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Can growing old in Brazil involve good health and quality of life?

The global phenomenon of longevity is one of the great achievements of the last century. Yet combined with a reduction in fertility, it has caused a drastic aging in the population of the planet. This process began at different times in different countries, and has evolved to varying degrees. In Brazil, its effects are even greater due to the short space of time in which it has occurred.

The speed of the process raises a number of crucial issues not only for researchers in the area of human aging, but for society as a whole. As if the problems inherent to the demographic phenomenon itself were not enough, in Brazil these changes are taking place in a context of social inequality, poverty and fragile institutions. Furthermore, despite a scarcity of resources, a large portion of young people also require quality public programs. In other words, there are two age groups excluded from the production cycle, each with special needs, requiring skill and creativity from the managers of resources in order to overcome the shortage.

We are a young country whose hair is already turning grey. Every year, 700,000 new elderly persons are incorporated into the population – most with chronic diseases and many with functional limitations. In less than 40 years, we have moved from the mortality profile of a young population to one of the complex and costly diseases typical of old age, characterized by multiple chronic illnesses that last for years, requiring constant care, continuous medication and periodic examinations. These changes bring about a significant increase in costs. We must build new paradigms and methods of planning, management and care.

It is for this reason that the area of aging has become a priority in the training of qualified personnel and the development of research projects and models. Proper care for the multiple demands of the elderly is a social issue of interest to us all, and a problem that forms part of the contemporary issues of the century.

All we professionals in the area of Human Aging are aware of the importance of the above issues, yet we do little to bring about the necessary changes. In this context, we are excited about the role of the Agência Nacional de Saúde Suplementar (the National Supplementary Health Agency) (ANS), which in recent years has sought to change the model of the delivery of health services and the form of remuneration in the sector to alternatives that make the user the center of health strategies.

Starting from the identified need to improve care for elderly persons who have health insurance, a book has been published featuring the participation of experts and scholars of the subject, resulting in a set of reflections, experiences and proposals. The aim of this publication

is to improve the debate and guide us towards providing the best care for this population, linked to the sustainability of the health sector.

The most important thing to remember is that these changes **are possible**. The health care of the elderly can be reoriented and an organization within the industry created to allow better care and improve financial results. And what will it take to achieve this? Simply that all actors in this area see themselves as responsible for the necessary changes and allow themselves to innovate. Innovate in the care they provide, in order to remunerate and evaluate the quality of the sector, always remembering that often innovate means to rescue and simpler forms of care and values, which have become lost to our health care system. We need to start constructing this new way of caring for the elderly. We cannot wait.

RBGG recommends this book, which can be downloaded free of charge by following the instructions below, using the QR Code.

Enjoy the book!

Renato Veras
Director, UnATI/UERJ and RBGG Editor

SUPPLEMENTARY HEALTH AND THE ELDERLY: AN URGENT NEED FOR THE HEALTH OF SOCIETY AND THE SUSTAINABILITY OF THE SECTOR

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The effect of supervised and home based exercises on balance in elderly subjects: a randomized controlled trial to prevent falls

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Abstract

Objective: The aim of the present study was to evaluate the influence of a balance training program on the semi-static balance of elderly persons by comparing a supervised group with individual home-based application. *Method:* A blinded randomized controlled multi-arm trial was conducted. The elderly individuals were randomized into: Supervised Group (SG; n=18); Domiciliary Group (DG; n=20) and Control Group (CG; n=18). The SG and DG participated in twice weekly training sessions for 10 weeks. A posturography evaluation was performed based on velocity, anterior-posterior (AP) and medial-lateral (ML) medial amplitude variables in firm surface with eyes open (FSEO) and closed (FSEC), tandem stance with eyes open (Tandem EO) and closed (Tandem EC), and single-leg stance (SL) situations. Two-way ANOVA and Tukey's post-hoc were used for parametric data, the Friedman and Wilcoxon post-hoc tests were used for intragroup analysis and the Kruskal-Wallis and Mann-Whitney post-hoc tests were used for intergroup analysis. *Results:* In intergroup analysis, the DG group showed improvement in body sway in the Tandem EC (velocity and medial amplitude AP) and single-leg stance (medial amplitude ML) situations. The SG showed a decline in the Tandem EO situation in all the variables. In intergroup analysis, the DG showed improvement in the FSEO position (medial amplitude ML), in the Tandem EC position (medial velocity ML), and the single-leg stance position (medial amplitude AP and ML). The SG showed improvement in the FSEO position (medial amplitude ML) and the single-leg stance position (medial amplitude AP), but showed a decline in the FSEO (variable medial velocity AP) and Tandem EO position (medial amplitude AP). *Conclusion:* The exercises were beneficial for the balance of the elderly individuals, with the DG presenting the best results. REBEC: RBR-3S9M65.

Key words: Physical Therapy Specialty; Elderly; Postural Balance, Exercise.

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INTRODUCTION

Postural control, which is considered good when postural sway is low,[1] is affected by the aging process. Increased postural sway can be verified by an increase in the amplitude of center of pressure (COP) fluctuations.[2]

Several studies have identified the benefits of exercise on the overall health of the elderly,[3-5] notably in the prevention of falls,[6,7] and a lack of postural control may be corrected through exercise-based intervention.[8]

A number of studies have shown that combined training (multifactorial or multiple-factor) has greater benefits in preventing falls than training in isolation.[8] Although some studies in scientific literature have evaluated the effect of balance training in groups[2,9,10] and others have analyzed the effect of home-based balance exercises among the elderly,[6,11] there is little research comparing group and home-based balance training in the same study.[12] No study has been found that predominantly considers balance exercises applied through individual home-based and supervised group training to identify the most effective strategy for the implementation of exercises.

It is therefore important to study the effects of a training program based predominantly on balance exercises, in order to assess whether specific exercise programs to improve balance as a preventative measure have better results in the shortest period of time possible. According to the fall prevention guides of the American Geriatrics Society and the British Geriatrics Society,[13] positive results have been achieved from training periods longer than 12 weeks, with sessions one to three times per week. The present study sought to evaluate whether ten weeks of training was sufficient to improve the balance of this population, when the treatment program prioritizes balance exercises.

In addition to reducing training time, a comparison of the same exercises performed in supervised groups or as individual home-based programs allow a wider range of options to be offered to elderly individuals who have difficulties attending therapy, considering that social factors (such as the encouragement, or the lack of encouragement, of other participants in the group, in other words the social awkwardness of performing a group activity); physical limitations (comorbidities, fear of falling when performing the exercise individually); competing priorities (little time to exercise due to family or work responsibilities); accessibility (lack of access to transport to therapy) and lack of motivation are barriers to adherence to therapy.[14]

The hypothesis of the present study is that ten weeks of predominantly balance based training, either unsupervised at home or in supervised groups, is sufficient to improve the postural control of elderly individuals, in order to offer this population a variety of health promotion options (either in groups in rehabilitation centers or at home alone) in order to improve adherence to fall prevention programs.

The objective of this randomized clinical trial was to evaluate the effect of a training program with predominantly balance exercises on the semi-static balance of the elderly, comparing supervised group and individual domiciliary application techniques.

METHOD

Design and ethical aspects of the study

A randomized controlled multi-armed clinical trial, registered with the Registro Brasileiro de Ensaios Clínicos - REBEC (the Brazilian Registry of Clinical Trials) in November 2011 under No. RBR-3S9M65, was performed. This study followed the recommendations of the Consolidated Standards of Reporting Trials (CONSORT)[15] and was approved by the Research Ethics Committee of the Hospital das Clínicas of the Faculdade de

Medicina de Ribeirão Preto of the Universidade de São Paulo (the Clinical Hospital of the Ribeirão Preto Medical School of the University of São Paulo) (FMRP/USP), under protocol number 5372/2010. All participants in the study signed a free and informed consent form. The study was developed in the city of Ribeirão Preto, São Paulo, Brazil. The survey was conducted between the years 2011 and 2014.

Recruitment/Selection

The elderly persons who participated voluntarily in the study were recruited through leaflets which provided the phone number of the Laboratório de Avaliação e Reabilitação do Equilíbrio - LARE (the Laboratory of the Evaluation and Rehabilitation of Balance), the location of the assessments, and by spoken invitation. After interest had been expressed, the first contact with the elderly person was made by telephone, to identify if he or she met the study eligibility criteria.

The inclusion criteria were: elderly persons aged over 60 years, from the local community, of both genders, who were functionally independent. The participants had to be independently mobile, be normotensive or have blood pressure controlled by drugs. Type 2 diabetes mellitus was permitted, provided that the individuals were capable of detecting the application of at least 10 g on the soles of the feet using Semmes-Weinstein monofilament testing (SORRI®, Bauru, SP, Brazil), according to the criteria adopted by the American Diabetes Association.[16]

The exclusion criteria were: participants with cardiovascular, neurological or musculoskeletal disease (with sequela or an impairment that interfered with semi-static balance); vestibular disorders; postural hypotension; foot deformities; visual disorders or cognitive deficit assessed by the Mini Mental State Examination (MMSE).[17,18] Elderly persons who practiced Tai Chi Chuan or muscle strengthening exercises in the gym were also excluded, as muscle-strengthening also contributes to the improvement of postural control.[8]

To calculate the sample size the anteroposterior (AP) velocity of the COP variable (considered to be the main outcome of the study) was considered, taken as the mean and standard deviation values of a study of elderly persons aged over 60 from the community of San Carlos, Sao Paulo,[19], taking into account a minimum alteration of 0.17 cm/s in AP velocity (corresponding to 30% of the post-training improvement), resulting in a sample size=12 (per group), power=0.8, error α=0.05.

Studies have suggested that average velocity is one of the most consistent and responsive postural control measures.[20,21] The primary outcome was assessed at two time points (baseline and post-training) along with the other Posturography variables - mediolateral (ML) velocity and mean AP and ML amplitude, which are considered as secondary outcomes in this study.

Randomization

Randomization was performed by a researcher who was not involved in recruitment or data collection and so had no direct contact with the research participants.

After the initial evaluation, simple randomization was performed using opaque envelopes from which three groups of options were randomly selected: the Supervised Group (SG), the Domiciliary Group (DG) and the Control Group (CG). The participants were not blinded. The evaluator performed two evaluations (baseline and after 10 weeks) and only after revaluations did the researcher responsible for randomization inform the evaluator about the groups to which the elderly persons had been allocated, so that data analysis could be carried out.

Evaluation

Data collection in the present study was performed by blinded examiners (physiotherapists), who were trained for one year in order to learn how to use the assessment instruments.

All samples were collected from the LARE of the Department of Biomechanics, Medicine and Rehabilitation of the Locomotive System of FMRP/USP. Participants began by visiting the LARE to measure body mass and height.

Data regarding education, number of comorbidities and medications used were obtained through questionnaires structured by the authors, which included questions about demographic and socio-educational data. The level of physical activity and routine activities at home (10 questions) were obtained by the Baecke questionnaire modified for the elderly.[22] This questionnaire was used as an exclusion criterion for patients who performed physical activities (gym or Tai Chi Chuan), and was also used during the revaluation process in order to identify whether an elderly person had altered their routine activities or the practice of sports during the study.

