC, van der Kooij H, Meskers CGM. Changes in sensory reweighting of proprioceptive information during standing balance with age and disease. *J Neurophysiol* 2015; 114(6):3220-3233.
7. Horak FB. Postural orientation and equilibrium: What do we need to know about neural control of balance to prevent falls? *Age Ageing* 2006; 35(Supl. 2):7-11.
8. Reed-Jones RJ, Solis GR, Lawson K, Loya AM, Cude-Islas D, Berger CS. Vision and falls: A multidisciplinary review of the contributions of visual impairment to falls among older adults. *Maturitas* 2013; 75(1):22-28.
9. Lord SR, Smith ST, Menant JC. Vision and falls in older people: Risk factors and intervention strategies. *Clin Geriatr Med* 2010; 26(4):569-581.
10. Desapriya E, Subzwari S, Scime-Beltrano G, Samayawardhena L, Pike I. Vision improvement and reduction in falls after expedited cataract surgery. Systematic review and metaanalysis. *J Cataract Refract Surg* 2010; 36(1):13-19.
11. Meuleners LB, Lee AH, Ng JQ, Morlet N, Fraser ML. First Eye Cataract Surgery and Hospitalization from Injuries Due to a Fall: A Population-Based Study. *J Am Geriatr Soc* 2012; 60(9):1730-1733.
12. Gillespie LD, Robertson MC, Gillespie WJ, Sherrington C, Gates S, Clemson LM, Lamb SE. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev* 2012; (9):CD007146.
13. Frith J, Davison J. Falls. *Rev Clin Gerontol* 2013; 23(02):101-117.
14. Rodrigues IG, Fraga GP, Barros MBDA. Falls among the elderly: risk factors in a population-based study. *Rev Bras Epidemiol* 2014; 17(3):705-718.
15. Deandrea S, Bravi F, Turati F, Lucenteforte E, La Vecchia C, Negri E. Risk factors for falls in older people in nursing homes and hospitals. A systematic review and meta-analysis. *Arch Gerontol Geriatr* 2013; 56(3):407-415.
16. Menezes RL, Bachion MM. Estudo da presença de fatores de riscos intrínsecos para quedas, em idosos institucionalizados. *Cien Saude Colet* 2008; 13(4):1209-1218.
17. Menezes RL, Bachion MM, Souza JT, Nakatani AYK. Estudo longitudinal dos aspectos multidimensionais da saúde de idosos institucionalizados. *Rev Bras Geriatr Gerontol* 2011; 14(3):485-496.
18. Salonen L, Kivel SL. Eye diseases and impaired vision as possible risk factors for recurrent falls in the aged: A systematic review. *Curr Gerontol Geriatr Res* 2012; 2012:1-10.
19. Brucki SMD, Nitrin R, Caramelli P, Bertolucci PHF, Okamoto IH. Sugestões para o uso do mini-exame do estado mental no Brasil. *Arq Neuropsiquiatr* 2003; 61(3 B):777-781.
20. Lamb SE, Jørstad-Stein EC, Hauer K, Becker C. Development of a common outcome data set for fall injury prevention trials: The Prevention of Falls Network Europe consensus. *J Am Geriatr Soc* 2005; 53(9):1618-1622.
21. Lustosa LP, Pereira DS, Dias RC, Britto R, Parentoni A, Pereira L. Tradução e adaptação transcultural do Minnesota Leisure Time Activities Questionnaire em idosos. *Geriatr Gerontol* 2011; 5(2):57-65.
22. Costa TB, Neri AL. Medidas de atividade física e fragilidade em idosos: dados do FIBRA Campinas, São Paulo, Brasil. *Cad Saude Publica* 2011; 27(8):1537-1550.
23. Nelson ME, Rejeski WJ, Blair SN, Duncan PW, Judge JO, King AC, Macera CA, Castaneda-Sceppa C; American College of Sports Medicine; American Heart Association. Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation* 2007; 116(9):1094-1105.
24. Nakano MM. *Versão brasileira da short physical performance battery – sppb: adaptação cultural e estudo da confiabilidade* [dissertação]. Campinas: Unicamp; 2007.
25. Podsiladlo SR. Timed Get Up and Go Test. *J Am Geriactrics Soc* 1991; 29(2):2006.
26. Parraca J, Olivares PR, Carbonell-Baeza A, Aparicio V, Adsuar JC, Gusi N. Test-retest reliability of biodex balance SD on physically active old people. *J Hum Sport Exerc* 2011; 6(2):444-451.