The MMSE was applied considering an educational level of 1 to 4 years, with the cutoff level set at 25 points.[17,18]

Semi-static balance was evaluated using a force platform in two phases: initial and post-training. A follow-up was not carried out. Five different conditions were adopted: standing on a fixed platform with eyes open (FPEO) and closed (FPEC); barefoot and with feet spread to the width of the shoulders and with arms alongside the body (bipedal positions); in a tandem position with the right leg in front of the left with eyes open (Tandem EO) and closed (Tandem EC) and on one leg only (Unipedal) with eyes open.

Participants were instructed to remain as still as possible. The order of evaluation of each position was randomized and two analyzes were performed for each position. In eyes open situations, the elderly persons were told to look at a black circle, 5 cm in diameter, that was set in the wall in front of them at eye level at a distance of 1.5 meters. Elderly people who regularly used corrective lenses used these devices during the test, as visual acuity can interfere with postural stability.[23]

Body balance was evaluated using a force platform (EMG System do Brasil®) with an acquisition frequency of 100 Hz, which measured the distribution of the vertical load at four points, allowing analysis of semi-static equilibrium, with quantitation of amplitude and mean AP and ML COP displacement velocity. The COP signal was filtered by a fourth order Butterworth low pass filter with 10 Hz cutoff frequency. The displacement and trajectory of the COP in AP and ML directions was analyzed using the Matlab program (Math Works, Inc.). The average oscillation amplitude was calculated by subtracting the mean value of a time series for each point and obtaining the standard deviation of said time series. The average amplitude corresponds to the variance of the COP values and was used to estimate the stability of the COP. The average velocity of the COP was calculated by dividing the total displacement in each direction by the total collection period. The mean error of the Root Mean Square (RMS) for the actual localization of the COP on the force platform was 0.02 cm, according to factory calibration.

Intervention

The intervention was performed for the SG and the DG twice a week in 55 minute sessions for a total of 10 weeks.

The SG performed 20 sessions. These sessions were in groups with a maximum of six elderly

persons, supervised by two physiotherapists (with at least two years' experience in the area of geriatric physical therapy and the group rehabilitation of patients) who were not the evaluators, with blinding maintained. However, the therapists were aware that the elderly persons were part of a supervised training group. The exercise program was conducted at the Centro Integrado de Reabilitação (the Center for Integrated Rehabilitation) (CIR) linked to the Hospital Estadual de Ribeirão Preto Center (the State Hospital of Ribeirão Preto).

The DG had two supervised intervention sessions in the CIR to learn the exercises which they then performed in 18 individual home-based (unsupervised) activity sessions. These were performed twice a week for 10 weeks. To standardize and facilitate the exercises, all DG members received a DVD and an illustrative booklet demonstrating the exercises that should be done at home, and an activity form to be filled out by each individual after completion of the program, describing the day and time they performed the exercise, if all the stages were completed. Telephone contact was made with the participants of the DG each week to resolve any doubts about the exercises, and encourage them to carry out the activities.

The CG did not participate in the 10-week exercise program and did not receive any intervention in this period, with the data from this group being used for comparison. Whether or not the group maintained the same lifestyle habits during the 10 weeks was verified by structured questionnaires before and after the research period. Participants who changed their routine activities, as verified by the questionnaires, or performed some physical activity during the research period, were excluded from the study. For ethical reasons, following the research period and revaluation, individuals from the CG who were interested in participating in the exercise program performed the intervention program, either supervised or at home, according to their preference. The exercise program carried out by the SG and the DG comprised:

- Warm-up (5 minutes), repeat each movement ten times: alternate abduction, adduction, flexion and extension movements of the upper limb; alternate triple flexion movement of the lower limbs.

- Stretching (10 minutes) in three series, with an initial duration of 10 seconds for each series, increasing from week 4 to a duration of 20 seconds and from week 7 to 30 seconds: trunk and abdominal; pectorals, with extension of the upper limbs; glutes; quadriceps; hamstring; tibialis anterior; triceps sural.

- Semi-static and dynamic balance (35 minutes). Training was divided into exercises with the individual sitting and standing for 30 minutes, increasing to 35 minutes, in three series, with an initial duration of 30 seconds, increasing from week 4 to 60 seconds and from week 7 to 90 seconds.

- In the sitting position, the training involved transferring body weight to the right and left legs, at increasing speeds, moving from a support to a no support stance; rotating the torso with increasing speed; alternately lifting the legs from the ground; moving from a sitting position to a standing position, reducing the support base.

- In a standing position, training consisted of walking in a straight line (on firm ground and unstable ground, using mats): with a neutral head position (looking at the horizon); a moving head position (lateral rotation); with dissociation between the arm and the leg; standing, reducing the support base and transferring the weight to the right and left legs; standing and moving the body

backwards and forwards; standing on one leg; walking on tiptoe; walking on heels; walking in zigzag; walking sideways; passing over obstacles; walking in tandem (one foot in front of the other); walking backwards; walking in curves and rotations; walking combined with a cognitive task; walking associated with a motor task (for example, transferring a ball from one hand to the other and passing a ball around the body in a circular motion).

- Cool-down (5 minutes): participants remain seated listening to their own choice of music, preferably soothing melodies.

Participants who performed at least 75.0% of the training sessions were reevaluated,[24,25] using the intention to treat method.

Statistical analysis

Statistical analysis was performed using the intention to treat principle of analysis with mean imputation for COP analyses. By this principle, the result the elderly persons would have obtained if they had continued the training protocol was estimated.[26,27]

The Shapiro-Wilk test was used to analyze the normality of the anthropometric and COP data. The parametric data was analyzed using two-way ANOVA followed by Tukey post-hoc. Non-parametric data was analyzed by the Friedman test followed by the post-hoc Wilcoxon test to evaluate the paired data (intragroup analysis), and the Kruskal-Wallis test followed by the post-hoc Mann-Whitney test for unpaired data (intergroup analysis). All statistical analyzes were performed using SPSS software version 13.0 and the significance level was 5% (p=0.05).

RESULTS

Of the 186 elderly persons contacted by telephone, 130 refused to participate in the study or were excluded due to the eligibility criteria (nine were excluded for attending the gym). In total, therefore, 56 elderly patients were randomized into the three research groups (Figure 1). No elderly individuals were excluded at the time of reevaluation for changing their lifestyle during the research, as evaluated by the Baecke questionnaire.[22]

The acceptance rate for participation in the study was 37.63%, representing the elderly who were contacted and agreed to participate in the balance training program for the prevention of falls. The adhesion rate (elderly persons who began the program and remained for its 10-week duration) of the elderly persons in their respective groups was 72.22% for the SG; 60.0% for the DG and 72.22% for the CG.

During the training, 18 elderly persons (SG=5, DG=8 and CG=5), who initiated the exercise protocol dropped out of the study. However, as the study was based on the intention to treat method, this data was included in the statistical analysis.-

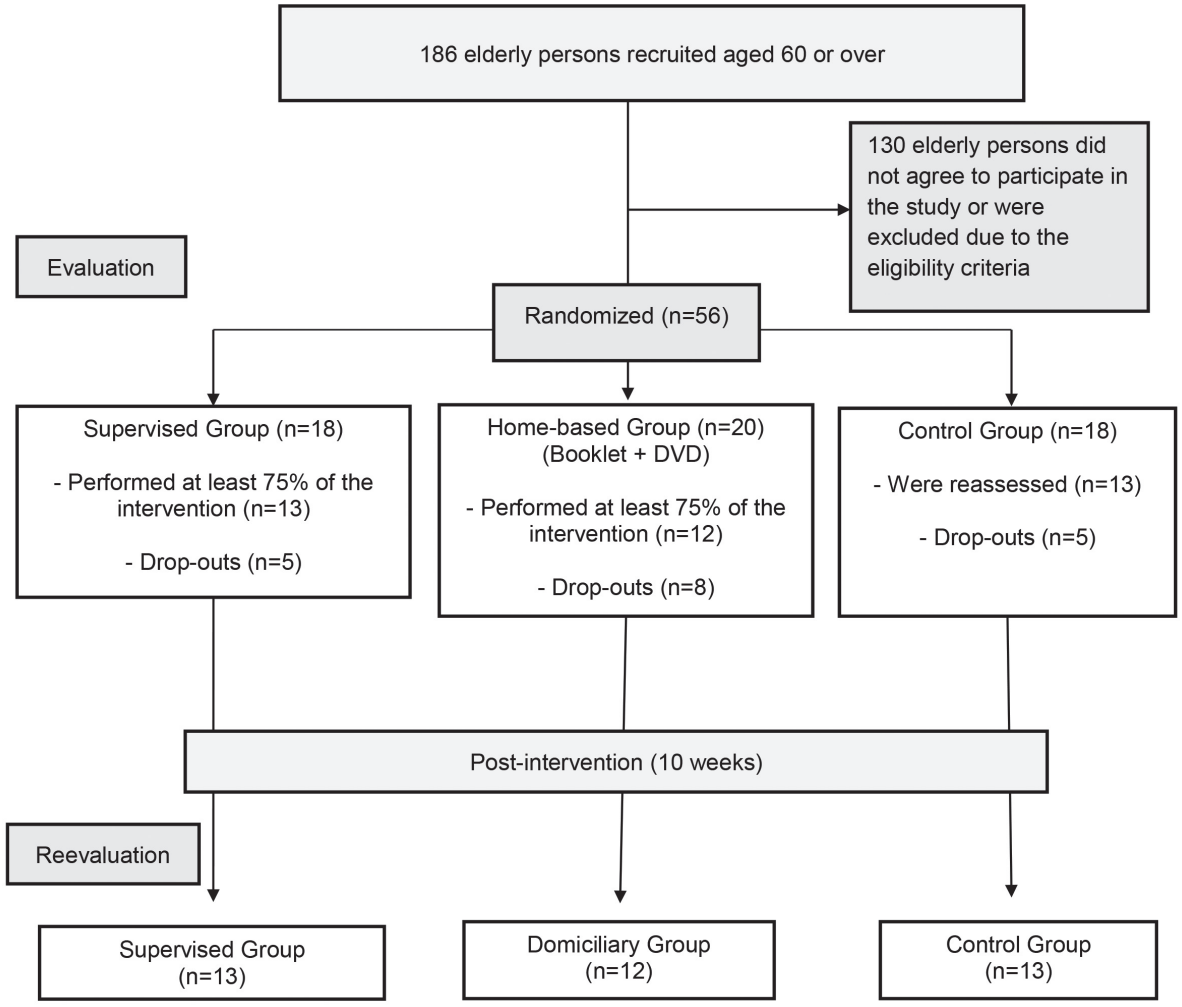

Figure 1. Flowchart of study participants. Ribeirão Preto, São Paulo, 2011-2014.

The SG therefore comprised 18 elderly persons, 13 of whom who completed the reevaluation and five who discontinued the intervention protocol. The DG contained 20 elderly persons, 12 of whom completed the reevaluation and eight of whom discontinued the intervention, and the control group contained 18 patients, 13 of whom who completed the reevaluation and five who declined to be reevaluated.

The reasons for withdrawal from the SG training were: transportation problems (n=1), personal health problems (n=1), health problems of spouse (n=1), competing priorities (n=2). In the DG, the reasons for withdrawal were personal health problems (n=3), health problems of spouse (n=1), competing priorities (n=4). In the control group, all claimed competing priorities (n=5).

The sociodemographic characteristics (Table 1) were compared to verify the homogeneity between groups. The Kruskal-Wallis test revealed no differences in these variables between the SG, DG and CG.

Table 1. Sociodemographic characteristics of sample. Ribeirão Preto, São Paulo, 2011-2014.

Variables	Groups				*p* valor
	Supervised	Domiciliary	Control	Total	
Number of participants (%)	18 (32.1)	20 (35.7)	18 (32.1)	56 (100)	--
Women, n (%)	17 (94.4)	19 (95.0)	16 (88.8)	52 (92.8)	--
Age (in years)*	66.4 (±3.5)	65.7 (±5.4)	66.7 (±4.1)	66.2 (±4.4)	0.47
Height (in meters)*	1.5 (±0.07)	1.5 (±0.07)	1.5 (±0.1)	1.5 (±0.08)	0.89
Weight (in kilos) *	66.1 (±15.5)	68.2 (±9.0)	72.3 (±18.9)	69.0 (±14.9)	0.71
BMI*	27.1 (±5.4)	27.7 (±3.2)	28.7 (±5.3)	27.8 (±4.6)	0.89
Right side dominance, n (%)	16 (88.8)	19 (95.0)	17 (94.4)	52 (92.8)	--
Comorbidities*	2.0 (±1.2)	2.0 (±1.4)	1.5 (±0.8)	1.8 (±1.2)	0.52
Number of medications*	2.6 (±1.6)	2.2 (±1.8)	2.1 (±1.6)	2.3 (±1.7)	0.65
MMSE*	28.5 (±1.7)	28.4 (±1.7)	27.69 (±2.0)	28.2 (±1.8)	0.32

*mean and standard deviation; BMI= body mass index (weight/height²); MMSE= mini-mental state examination.

In intragroup analysis, the CG showed an increase in average ML COP velocity in the FPEO, FPEC and Tandem EO positions. In the SG there was an increase in the average AP and ML velocity and mean AP and ML amplitude in the Tandem EO position. The DG presented a reduction in mean AP velocity and amplitude in the Tandem EC position and mean ML amplitude in the Unipedal stance (Table 2).

Table 2 also shows the Intergroup analyzes for all the conditions and variables. In the initial evaluation, differences were observed between the groups in relation to the conditions and variables analyzed, except for the Tandem EO and Unipedal positions. However, these initial differences were not sustained after treatment due to increased deterioration in the CG or an improvement in the intervention groups, suggesting that the training protocol improved balance in both groups (supervised and domiciliary). The only variable that maintained a difference the intergroup analysis after 10 weeks was AP amplitude in the Tandem EC position.

The DG showed improvement in average ML amplitude in the FPEO position, average ML velocity in the Tandem EC position and an improvement in the average AP and ML amplitude in the Unipedal position. The SG showed improvement in average ML amplitude in the FPEO position and mean AP amplitude in the Unipedal position, but a decline in mean AP velocity in the FPEO position and mean AP amplitude in the Tandem EO position.

Table 2. Mean and standard deviation of Center of Pressure (COP) variables analyzed in the Control Group (CG), Domiciliary Group (DG) and Supervised Group (SG) during the pre- and post-intervention periods. Ribeirão Preto, São Paulo, 2011-2014.

	Variables	Pre-intervention						Post-intervention						*p* value Pre vs. Post		
					p value						*p* value					
		CG	DG	SG	CG vs.DG	CG vs.SG	DG vs.SG	CG	DG	SG	CG vs.DG	CG vs.SG	DG vs.SG	CG	DG	SG
FPEO	AP velocity	0.47 ± 0.12	0.54 ± 0.18	0.51 ± 0.17	0.77	0.646	0.884	0.49 ± 0.16	0.51 ± 0.14	0.55 ± 0.11	0.216	0.027*	0.191	0.486	0.654	0.446
	ML velocity	0.29 ± 0.05	0.39 ± 0.13	0.33 ± 0.07	0.006*	0.031*	0.178	0.34 ± 0.08	0.37 ± 0.11	0.38 ± 0.09	0.176	0.096	0.317	0.004&	0.341	0.093
	AP amplitude	0.30 ± 0.08	0.27 ± 0.10	0.31 ± 0.09	0.677	0.9	0.405	0.28 ± 0.04	0.27 ± 0.06	0.31 ± 0.06	0.716	0.402	0.097	0.369	0.81	0.791
	ML amplitude	0.19 ± 0.08	0.23 ± 0.11	0.20 ± 0.07	0.279	0.601	0.38	0.21 ± 0.05	0.18 ± 0.08	0.18 ± 0.04	0.011*	0.019*	0.825	0.275	0.062	0.252
FPEC	AP velocity	0.59 ± 0.18	0.64 ± 0.20	0.67 ± 0.23	0.619	0.342	0.279	0.65 ± 0.17	0.64 ± 0.20	0.60 ± 0.10	0.59	0.176	0.206	0.372	0.433	0.69
	ML velocity	0.31 ± 0.05	0.41 ± 0.15	0.36 ± 0.08	0.038	0.044*	0.465	0.36 ± 0.07	0.39 ± 0.11	0.39 ± 0.11	0.339	0.247	0.378	0.008&	0.525	0.408
	AP amplitude	0.34 ± 0.09	0.30 ± 0.10	0.34 ± 0.08	0.107	0.438	0.121	0.33 ± 0.05	0.31 ± 0.09	0.33 ± 0.07	0.531	0.998	0.531	0.981	0.663	0.63
	ML amplitude	0.20 ± 0.08	0.19 ± 0.09	0.20 ± 0.09	0.33	0.933	0.33	0.20 ± 0.07	0.19 ± 0.08	0.21 ± 0.08	0.861	0.201	0.402	0.795	0.747	0.913
TANDEM OA	AP velocity	1.02 ± 0.24	1.48 ± 0.61	1.20 ± 0.35	0.104	0.874	0.161	1.29 ± 0.46	1.39 ± 0.58	1.27 ± 0.35	0.24	0.638	0.167	0.157	0.247	0.008&
	ML velocity	1.61 ± 0.48	2.05 ± 0.80	1.69 ± 0.48	0.132	0.558	0.231	2.02 ± 0.59	1.99 ± 0.77	1.91 ± 0.47	0.419	0.6	0.724	0.005&	0.765	0.031&
	AP amplitude	0.33 ± 0.11	0.46 ± 0.27	0.35 ± 0.13	0.108	0.692	0.179	0.36 ± 0.16	0.39 ± 0.12	0.41 ± 0.09	0.094	0.008*	0.181	0.472	0.411	0.011&
	ML amplitude	0.51 ± 0.10	0.63 ± 0.37	0.51 ± 0.16	0.539	0.516	0.144	0.54 ± 0.11	0.51 ± 0.15	0.55 ± 0.13	0.078	0.437	0.054	0.486	0.108	0.028&

Continues on next page

Continuation of Table 2

	Variables	Pre-intervention						Post-intervention						*p* value Pre vs. Post		
					p value						*p* value					
		CG	DG	SG	CG vs.DG	CG vs.SG	DG vs.SG	CG	DG	SG	CG vs.DG	CG vs.SG	DG vs.SG	CG	DG	SG
TANDEM EC	AP velocity	1.58 ± 0.36	2.33 ± 0.65	1.99 ± 0.76	0.0001[8]	0.018[8]	0.128	1.73 ± 0.59	1.97 ± 0.44	1.77 ± 0.43	0.08	0.359	0.128	0.557	0.002[&]	0.094
	ML velocity	2.55 ± 0.53	2.87 ± 0.58	2.65 ± 0.80	0.121	0.98	0.174	2.59 ± 0.62	2.76 ± 0.55	2.52 ± 0.50	0.261	0.273	0.036[*]	0.845	0.455	0.0001[#]
	AP amplitude	0.42 ± 0.09	0.63 ± 0.18	0.55 ± 0.18	0.0003[#]	0.032[#]	0.281	0.41 ± 0.10	0.45 ± 0.06	0.49 ± 0.16	0.027*	0.044*	0.478	0.83	0.001[&]	0.136
	ML amplitude	0.75 ± 0.12	0.90 ± 0.26	0.82 ± 0.20	0.058	0.483	0.483	0.77 ± 0.14	0.75 ± 0.12	0.77 ± 0.16	0.183	0.557	0.287	0.526	0.011[&]	0.408
UNIPEDAL	AP velocity	2.22 ± 0.63	2.61 ± 0.93	2.21 ± 0.54	0.884	0.624	0.953	2.45 ± 0.85	2.55 ± 0.98	2.09 ± 0.47	0.202	0.082	0.723	0.744	0.179	0.845
	ML velocity	3.05 ± 0.64	3.16 ± 0.86	2.82 ± 0.59	0.826	0.289	0.273	3.14 ± 0.62	3.30 ± 0.98	2.95 ± 0.38	0.376	0.425	0.225	0.528	0.502	0.528
	AP amplitude	0.61 ± 0.19	0.61 ± 0.20	0.58 ± 0.15	0.759	0.613	0.861	0.66 ± 0.16	0.60 ± 0.22	0.59 ± 0.17	0.048*	0.045*	0.359	0.349	0.94	0.647
	ML amplitude	0.72 ± 0.16	0.73 ± 0.26	0.68 ± 0.19	0.715	0.229	0.52	0.69 ± 0.14	0.60 ± 0.18	0.67 ± 0.11	0.013*	0.355	0.005*	0.622	0.022[&]	0.983

FPEO= fixed platform with eyes open; FPEC= fixed platform with eyes closed; Tandem EO= tandem with eyes open; Tandem EC= tandem with eyes closed; AP= anteroposterior. ML= mediolateral; *$p \leq 0.05$ in accordance with Kruskal-Wallis Followed by Mann-Whitney *post-hoc*; [#]$p \leq 0.05$ in accordance with Tukey test; [&]$p \leq 0.05$ in accordance with Friedman followed by Wilcoxon *post-hoc*.

DISCUSSION

A number of studies have identified the benefits of physical exercise on the general health of the elderly.[28,29] In terms of the prevention of falls in the elderly, there is scientific evidence through randomized controlled trials, systematic reviews and meta-analyzes that regular strength and balance training among this population can reduce the risk of falls by 15-50%.[5,30] However, the intervention based studies use various protocols and multicomponents, and few have assessed the effects of predominantly balance based training focused on preventing falls.

Additionally, based on practical experience of the low adherence of elderly persons to preventive exercise, it is important to compare the results of exercise programs applied in a supervised manner and those that are performed individually at home, expanding and adapting therapeutic strategy options for the needs and interests of the elderly.