27. Lino VTS, Pereira SRM, Camacho LAB, Ribeiro Filho ST, Buksman S. Cross-cultural adaptation of the Independence in Activities of Daily Living Index (Katz Index). *Cad Saude Publica* 2008; 24(1):103-112.
28. Santos RL, Virtuoso Júnior JS. Confiabilidade da versão brasileira da Escala de Atividades Instrumentais da Vida Diária. *Rev Bras Promoção da Saúde* 2008; 21(1):290-296.
29. Macedo BG, Pereira LSM, Rocha FL, Castro ANBV. Association between funcional vision, balance and fear of falling in older adults with cataracts. *Rev Bras Geriatr e Gerontol* 2012; 15(2):265-274.
30. Macedo BG, Pereira LSM, Rocha FL, Castro ANBV. Medo de cair e qualidade de vida em idosos com catarata. *Rev Bras Geriatr e Gerontol* 2013; 16(3):569-577.
31. Carlos GA, Schellini SA, Espindola RF, Lana FP, Rodrigues AC, Padovani CR. Cataract prevalence in Central-West region of Sao Paulo State, Brazil. *Arq Bras Oftalmol* 2009; 72(3):375-379.
32. Silva LMP, Muccioli C, Belfort Júnior R. Perfil socioeconômico e satisfação dos pacientes atendidos no mutirão de catarata do Instituto da Visão - UNIFESP. *Arq Bras Oftalmol* 2004; 67(5):737-744.

33. Kulmala J, Viljanen A, Sipilä S, Pajala S, Pärssinen O, Kauppinen M, Koskenvuo M, Kaprio J, Rantanen T. Poor vision accompanied with other sensory impairments as a predictor of falls in older women. *Age Ageing* 2009; 38(2):162-167.
34. West CG, Gildengorin G, Haegerstrom-Portnoy G, Schneck ME, Lott L, Brabyn J. Is vision function related to physical functional ability in older adults? *J Am Geriatr Soc* 2002; 50(1):136-145.
35. Deandrea S, Lucenteforte E, Bravi F, Foschi R, La Vecchia C, Negri E. Risk Factors for Falls in Community-dwelling Older People. *Epidemiology* 2010; 21(5):658-668.
36. Bauer JM, Sieber CC. Sarcopenia and frailty: A clinician's controversial point of view. *Exp Gerontol* 2008; 43(7):674-678.
37. Chew FLM, Yong CK, Mas Ayu S, Tajunisah I. The association between various visual function tests and low fragility hip fractures among the elderly: A Malaysian experience. *Age Ageing* 2010; 39(2):239-245.
38. Court H, McLean G, Guthrie B, Mercer SW, Smith DJ. Visual impairment is associated with physical and mental comorbidities in older adults: a cross-sectional study. *BMC Med* 2014; 12(1):181.
39. Beauchet O, Fantino B, Allali G, Muir SW, Montero-Odasso M, Annweiler C. Timed up and go test and risk of falls in older adults : a systematic review. *J Nutr Heal Aging* 2011; 15(10):6-11.
40. Schoene D, Wu SM, Mikolaizak AS, Menant JC, Smith ST, Delbaere K, Lord SR. Discriminative ability and predictive validity of the timed up and go test in identifying older people who fall: Systematic review and meta-analysis. *J Am Geriatr Soc* 2013; 61(2):202-208.
41. Barry E, Galvin R, Keogh C, Horgan F, Fahey T. Is the Timed Up and Go test a useful predictor of risk of falls in community dwelling older adults: a systematic review and meta- analysis. *BMC Geriatrics* 2014; 14(1):14.
42. Pau M, Leban B, Collu G, Migliaccio GM. Effect of light and vigorous physical activity on balance and gait of older adults. *Arch Gerontol Geriatr* 2014; 59(3):568-573.
43. Hernandez D, Rose DJ. Predicting Which Older Adults Will or Will Not Fall Using the Fullerton Advanced Balance Scale. *Arch Phys Med Rehabil* 2008; 89(12):2309-2315.
44. Muir SW, Berg K, Chesworth B, Klar N, Speechley M. Balance impairment as a risk factor for falls in community-dwelling older adults who are high functioning: a prospective study. *Phys Ther* 2010; 90(3):338-347.
45. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa Nacional de Saúde - 2013: percepção do estado de saude, estilos de vida e doenças crônicas - Brasil, Grandes Regiões e Unidades da Federação*. Rio de Janeiro: IBGE; 2014.