Furthermore, predominantly balance-based training aims to focus on a specific component, which could allow therapeutic goals to be achieved in a shorter time, facilitating the return of individuals to routine habits and social and leisure activities that are often avoided due to postural instability and the risk of falls.

The results of the present research partly confirm the initial study hypothesis, as intergroup results suggest that both the SG and the DG achieved improvements in balance due to the exercise program. However, the domiciliary group tended to achieve greater benefits than the supervised group. In addition, the benefits were different for each group depending on the position adopted.

Studies have demonstrated the benefits of balance training in an orthostatic position on a force platform.[2,31,32] Brouwer et al.[31] observed significant improvement in the balance (AP and ML direction) of elderly patients following the completion of supervised (one hour per week) and home-based (40 minutes, twice a week) exercise programs, for eight weeks, involving low resistance exercises against gravity, using an elastic band for the legs and torso and reach, weight displacement and walking on the spot exercises. Also, Jessup et al.[32] found a reduction in the mean total AP and ML oscillation in bipedal and tandem positions in a group of elderly women after 32 weeks of an exercise protocol that included stretching, warm-up, muscle strengthening and balance exercises (tandem forward and backward walking, walking with obstacles) and going up and down stairs using vests of progressive weight. Penzer et al.[2] observed a significant improvement in the balance of older people (average and maximum AP amplitude) in the bipedal position on foam after the completion of a supervised group exercise program (one hour, twice a week) for six weeks involving 10 minutes of warm-up and strengthening (three muscle strengthening exercises involving the lower limbs performed using equipment, strengthening the ankle extensors with an elastic band) or balance exercises (maintain balance on different surfaces: stiff, foam, bosu; with the eyes open and closed, and in bipedal, single leg and tandem positions), finalized by stretching.

In the present study intergroup analysis revealed a decrease in mean ML amplitude in the FPEO position for the DG, along with a reduction in mean ML velocity in the Tandem EC position and a decrease in mean AP and ML amplitude in a unipedal stance. The SG, however, displayed a reduction in mean ML amplitude in the FPEO position and a decrease in mean AP amplitude in a single leg stance.

In contrast, other training protocols did not achieve a reduction in the rate of falls or improved semi-static balance among the elderly.[33,34] Lord et al.[33] found no improvements in semi-static balance after an intervention program with individualized exercises that consisted of a 5 to 10 minute warm up, 30 minutes of group conditioning (strengthening,

flexibility, coordination and balance exercises) and 10 minutes of individualized exercises (based on needs identified in evaluations), performed twice a week over 12 months. Another group received a minimal intervention through instruction sheets for exercises to perform at home, according to needs detected in an evaluation. The control group performed its habitual activities only. Ramsbottom et al.[34] also failed to improve semi-static balance through a multicomponent training protocol performed twice weekly for 24 weeks. The hypothesis for the lack of improvement in semi-static balance after the completion of these training[33,34] protocols included insufficient intensity, exercises that were either unsuitable for the population studied (considering that individuals with different functional skills trained in the same group) or non-specific (exercises focused more on the dynamic aspects of balance at the expense of semi-static balance). The training protocols that were not successful were supervised studies without specific training,[8,34] those that used balance assessment positions that lacked sensitivity, such as a broad force platform base[35], or those performed with insufficient intensity.[33] According to Penzer et al.,[2] the contrasting findings stem from the variations in training regimens (intensity, duration, frequency) and balance evaluations (position of the feet, duration in the study protocols) used.

In the intra-group analysis of the present study, the SG displayed increased oscillation in the Tandem EO position (in both mean AP and ML amplitude and speeds), which may be associated with the fact that the exercise protocol was not specific to the individual needs of each participant, as individuals with different functional abilities were included in the same training group. In group training, the evolution of the exercises took place in a similar manner for all individuals, without considering the specific needs of each participant.

In the DG, despite the fact that this group followed an instruction booklet and DVD, the elderly individuals had the possibility of performing a specific type of exercise which presented difficulty for a longer period of time according to their individual needs, and could perform a more advanced exercise program twice a week. The freedom to design their own protocols may explain the more obvious improvements observed in this group. In contrast, safer exercises could be carried out for longer at the expense of more unstable exercises which are most challenging for balance, as each elderly person was responsible for his or her training, making them active agents in the promotion of their own health.

In the exercise protocol proposed in this study, the training time (10 weeks) was lower than the time recommended by the prevention of falls guidelines of the American Geriatrics Society and the British Geriatrics Society, which recommend 12 weeks[13], and few exercises were applied aimed at semi-static balance training (the principle of specificity). The exercises involving the orthostatic position were the single leg stance (which achieved an improvement post-intervention) and dynamic balance exercises.

Preventive action to improve semi-static balance, in relation to COP oscillation parameters, can help prevent the occurrence of falls in the elderly, as studies have shown that the risk of recurrent falls increases after an individual's first fall.[4] However, further studies are needed to investigate exercise protocols that more effectively improve postural control, as well as more motivating and appropriate therapeutic strategies and instructions on the benefits of physical exercise for improving balance in older people, in order to achieve greater adherence to physical interventions. Additional studies for the creation of exercise protocols for preventing falls with increased progression and safely that can be applied both at home and in a supervised manner are important for clinical practice.

The present study had some limitations: the sample size and the non-inclusion of elderly persons from all age groups (the mean age of this population was 65-66 years) which limits extrapolating the results to the entire elderly population; the lack of a prediction for the dropout rate when determining the sample size; the subtle progression and the

low difficulty of the procedures (as the exercises were designed to be safely performed by the participants at home without supervision); the lack of comparison of individual training with and without supervision; the short duration of the training (to avoid losses/dropouts) and the lack of analysis of whether the improvement was due to the number of repetitions performed during the week or the total duration of 10 weeks; and the lack of control of the performance of the home exercises, as the participants did not complete the daily exercise record, and no follow-up was performed.

CONCLUSION

The exercise protocol was sufficient to increase semi-static balance in both individual home-based and supervised group therapy strategies. Although the home group presented lower adherence to the program, these individuals obtained more benefits by reducing body sway on the fixed platform with eyes open (FPEO), tandem with eyes closed (Tandem EC) and single leg positions. The supervised group had lower body sway in the tandem eyes closed (Tandem EC) and unipedal positions, but showed deterioration in the fixed platform with eyes open (FPEO) and tandem with eyes open (Tandem EO) positions.

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REFERENCES

1. Strang AJ, Haworth J, Hieronymus M, Walsh M, Smart LJ Jr. Structural changes in postural sway lend insight into effects of balance training, vision, and support surface on postural control in a healthy population. Eur J Appl Physiol 2011;111(7):1485-95.
2. Penzer F, Duchateau J, Baudry S. Effects of short-term training combining strength and balance exercises on maximal strength and upright standing steadiness in elderly adults. Exp Gerontol 2015;61:38-46.
3. Reed-Jones RJ, Dorgo S, Hitchings MK, Bader JO. Vision and agility training in community dwelling older adults: incorporating visual training into programs for fall prevention. Gait Posture 2012;35(4):585-9.
4. Tanvi B, Feng Y, Yi-Chung P. Learning to resist gait-slip falls: long-term retention in community-dwelling older adults. Arch Phys Med Rehabil 2012; 93(4):557-64.
5. Uusi-Rasi K, Kannus P, Karinkanta S, Pasanen M, Patil R, Lamberg-Allardt C, et al. Study protocol for prevention of falls: a randomized controlled trial of effects of vitamin D and exercise on falls prevention. BMC Geriatr 2012;12:1-7.
6. Delbaere K, Valenzuela T, Woodbury A, Davies T, Yeong J, Steffens D, et al. Evaluating the effectiveness of a home-based exercise programme delivered through a tablet computer for preventing falls in older community-dwelling people over 2 years: study protocol for the Standing Tall randomised controlled trial. BMJ Open 2015;5(10):1-9.
7. Gillespie LD, Robertson MC, Gillespie WJ, Sherrington C, Gates S, Clemson LM, et al. Interventions for preventing falls in older people living in the community. Cochrane Database Syst Rev 2012;9:1-5.
8. Alfieri FM, Riberto M, Gatz LS, Ribeiro CPC, Battistella LR. Use of clinical tests for verification of postural control in healthy elderly submitted to physical exercise programs. Acta Fisiátrica 2010;17(4):153-8.
9. Ansai JH, Aurichio TR, Goncalves R, Rebelatto JR. Effects of two physical exercise protocols on physical performance related to falls in the oldest old: A randomized controlled trial. Geriatr Gerontol Int 2015. Epub Apr 14.

10. Alfieri FM, Riberto M, Abril-Carreres A, Boldo-Alcaine M, Rusca-Castellet E, Garreta-Figuera R, et al. Effectiveness of an exercise program on postural control in frail older adults. Clin Interv Aging 2012;7:593-8.

11. Liu-Ambrose T, Davis JC, Hsu CL, Gomez C, Vertes K, Marra C, et al. Action seniors! -Ssecondary falls prevention in community-dwelling senior fallers: study protocol for a randomized controlled trial. Trials 2015;16:144.

12. El-Khoury F, Cassou B, Latouche A, Aegerter P, Charles MA, Dargent-Molina P. Effectiveness of two year balance training programme on prevention of fall induced injuries in at risk women aged 75-85 living in community: Ossebo randomised controlled trial. BMJ 2015;351:1-10.

13. Summary of the Updated American Geriatrics Society/British Geriatrics Society clinical practice guideline for prevention of falls in older persons. J Am Geriatr Soc 2011;59(1):148-57. Developed by the Panel on Prevention of Falls in Older Persons, American Geriatrics Society and British Geriatrics Society.

14. Franco MR, Tong A, Howard K, Sherrington C, Ferreira PH, Pinto RZ, et al. Older people's perspectives on participation in physical activity: a systematic review and thematic synthesis of qualitative literature. Br J Sports Med 2015;49(19):1268-76.

15. Martins J, Sousa LM, Oliveira AS. Recomendações do enunciado CONSORT para o relato de estudos clínicos controlados e randomizados. Medicina (Ribeirão Preto) 2009;42(1):9-21.

16. Silva P, Botelho PFFB, D Guirro ECO, Vaz MM, De Abreu DC. Long-term benefits of somatosensory training to improve balance of elderly with diabetes mellitus. J Bodyw Mov Ther 2015;19(3):453-7.

17. Brucki SM, Nitrini R, Caramelli P, Bertolucci PH, Okamoto IH. [Suggestions for utilization of the mini-mental state examination in Brazil]. Arq Neuropsiquiatr 2003;61(3B):777-81.Português.

18. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12(3):189-98.

19. Aveiro MC. Efeitos de um treinamento físico sobre o equilíbrio estático e dinâmico de mulheres idosas residentes na área de abrangência do Programa Saúde da Família de São Carlos [tese]. São Carlos: Universidade Federal de São Carlos; 2010.

20. Caballero C, Barbado D, Moreno FJ. What COP and Kinematic parameters better characterize postural control in standing balance tasks? J Mot Behav 2015;47(6):550-62.

21. Moghadam M, Ashayeri H, Salavati M, Sarafzadeh J, Taghipoor KD, Saeedi A, et al. Reliability of center of pressure measures of postural stability in healthy older adults: effects of postural task difficulty and cognitive load. Gait Posture 2011;33(4):651-5.

22. Mazo GZ, Mota J, Benedetti TB, De Barros MVG. Validade concorrente e reprodutibilidade: teste-reteste do Questionário de Baecke modificado para idosos. Rev Bras AtivFís Saúde 2001;6(1):5-11.

23. Paulus WM, Straube A, Brandt T. Visual stabilization of posture: physiological stimulus characteristics and clinical aspects. Brain 1984;107 (4):1143-63.

24. Wayne PM, Kiel DP, Buring JE, Connors EM, Bonato P, Yeh GY, et al. Impact of Tai Chi exercise on multiple fracture-related risk factors in post-menopausal osteopenic women: a pilot pragmatic, randomized trial. BMC Complement Altern Med 2012;12:7.

25. Freiberger E, Haberle L, Spirduso WW, Zijlstra GA. Long-term effects of three multicomponent exercise interventions on physical performance and fall-related psychological outcomes in community-dwelling older adults: a randomized controlled trial. J Am Geriatr Soc 2012;60(3):437-46.

26. Gupta SK. Intention-to-treat concept: a review. Perspect Clin Res 2011;2(3):109-12.

27. Shrier I, Steele RJ, Verhagen E, Herbert R, Riddell CA, Kaufman JS. Beyond intention to treat: what is the right question? Clin Trials 2014;11(1):28-37.

28. Rubenstein LZ, Josephson KR, Trueblood PR, Loy S, Harker JO, Pietruska FM,et al. Effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. J Gerontol Ser A Biol Sci Med Sci 2000;55(6):317-21.

29. Shimada H, Obuchi S, Furuna T, Suzuki T. New intervention program for preventing fall among frail elderly people: the effects of perturbed walking exercise using a bilateral separated treadmill. Am J Phys Med Rehabilit 2004;83(7):493-9.

30. Gillespie LD, Robertson MC, Gillespie WJ, Lamb SE, Gates S, Cumming RG, et al.. Interventions for preventing falls in older people living in the community. Cochrane Database Syst Rev 2009;15(2):1-4..

31. Brouwer BJ, Walker C, Rydahl SJ, Culham EG. Reducing fear of falling in seniors through education and activity programs: a randomized trial. J Am Geriatr Soc 2003;51(6):829-34.

32. Jessup JV, Horne C, Vishen RK, Wheeler D. Effects of exercise on bone density, balance, and self-efficacy in older women. Biol Res Nurs 2003;4(3):171-80.

33. Lord SR, Tiedemann A, Chapman K, Munro B, Murray SM;Gerontology M, et al. The effect of an individualized fall prevention program on fall risk and falls in older people: a randomized, controlled trial. J Am Geriatr Soc 2005;53(8):1296-304.

34. Ramsbottom R, Ambler A, Potter J, Jordan B, Nevill A, Williams C. The effect of 6 months training on leg power, balance, and functional mobility of independently living adults over 70 years old. J Aging Phys Act 2004;12(4):497-510.

35. Judge JO, Lindsey C, Underwood M, Winsemius D. Balance improvements in older women: effects of exercise training. Phys Ther 1993;73(4):254-62.

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Indicators of sarcopenia and their relation to intrinsic and extrinsic factors relating to falls among active elderly women

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Abstract

Introduction: Musculoskeletal aging can impair functional performance increasing the risk of falls. *Objective:* To analyze the correlation between sarcopenia and the intrinsic and extrinsic factors involved in falls among community-dwelling elderly women. *Method:* A cross-sectional study evaluated the number of falls of 85 active community-dwelling elderly women in the previous year and then divided them into two groups: non-fallers (n=61) and fallers (n=24). The sarcopenia indicators assessed were gait speed (GS, 10m); handgrip strength (HS); calf circumference; appendicular muscle mass index (DXA). Intrinsic factors: Mental State Examination (MSE); visual acuity; depression (GDS-30); hip, knee (Lequesne) and ankle/foot (FAOS) pain/function; vestibular function (Fukuda test); functional mobility and risk of falls (TUG); power (sitting and standing five times); gait (treadmill); fear of falling (FES-I-Brazil). Extrinsic factors: risk/security features in homes. The independent t test was applied for comparisons between groups and the Pearson and Spearman tests were used for correlations ($p<0.05$). *Results:* There was a moderate correlation between HS and GS in non-fallers ($r=0.47$; $p=0.001$) and fallers ($r= 0.54$; $p=0.03$). There was a moderate negative correlation ($r= -0.52$; $p=0.03$) between FES-I-Brazil and gait cadence in fallers. There was a greater presence of stairs ($p=0.001$) and throw rugs ($p=0.03$) in the homes of fallers than non-fallers. *Conclusion:* The elderly women were not sarcopenic. Elderly fallers presented inferior gait cadence and a greater fear of falling. Residential risks were determining factors for falls, and were more relevant than intrinsic factors in the evaluation of falls among active community-dwelling elders.

Key words: Sarcopenia; Accidental Falls; Gait; Muscle, Skeletal.

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INTRODUCTION

Falls are considered one of the most significant health problems for the elderly population.[1] The etiology of falls is multi-factorial, including both intrinsic and extrinsic factors.[2] Intrinsic factors include reduced strength and muscle power, modifications in gait, sight problems, functional, cognitive and balance issues, vestibular function, muscle reaction time, reductions in motion range, pain and psychological factors such as fear of falls and depression.[3-7] Extrinsic factors include social conditions and environmental factors, such as: lighting; uneven surfaces; carpets and rugs; random objects on the ground; stairs without handrails and untethered animals.[2] The risk of falls increases in accordance with age and the number of risk factors present.[7]

The reduction in muscle mass caused by the aging process should also be considered. Sarcopenia is a geriatric syndrome that involves diminished muscle mass and muscle function (strength or physical performance), which can affect the balance and gait of elderly persons.[8]

Several methods are available to assess muscle mass. The most common method in literature involves indirect estimates to assess the body composition using anthropometric data, such as the Body Mass Index (BMI), and bioimpedance.[9,10] However, Dual Energy X-Ray Absorptiometry (DXA) is a more precise method and is the gold standard for assessments of body composition. This method can quantify fat content, muscle mass and body bone mass more accurately, especially among the elderly population.[9,11]

The correlation between sarcopenia and balance in the elderly has previously been investigated. Studies have shown that muscle strength affects the static balance (feet together, tandem, semi-tandem, eyes open and eyes closed) and gait of elderly community-dwellers. Muscle mass in elderly men and women has been assessed using bioimpedance and plethysmography, with the only correlation found with balance in the tandem position.[8,10] Therefore, it is not yet known if muscle mass (assessed using DXA) and/or sarcopenia affect the factors involved in the risk of falls among the elderly.

We were unable to find any studies that investigated the main intrinsic and extrinsic factors related to falls in the elderly and their correlations with sarcopenia.[12]

Therefore, the aim of the present study was to assess indicators of sarcopenia and to correlate them with the intrinsic and extrinsic factors involved in the risk of falls among active, elderly, community dwellers who were classified as fallers or non-fallers.

METHODS

The present cross-sectional study received approval from the Research Ethics Committee of the Health Sciences Sector of the Universidade Federal do Paraná (Federal University of Paraná) under protocol number CAAE: 25239713.3.0000.0102.

The sample was calculated using G**Power* 3.1 software, considering an effect size of 0.80; an α error of 0.05 and a power (1-β) of 0.88%. The total sample contained 83 elderly women.

The following inclusion criteria were applied: women; aged 65 years or more; healthy; functionally independent and capable of performing the required tests. The following exclusion criteria were applied: elderly women with neurological and/or trauma-orthopedic disorders; prostheses containing metallic or non-metallic implants that would hinder the performance of the proposed assessments; decompensated diseases and/or high blood pressure on the day of the assessment. In total, 85 elderly women participated in the present study, all of whom signed a free and informed consent form (FICF).

The data was collected between August and December 2014. Firstly, the participants were assessed by a geriatric doctor who performed anamnesis and a physical examination, providing data related to *previously diagnosed diseases, drug consumption, urinary and fecal incontinence, auditory acuity, current physical activity levels (and weekly routines) and psychosocial data: education (illiterate, 1-4 years, 5-8 years, >8 years); marital status; occupation; type of residence; and participation in social activities. The physical examination involved the collection of vital signs and a segmental examination, including a test of visual acuity using a Snellen card. Subsequently, physical assessments were performed to determine the body composition of the participants and the extrinsic and intrinsic factors related to falls.*

Body mass was measured using scales (Filizola) and height was measured using a wall stadiometer (*Sanny).* BMI values were calculated using the body mass and height ratio squared, based on the classification of the Pan-American Health Organization.[13]

The participants were asked about the number of falls they had suffered in the previous 12 months and were classified as fallers if they had experienced one or more falls in that time period.

Sarcopenia Indicators

Sarcopenia screening used the values obtained in the tests for gait speed (GS), handgrip strength (HGS) and calf circumference (CC), as proposed by Cruz-Jentoft et al.[14] In addition, appendicular muscle mass index (AMMI) was obtained using DXA.

GS was assessed on a rectilinear and flat 10-meter track. The first two meters and the last two meters were not included in the analysis to take into account phases of acceleration and deceleration. The time required to cover the remaining six meters was recorded in seconds (s). In the analysis, >1 m/s[15] was considered to be an adequate speed, with no risk of falls.

HGS was measured by a manual dynamometer (SH), using the dominant limb of the participant. Three maximal movements were performed, with an interval of one minute of rest between each movement. The result (Kgf) was taken as the mean of the three attempts.[14]

CC was measured using a metric tape, which was placed around the widest point of the calf. Values of less than 31 cm were considered indicative of depleted muscle mass and correlated with incapacity. [16]

The AMMI and body composition assessments were performed using Dual Energy X-Ray Absorptiometry (DXA, Discovery A Hologic model). These assessments were conducted in the Laboratório Bioquímico e Densitométrico (Biochemistry and Densitometry Laboratory) (LABDEN) of the Universidade Tecnológica Federal do Paraná (Federal University of Technology of Paraná). The participants were positioned in dorsal decubitus, with their lower limbs rotated medially, their arms by their sides, their fingers together and the head aligned with the body. Absolute and percentage values were obtained for the body and its segments, using the following parameters: body fat; muscle mass; AMMI; upper leg muscle mass (ULMM); lower limb muscle mass (LLMM) and bone mineral content.[9] The examination was carried out by a technician who had been trained by the International Society for Clinical Densitometry (ISCD). The equipment used was calibrated according to ISCD 2013-2015 regulations.

In order to calculate the AMMI, the sum of muscle mass and the bone mineral content of the four limbs was divided by the squared height of the individual.[11]

Intrinsic factors related to falls

A set of tests was conducted to investigate the main intrinsic factors related to falls. These tests are described below.