46. Thibaud M, Bloch F, Tournoux-Facon C, Brèque C, Rigaud AS, Dugué B, Kemoun G. Impact of physical activity and sedentary behaviour on fall risks in older people: A systematic review and meta-analysis of observational studies. *Eur Rev Aging Phys Act* 2012; 9(1):5-15.
47. Oliveira AS, Trevizan PF, Bestetti MLT, Melo RC. Fatores ambientais e risco de quedas em idosos: revisão sistemática. *Rev Bras Geriatr e Gerontol* 2014; 17(3):637-645.
48. Okubo Y, Seino S, Yabushita N, Osuka Y, Jung S, Nemoto M, et al. Longitudinal association between habitual walking and fall occurrences among community-dwelling older adults: Analyzing the different risks of falling. *Arch Gerontol Geriatr* 2015; 60(1):45-51.
49. Chang VC, Do MT. Risk Factors for Falls Among Seniors: Implications of Gender. *Am J Epidemiol* 2015; 181(7):521-531.
50. Foldvari M, Clark M, Laviolette LC, Bernstein MA, Kaliton D, Castaneda C, Pu CT, Hausdorff JM, Fielding RA, Singh MA. Association of Muscle Power With Functional Status in Community-Dwelling Elderly Women. *J Gerontol A Biol Sci Med Sci* 2000; 55(4):M192-M199.
51. Destro JR, Boing AF, D'Orsi E. Factors associated to medical consultations by elderly adults in southern Brazil: a population based study. *Rev Bras Epidemiol* 2014; 17(3):692-704.
52. Olofsson P, Lundstrom M, Stenevi U. Gender and referral to cataract surgery in Sweden. *Acta OphthalmolScand* 2001; 79(1395-3907):350-353.
53. Tobacman JK, Zimmerman B, Lee P, Hilborne L, Kolder H, Brook RH. Visual function impairments in relation to gender, age, and visual acuity in patients who undergo cataract surgery. *Ophthalmology* 1998; 105(9):1745-1750.
54. Pohl P, Ahlgren C, Nordin E, Lundquist A, Lundin-Olsson L. Gender perspective on fear of falling using the classification of functioning as the model. *Disabil Rehabil* 2015; 37(3):214-222.
55. Lee HKM, Scudds RJ. Comparison of balance in older people with and without visual impairment. *Age Ageing* 2003; 32(6):643-649.
56. Morie M, Reid KF, Miciek R, Lajevardi N, Choong K, Krasnoff JB, Storer TW, Fielding RA, Bhasin S, Lebrasseur NK. Habitual physical activity levels are associated with performance in measures of physical function and mobility in older men. *J Am Geriatr Soc* 2010; 58(9):1727-1733.
57. Chang SF, Yang R Sen, Lin TC, Chiu SC, Chen ML, Lee HC. The Discrimination of using the short physical performance battery to screen frailty for Community-Dwelling elderly people. *J Nurs Scholarsh* 2014; 46(3):207-215.
58. Ferriolli E, Perracini MR. Factors associated with falls and recurrent falls in elderly: a population-based study. *Rev Bras Geriatr e Gerontol* 2007; 1(2):49-60.
59. Gillespie LD, Robertson MC, Gillespie WJ, Sherrington C, Gates S, Clemson LM, Lamb SE. Interventions for preventing falls in older people living in the community. *Cochrane database Syst Rev* 2012; 9(9):CD007146.
60. Meuleners LB, Fraser ML, Ng J, Morlet N. The impact of first-and second-eye cataract surgery on injurious falls that require hospitalisation: A whole-population study. *Age Ageing* 2014; 43(3):341-346.
61. Close JCT, Lord SR. Fall assessment in older people. *BMJ* 2011; 343:d5153.

62. Tiedemann A, Lord SR, Sherrington C. The development and validation of a brief performance-based fall risk assessment tool for use in primary care. *J Gerontol A Biol Sci Med Sci* 2010; 65(8):896-903.
63. Araújo Filho A, Salomão SR, Berezovsky A, Cinoto RW, Morales PHA, Santos FR, Belfort Júnior R. Prevalence of visual impairment, blindness, ocular disorders and cataract surgery outcomes in low-income elderly from a metropolitan region of São Paulo--Brazil. *Arq Bras Oftalmol* 2008; 71(2):246-253.
64. Brasil. Ministério da Saúde (BR). *Envelhecimento e saúde da pessoa idosa*. Brasília: MS; 2007.

Article submitted 18/12/2015
Approved 30/08/2016
Final version submitted 02/09/2016