Cognitive function was assessed using the Mini Mental State Examination (MMSE). The following scores were considered for the tests: 13 for illiterate individuals; 18 for individuals with one to seven years of education; and 26 for those with eight or more years of education.[17] Depressive symptoms were assessed using the Geriatric Depression Scale (GDS-30), adopting a cutoff point of up to 10 points for the absence of depressive symptoms.[18] Fear of falls was assessed using the Falls Efficacy Scale-International Brazil (FES-I-Brazil), in which the final score can range from 16 (not worried) to 64 (extremely worried). Scores of ≥23 points were associated with a history of sporadic falls and those of ≥31 points were associated with recurring falls.[1] The individual health assessment involved answering the following question: *"In general, do you consider your health to be: excellent; very good; good; poor; very poor"*.[15]

Hip and knee pain/function were assessed using the Lequesne algofunctional index,[19] based on the following scores: 0 no impairment; 1-4 little impairment; 5-7 moderate impairment; 8-10 severe impairment. The function and symptoms of the foot and ankle were assessed using the Foot and Ankle Outcome Score (FAOS), with a score of >75 points indicating a satisfactory function.[20]

The Human Activity Profile (HAP) was used to determine the level of physical activity, with the participants classified in one of the following categories: adjusted score activities (EAA) of >74 = active; between 53<EAA<74 = moderately active and EAA<53=inactive.[21] The performance of activities of daily living (ADL) was assessed using the Katz Scale,[22] considering 6 points as independent, 4 points as moderately dependent and 2 or less points as very dependent. Instrumental activities of daily living (IADL) were assessed using the Lawton scale, on which scores can range from 7 to 21, with higher scores representing better performance.[23]

Tactile sensitivity was assessed in the region of the first metacarpal and metatarsal of the dominant limb. To do so, an esthesiometer (Semmes–Weinstein®) applied slow pressure until reaching the force required to bend the filament, as per the manufacturer's instructions. The test began with a thinner filament (0.05 g). The participant was instructed to close their eyes and say "yes" when they felt pressure on the skin, as well as indicating where they felt the filament pressure.[24]

In order to assess the strength and muscle power of the lower limbs, the participant was asked to stand and sit in a chair five times, as quickly as possible, with their arms crossed in front of their body. The time (s) that elapsed between the instructor saying "now" and the end of the fifth movement was recorded. The following cutoff points were used: 60 to 69 years; 11.4 s; 70 to 79 years; 12.6 s; 80 to 89, 12.7 s.[25]

Functional mobility and the risk of falls were assessed using the timed up and go (TUG) test, which involves getting up from a chair without using the arms and walking at a comfortable and safe pace for three meters, before turning around, returning to the chair and sitting down again.[26] At the beginning and end of the test, the participant's back must touch the back of the chair. The time (s) was recorded and the following scores were considered: 60-69 years, 8.1 s; 70-79 years, 9.2 s; 80-99 years, 11.3 s.[26]

The Fukuda stepping test was performed to analyze vestibular dysfunction.[27] The participant was asked to stand, with their eyes closed, and walk for 50 paces in an area with ground markings. Displacement of more than 0.5 m (measured with a metric tape) and/or a lateral rotation angle of more than 30 degrees (measured with a CARCI® goniometer) were indicative of an imbalance in the vestibular system.[27]

A treadmill (Gait Trainer 2- BIODEX) was used to assess gait speed (m/s), step length (m) and cadence (steps/minute). The participants were instructed to walk on the treadmill for three minutes, with the speed calculated based on the result of the GS test (10 m), which was completed in advance. Two attempts were made, with an interval of two minutes between each attempt: the

first attempt was used to familiarize themselves with the procedure; the values recorded during the second attempt were used in the analysis.[28]

In the individual health assessment, each alternative received a decreasing numeric value (excellent 4, very good 3, good 2, poor 1 and very poor 0) and was assessed in terms of absolute and relative frequency. The following factors were considered in the analysis: education (illiterate: 0; 1-4 years: 1; 5-8 years: 2; >8 years: 3); marital status (married 1, separated 2, divorced 4, widow 5, single 6); occupation (retired with other occupation 1, retired without other occupation 2; domestic work 3, work outside the home 4); income [up to two minimum salaries (MS) 1, up to five MS 2, up to 10 MS 3, up to 20 MS 4]; type of residence (one-story house 1, two-story house 2, apartment 3); social activities (yes 1, no 0); auditory acuity (normal 1, hearing problem 2, uses a hearing aid 3); fecal and urinary incontinence (yes 1, no 0); sleep (normal 0, sleep disorder 1).

Extrinsic factors related to falls

The participants were also questioned about the risks and safety accessories in their homes, including: stairs; non-slip adhesives on stairs; handrails on stairs; ramps; non-slip adhesives on ramps; handrails on ramps; uneven surfaces (obstacle that need to be stepped over); loose carpets or rugs on the ground; anti-slip backing for carpets; loose pieces of wood on the ground; exposed cables or wires (extensions); slippery floors; poor lighting (causing vision problems); slippery-when-wet bathroom floor; handrails in bathrooms; high bed; high chair; high toilet; untethered animals; random objects on the ground.[2]

Statistical analysis

The normality of the data was assessed using the Shapiro-Wilk test and the results were expressed using descriptive statistics (mean, standard deviation, median, minimum and maximum), depending on the type of variable.

The independent t-test was used for comparisons between elderly fallers and non-fallers.

The following dependent variables were considered: cadence; gait speed; step length; handgrip strength; power (sit-to-stand test) and mobility (TUG). The following independent variables were used: demographic data; anthropometric data; clinical data; functional data; fear of falls; muscle mass and residential factors.

Pearson's correlation test or Spearman's correlation test were used to analyze the correlation between the parametric and non-parametric variables, respectively. In addition, when a moderate-high ($r>0.30$) and/or significant correlation ($p<0.05$) was recorded, linear and multiple regression were used.

Statistical analysis was conducted using Excel® and Statistica 12 (StastSoft) software, with the level of significance set at $p<0.05$.

RESULTS

Initially, 99 elderly individuals were contacted. However, five of these were not interested in participating in the research. Three were excluded due to uncontrolled hypertension, while another five gave up during the research and one began a program of health treatment. Thus, 85 elderly women, with a mean age of 70 years, participated in the present study. They were classified as overweight according to the BMI values (28±4.53 kg/m²) and moderately-active according to the HAP score (62±9.67). The participants were also stratified as fallers (n=24; 28.23%) and non-fallers (n=61; 71.76%), in accordance with their history of falls in the previous 12 months. The demographic, anthropometric, clinical and functional characteristics are displayed in Chart 1.

Chart 1. Demographic, anthropometric, clinical and functional characteristics of elderly fallers and non-fallers. Curitiba-PR, 2015.

		Non-fallers (n=61)	Reference/Outcome	Fallers (n=24)	Reference/Outcome	*p**
Age (years)		69 (65-81)	-	69 (64-86)	-	0.74
Education (years)	Illiterate	0	>8 years	1 (4.17%)	>8 years	0.68
	1-4 years	14 (22.95%)		4 (16.67%)		
	5-8 years	15 (24.59%)		8 (33.34%)		
	>8 years	32 (52.46%)		11 (45.83%)		
Marital status	Married	22 (36.06%)	Widows	7 (29.17%)	Widows	0.61
	Separated	3 (4.92%)		1 (4.17%)		
	Divorced	7 (11.47%)		3 (12.5%)		
	Widow	24 (39.34%)		12 (50%)		
	Single	5 (8.18%)		1 (4.17%)		
Occupation	Retired with other occupation	41 (67.21%)	Retired with other occupation	7 (29.17%)	Domestic work	0.003*
	Retired without other occupation	7 (11.47%)		5 (20.84%)		
	Domestic work	12 (19.67%)		11 (45.83%)		
	Work outside the home	1 (1.64%)		1 (4.17%)		
Income (number of minimum salaries)	Up to 2 MS	29 (47.54%)	Up to 2 MS	11 (45.83%)	Up to 2 SM	0.68
	Up to 5 MS	24 (39.34%)		8 (33.34%)		
	Up to 10 MS	5 (8.18%)		4 (16.67%)		
	Up to 20 MS	3 (4.92%)		1 (4.17%)		
Type of residence	One-story house	33 (54.1%)	One-story house	11 (45.83%)	One-story house	0.66
	Two-story house	13 (21.31%)		7 (29.17%)		
	Apartment	15 (24.59%)		6 (25%)		

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Continuation of Chart 1

		Non-fallers (n=61)	Reference/Outcome	Fallers (n=24)	Reference/Outcome	*p**
Social activities	Yes	41 (67.21%)	Participate	22 (91.7%)	Participate	0.004*
	No	20 (32.79%)		2 (8.3%)		
Cognitive condition (MMSE score)		28 (18-30)	No cognitive impairment[17]	28 (14.5-30)	No cognitive impairment[17]	0.88
Height (m)		1.55 (±0.07)	-	1.56 (±0.05)	-	0.96
Weight (kg)		68 (±12)	-	70 (±13)	-	0.40
BMI (Kg/m^2)		28 (±4)	Overweight[13]	29 (±5)	Overweight[13]	0.35
Physical activity level (HAP) (score)		63 (41-83)	Moderately active[21]	63 (35-75)	Moderately active[21]	0.48
Type of physical activity	Practitioners	43 (70.49%)	Gym, stretching, walks, dancing, gymnastics, weights training, hydro-gymnastics and Pilates	18 (75%)	Stretching, walks, gymnastics, physical conditioning, weights training, hydro-gymnastics and yoga	
	Non-practitioners	18 (29.50%)		6 (25%)		
Weekly exercise		2 (0-5)	Twice weekly	2 (0-3)	Twice weekly	0.74
Urinary incontinence		6 (9.84%) incontinent individuals	Urinary incontinence	7 (29.17%) incontinent individuals	Urinary incontinence	0.02*
		55 (90.16%) incontinent individuals		17 (70.83%) continent individuals		
Fecal incontinence		1 (1.64%)	Fecal incontinence	0	Fecal incontinence	0.53
		0				
Hearing ability	Normal	43 (70.49%)	Normal	18 (75%)	Normal	0.77
	Deficient	13 (21.31%)		4 (16.67%)		
	Uses a hearing aid	5 (8.18%)		2 (8.3%)		
Sleep	Normal	42 (68.85%)	Normal	17 (70.83%)	Normal	0.86
	Abnormal	19 (31.15%)		7 (29.17%)		
Sight (Snellen score)		47 use devices and have normal sight	Use devices and have normal sight	18 use devices and have normal sight	Use devices and have normal sight	
		8 normal sight		6 Normal sight		
		6 slight vision impairment				

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Continuation of Chart 1

		Non-fallers (n=61)	Reference/Outcome	Fallers (n=24)	Reference/Outcome	*p**
Vestibular function (Fukuda test) angles in degrees		20 (±26)	No indication of an imbalance in the labyrinthine system[27]	25 (±24)	No indication of an imbalance in the labyrinthine system[27]	0.39
Sensitivity of the foot (g) (esthesiometer)		0.2 (0.05-4)	Normal	0.2 (0.05-10)	Normal	0.25
ADL (Katz scale) (score)		6	Independent elderly individuals[22]	6	Independent elderly individuals [22]	-
IADL (Lawton scale) score)		20 (17-21)	Independent elderly individuals [23]	20 (18-21)	Independent elderly individuals [23]	0.84
Depression (Geriatric Depression Scale- GDS-30) (score)		6 (±4)	No clinically significant symptoms of depression[18]	6 (±4)	No clinically significant symptoms of depression[18]	0.73
Pain/hip function (Lequesne)		2 (±3)	Very little impairment	2 (±2)	Very little impairment	0.97
Pain/knee function (Lequesne) (score)		4 (±5)	Very little impairment	4 (±3)	Very little impairment	0.86
Pain/ankle function (FAOS) (score)	Pain	97 (52.77-100)	No symptoms[20]	97 (55-100)	No symptoms[20]	0.98
	Other symptoms	96 (35.71-100)		93 (57.14-100)		0.44
	Activities of daily living	100 (60.71-100)		100 (82.35-100)		0.35
	Sport and recreation	100 (15-100)		100 (75-100)		0.51
	Quality of life	100 (43.75-100)		87 (43.75-100)		0.38
General health status	Excellent	4 (4.91%)	Good	4 (0%)	Good	0.09
	Very good	3 (11%)		3 (8%)		
	Good	2 (77%)		2 (79%)		
	Poor	1 (6%)		1 (4%)		
	Very poor	0 (0%)		0 (8%)		

Reference values: Bertolucci et al.[17]; SABE[13]; Souza et al.[21]; Zhang & Wang[27]; Lino et al.[22]; Lawton & Brody[23]; Sousa et al.[18]; Imoto et al.[20]; *independent t-test; ADL: activities of daily living

Among the demographic, anthropometric, clinical and functional characteristics, significant differences were found between elderly fallers and non-fallers for the variables occupation (p=0.003), participation in social activities (p=0.004) and urinary incontinence (p=0.02).

No significant differences were found between the fallers and the non-fallers in relation to the intrinsic factors (muscle power; HGS; functional mobility; pain/joint function; vestibular function; sensory-motor skills; visual acuity; cognitive function; gait parameters; fear of falls and depression), as can be seen in Table 1.

Table 1. Functional mobility, power, risk of falls, fear of falling and gait of elderly fallers and non-fallers. Curitiba-PR, 2015.

	Non-fallers (n=61)	Outcome	Fallers (n=24)	Outcome	p^*-
Functional mobility/risk of falls (s) (TUG)	7.64 (±1.25)	Low risk of falls and satisfactory functional mobility[25]	7.94 (±1.49)	Low risk of falls and satisfactory functional mobility[25]	0.40
Muscle strength/ risk of falls (s) (5XSST)	11.02 (±1.80)	Low risk of falls[26]	11.05 (±2.25)	Low risk of falls[26]	0.95
Fear of falling (score) (FES-I-Brazil)	25 (16-45)	History of sporadic falls[1]	25 (17-44)	History of sporadic falls[1]	0.73
	(n=48)		(n=16)		
Treadmill speed (m/s)	1.38 (1.1-1.38)	Above the mean (0.70±1.92)[29]	1.24 (±0.19)	Above the mean (0.70 ±1.92)[29]	0.67
Cadence (steps/ min)	120 (±11.58)	Normal (120.8±7.5)[30]	121 (111-156)	Normal (119.4±9)[30]	0.48
Gait speed (cm/s)	121 (±18)	Below the mean 128.3 (±15.6)[30]	123 (±20)	Below the mean 125.8 (±15.9)[30]	0.71
Left step length (cm)	67.97 (±8.51)	Normal (63.7±5.8 cm)[30]	67.5 (±10.68)	Normal (63.2±6.5 cm)[30]	0.96
Right step length (cm)	68.52 (±8.69)	Normal (63.7±5.8 cm)[30]	67.75 (±10.84)	Normal (63.2±6.5 cm)[30]	0.91

Reference values: Bohannon[25]; Bohannon[26]; Camargos et al.[1]; Hallal et al.[29]; Moreira et al.[30]; *independent t-test; 5XSST= five times sit-to-stand test; TUG: timed up and go FES-I-Brazil: Falls Efficacy Scale-International.

Sarcopenia screening

No sarcopenia indicators were found in either group (Chart 2), given that the values recorded in the GS, HGS and CC tests were all normal.

However, the muscle mass of the upper and lower limbs, as well as the AMMI of both groups, were below the reference values, although there were no significant differences between elderly fallers and non-fallers.

Chart 2. Sarcopenia screening among elderly fallers and non-fallers. Curitiba-PR, 2015.

	Non-fallers (n=31) 60-69 years	Non-fallers (n=30) 70-80 years	Reference/ Outcome	Fallers (n=14) 60-69 years	Fallers (n=10) 70-80 years	Reference/ Outcome	*p**
GS (m/s)	1.48 (±0.26)	-	No risk of falls[15]	1.49 (±0.23)	-	No risk of falls[15]	0.84
HGS (Kg)	22.21 (±55.84)	-	Adequate[14]	19.77 (±4.60)	-	Adequate[14]	0.06
CC (cm)	35.2 (27-53.5)	-	Adequate[14]	35.99 (±4.14)	-	Adequate[14]	0.72
AMMI-DXA (kg/m^2)	6.49 (±0.68)	6.02 (±0.74)	Below the reference[11]	6.66 (±0.55)	6.10 (±0.89)	Below the reference[11]	0.38/ 0.80
Muscle mass ULMM (kg)	3.90 (±0.65)	3.54 (±0.6)	Below the reference[11]	5.43 (±4.73)	3.48 (±0.72)	Normal/ Below the reference[11]	0.24/ 0.80
Muscle mass LLMM (kg)	11.03 (±1.86)	10.48 (±1.74)	Below the reference[11]	10.24 (±1.94)	11.59 (±1.29)	Below the reference[11]	0.24/ 0.74

GS= gait speed; HGS= handgrip strength test; CC= calf circumference; AMMI= appendicular muscle mass index; ULMM= upper limbs; LLMM= lower limbs. Reference values: Studenski et al.[15]; Cruz-Jentoft et al.[14]; Coin et al.[11]; *independent t-test.

Musculoskeletal correlations of elderly fallers and non-fallers

Analysis of the muscle mass of the ULMM and HGS confirmed a slightly significant correlation (r=0.26; p=0.04) among the non-fallers. However, no significant correlation (r=0.17; p=0.23) was found for the fallers. Linear regression analysis indicated that only 0.6% of muscle mass could explain the HGS of elderly non-fallers (r^2=0.006 and p=0.004).

A moderate and significant correlation was found between HGS and GS among elderly non-fallers (r=0.47; p=0.001) and fallers (r= 0.54; p=0.03), indicating that a stronger HGS is associated with a higher GS. The linear regression values between HGS and GS were r^2=0.29 and p=0.005 for fallers and r^2=0.22 and p=0.0001 for non-fallers. These values demonstrate that 29% of HGS can affect the GS of fallers and 22% for non-fallers.

A moderate, negative and significant correlation (r=-0.52; *p*=0.03) was found between the FES-I-Brazil and the gait cadence of fallers, indicating that increases in gait cadence decrease fear of falls. The linear regression values were r^2=0.25 and *p*=0,004, indicating that 25% of gait cadence can affect fear of falls among elderly fallers.

In the multiple linear regression analysis of the HGS, FES-I-Brazil and GS values, it was found that 53% (r^2=0.53; *p*=0.0003) and 31% (r^2=0.31; *p*=0.0001) of the HGS and fear of falls (FES-I-Brazil) explained the GS of elderly fallers and non-fallers, respectively.

Table 2 displays the results of the musculoskeletal correlations.

Table 2. Musculoskeletal correlations of elderly fallers and non-fallers. Curitiba-PR, 2015.

	Non-fallers n=61		Fallers n=24	
	r	p	r	p
Muscle mass ULMM x HGS	0.26	0.04*	0.15	0.45
Muscle mass LLMM x 5XSST	0.03	0.77	0.01	0.94
HGS x gait speed	0.47	0.0001*	0.54	0.005*
TUG x FES-I-Brazil	0.09	0.53#	0.22	0.40#
	Non-fallers n=48		Fallers n=16	
	r	*p*	r	*p*
Gait cadence x TUG	0.15	0.29	-0.11	0.67#
Gait cadence x FES-I-Brazil	0.17	0.23#	-0.52	0.03#
Step length x TUG	0.15	0.30	0.13	0.62
Step length x FES-I-Brazil	-0.13	0.36#	0.14	0.58#

LLMM= lower limbs; TUG= timed up and go; 5XSST= five times sit-to-stand test; FES-I-Brazil= Falls Efficacy Scale International Brazil; #Spearman correlation; the other variables were analyzed using Pearson's correlation; *p<0.05 Pearson's correlation.

Extrinsic/environmental factors related to the risk of falls

Analysis of the extrinsic factors related to the risk of falls confirmed the following statistically significant differences between type of residence in both groups: the presence of stairs; the presence of rugs; and the presence of loose pieces of wood on the floor. Elderly fallers did not report the presence of exposed wires and extensions, whereas 6.55% of the fallers did so. The non-fallers reported high toilets in their homes, unlike the fallers. Table 3 displays these results.

Table 3. Extrinsic factors related to the risk of falls in elderly individuals. Curitiba-PR, 2015.

Risks and safety resources found in the homes of the participants	%	Non-fallers n=61	Fallers n=24	*p**
Stairs	54.11	54.45	58.33	0.001*
Non-slip adhesive on stairs	10.58	9.83	12.50	0.09
Handrails on stairs	35.29	34.42	37.50	0.86
Ramps	24.70	26.22	20.83	0.75
Non-slip adhesive on ramps	4.70	6.55	0	0.16
Handrails on ramps	2.35	1.63	4.16	0.06
Any obstacles on the ground (that would have to be stepped over)	34.11	31.14	41.66	0.65
Loose carpets	64.70	63.93	66.66	0.03*
Non-slip adhesive for carpets	31.76	29.50	37.50	0.69
Pieces of wood on the floor	2.35	1.63	4.16	0.03*
Exposed cables, wires (extensions)	4.70	6.55	0	0.03*
Slippery floor	35.29	34.42	37.50	0.68
Poor lighting (hindering sight)	16.47	16.39	16.66	0.32
Slippery-when-wet bathroom floor	50.58	52.45	45.83	0.87
Handrails in bathrooms	21.17	22.95	16.66	0.33
High bed	35.29	36.06	33.33	0.65
High chair	10.58	9.83	12.50	0.06
High toilet	2.35	3.27	0	0.01*
Pets (ex. cat, dog)	36.47	42.62	20.83	0.35
Random objects on the floor (ex. shoes, boxes, toys, etc.)	25.88	22.95	33.33	1

*$p<0.05$ independent t-test.

DISCUSSION

The sociodemographic characteristics of the elderly community-dwellers assessed in the present study were as follows: a mean age of 71 years; more than eight years of education; preserved cognitive state; retired with other occupation; a mean income of up to two minimum salaries; widows; adequate auditory and visual acuity; independent in relation to ADL and IADL.

According to the sarcopenia screening methods proposed by the European Sarcopenia Council,[14] none of the participants (fallers and non-fallers) exhibited risk indicators. However, when assessed using a more precise method (DXA), the muscle mass values were below the recommended level for their age group,[11,14] despite the fact that neither their musculoskeletal function nor their physical performance were affected.[14,15,26] This highlights the importance of conducting more accurate assessments in order to prevent sarcopenia.

Concerning falls, even the participants classified as moderately active (mean of two sessions of physical exercise per week) were associated with

an occurrence rate of 28% for falls, which is similar to the results found in another Brazilian study.[31] When the intrinsic factors related to falls (power, muscle force, functional mobility, pain, vestibular function, sensory motor skills, visual acuity, cognitive function, gait, fear of falls and depression) were analyzed, no statistically significant differences were found between elderly fallers and non-fallers.[7,31]

However, extrinsic factors such as the presence of stairs, rugs and pieces of loose wood were more common in the homes of fallers than in those of the non-fallers. Meta-analysis of the effects of environmental factors on the risk of falls among the elderly population concluded that residential interventions should be a part of planning strategies to prevent falls. In addition, when these residential interventions are completely understood by the elderly and adopted as safety measures, there is a significant reduction in the number of falls recorded. [2]

Concerning the characteristics of the participants, it was found that 76% of the elderly women had normal vision and 72% had normal hearing. This data is contrary to the results reported by other authors: 61% of elderly individuals had poor or regular vision and 31% had poor or regular hearing, with a 31% frequency of falls.[31] These outcomes could indicate that although visual and auditory acuity are intrinsic factors related to the risk of falls, in the present study, the occurrence of falls was similar among the moderately-active community-dwelling elderly women with normal visual and auditory acuity and community-dwelling elderly women with deficits in these areas.[31] Thus, it is possible to suggest that visual and auditory acuity are not determining factors for the risk of falls among active, community-dwelling, elderly women.

Despite the fact that most of the participants suffered from urinary incontinence, a significant difference was found between non-fallers (90%) and fallers (70%). Borges et al.[32] conducted a profile study of 197 elderly individuals in convenience groups and found a prevalence of 57% for urinary incontinence. In the present study, only 15% of the sample reported urinary incontinence. Thus, it seems that urinary incontinence is not a determinant for falls among independent, active, community-dwelling elderly women, given that the prevalence of falls in the present study and in the abovementioned study was 28% and 36%, respectively.[32]

Functional mobility/the risk of falls was assessed using the TUG test, with no significant differences found between the groups. Another study assessed elderly women between the ages of 74 and 89 years and found no significant differences between female fallers and non-fallers based on their performance in the TUG test.[33] The authors indicated that the absence of a difference in the age group of 74-89 years could be due to the low number of participants with mobility deficits, similar to the outcomes of the present study.[33] Therefore, it is suggested that the TUG test should not be used to screen for the risk of falls among moderately-active, community-dwelling, elderly women, given that the results of this test were very similar in both groups (7.64 s for non-fallers and 7.94 s for fallers).

Concerning the fear of falls, which is considered one of the psychological factors related to the risk of falls, the participants had a mean score of 25, which is associated with a history of sporadic falls.[1] This result is significant since the non-fallers obtained the same score as the fallers. Indeed, a recent study by Kumar et al.[34] suggested that one in every five people (relatively active community-dwellers) is afraid of falling. This syndrome has been associated with the following: low education levels; high BMI scores; a lower family income; difficulty in using public transport; the use of walking aids (canes, crutches); a low perception of physical health; self-reported balance issues and the inability to get up from a knee-height chair.

Reelick et al.[4] assessed fear of falls, GS, step length and step variability among male and female elderly community-dwellers and found that those diagnosed with a fear of falls performed similarly in all of the abovementioned variables in comparison to those who did not fear falling. The results of the present study partly agree with an earlier study,[4] in which the correlation between the TUG test and a fear of falls was assessed, with no significant

associations recorded.

In the present study, there was a moderate, negative and significant correlation between the FES-I-Brazil and the gait cadence of elderly fallers, indicating that a greater fear of falls leads to a worsening in gait cadence. A recent study also confirmed a moderate, negative and significant association between the fear of falls, which was assessed using the FES-I-Brazil, and a gait speed of 4.6 m.[30] These authors indicated that a slow GS, with a shorter step length, a greater support base and a longer double support time, could be associated with a pre-existing fear of falls. Other authors have also reported that a fear of falls can result in the simultaneous recruitment of agonist and antagonist muscles, leading to a rigid posture, an abnormal gait, inadequate postural strategies, uncertainty, dependence on stability devices (orthoses) and an increase in the risk of falls.[5]

A moderate, significant correlation was found between HGS and GS for both fallers and non-fallers, indicating that a stronger HGS leads to a faster GS. This result corroborates the findings of Stevens et al.,[35] who assessed 349 men and 280 women aged between 63 and 73 years and identified associations between a stronger HGS and a better performance in the three-meter walking test. These authors indicated that HGS is a good indicator of physical performance in this age group and could be more viable than completing a battery of physical performance tests in certain clinical situations.[35] However, in the present study, no differences were found between fallers and non-fallers, which suggests that, despite the significant correlation between HGS and GS, the test was not sensitive enough to identify fallers.

The results of gait analysis on the treadmill confirmed no statistically significant differences between the groups. A prospective study by Moreira et al.[30] sought to determine if the spatiotemporal parameters of gait could predict recurring falls in 148 women aged between 65 and 85 years. The results showed that neither GS nor the other gait parameters analyzed (cadence, step length, balance time and support time) significantly predicted recurrent falls. The same authors suggested that future studies should investigate the capacity of gait parameters to predict recurrent falls among healthy elderly individuals with no mobility deficiencies in "real life" situations, such as walking over obstacles or executing cognitive and motor tasks (talking, making calculations or carrying objects). It is possible that more challenging tasks may place more pressure on the physiological and cognitive systems and provide more data related to recurring falls and the risk of falls. Therefore, future studies should include gait assessments with challenges for moderately-active, elderly community-dwellers in order to investigate the gait differences between fallers and non-fallers.

A possible limitation of the gait analysis performed in the present study was that the task involving walking on a motorized treadmill. According to Kang & Dingwell,[28] treadmill assessments can artificially reduce the natural variability of the gait of an individual, when compared with normal walking, due to the fact that speed is vigorously maintained, without the possibility of adjustments. In the present study, eight of the participants were unable to walk at the speed required to assess gait on the treadmill and asked for the test to be stopped, claiming that "*the speed was too high*". In addition, 13 participants were unable to be present on the day of the assessment. Consequently, the number of elderly women assessed on the treadmill was lower than the 85 individuals included in this research.

The outcomes indicate that these methods do not provide specificity for assessments of intrinsic factors related to falls among moderately-active, community-dwelling elderly individuals, in relation to the differences between fallers and non-fallers. More precise methods are needed for this type of investigation. Furthermore, the present study did not assess a number of intrinsic factors, such as range of motion, balance and muscle reaction time. Therefore, these factors should be investigated in more detail in order to better characterize active, community-dwelling elderly fallers and non-fallers. Conversely, significant differences were found between the residences of elderly fallers and non-fallers. Thus, extrinsic factors seem to play an important role in falls and should be considered in future studies.

Other limitations should be considered, including the cross-sectional design of the present study, which prevented the establishment of a causal relationship. In addition, the number of falls was under-estimated, due to the difficulty the participants faced when trying to remember falls in the previous 12 months. We also did not investigate the circumstances of the falls, such as: where the fall occurred (indoors or outdoors); what caused the fall; and if the individuals were able to support themselves and prevent a direct fall on the ground. Future studies should investigate these factors.

CONCLUSION

Appendicular muscle mass was below the cutoff points. However, muscle function and physical performance were normal, which meant that the elderly participants were not sarcopenic. Greater muscle strength indicated a higher gait speed. Elderly fallers exhibited worse gait cadence and a greater fear of falls than non-fallers. Residential factors related to the risk of falls and safety resources were determined for falls, indicating the relevance of assessing the risk of falls in moderately active, community-dwelling elderly women.

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REFERENCES

1. Camargos FF, Dias RC, Dias JF, Freire MT. Cross-cultural adaptation and evaluation of the psychometric properties of the Falls Efficacy Scale-International Among Elderly Brazilians (FES-I-BRAZIL). Rev Bras Fisioter 2010;14(3):237-43.
2. Clemson L, Mackenzie L, Ballinger C, Close JC, Cumming RG. Environmental interventions to prevent falls in community-dwelling older people: A meta-analysis of randomized trials. J Aging Health 2008;20(8):954-71.
3. Callisaya ML, Blizzard L, Schmidt MD, McGinley JL, Lord SR, Srikanth VK. A population-based study of sensorimotor factors affecting gait in older people. Age Ageing 2009;38(3):290-5.
4. Reelick MF, Van Iersel MB, Kessels RP, Rikkert MG. The influence of fear of falling on gait and balance in older people. Age Ageing 2009;38(4):435-40.
5. Delbaere K, Sturnieks DL, Crombez G, Lord SR. Concern about falls elicits changes in gait parameters in conditions of postural threat in older people. J Gerontol Ser A Biol Sci Med Sci 2009;64(2):237-42.
6. Melzer I, Benjuya B, Kaplanski J. Postural stability in the elderly: a comparison between fallers and non-fallers. Age Ageing 2004;33(6):602-7.
7. Iinattiniemi S, Jokelainen J, Luukinen H. Falls risk among a very old home-dwelling population. Scand J Prim Health Care 2009;27(1):25-30.
8. Krause KE, Mcintosh EI, Vallis LA. Sarcopenia and predictors of the fat free mass index in community-dwelling and assisted-living older men and women. Gait Posture 2012;35(2):180-5.
9. Shaw KA, Srikanth VK, Fryer JL, Blizzard L, Dwyer T, Venn AJ. Dual energy X-ray absorptiometry body composition and aging in a population-based older cohort. Int J Obes 2007;31(2):279-84.
10. Bijlsma AY, Pasma JH, Lambers D, Stijntjes M, Blauw GJ, Meskers CGM, et al. Muscle strength rather than muscle mass is associated with standing balance in elderly outpatients. JAMDA 2013;4(7):493-98.
11. Coin A, Sarti S, Ruggiero E, Giannini S, Pedrazzoni M, Minisola S, et al. Prevalence of sarcopenia based on different diagnostic criteria using DEXA and appendicular skeletal muscle mass reference values in an italian population aged 20 to 80. J Am Med Dir Assoc 2013;14(7):507-12.

12. Barbosa-Silva TG, Bielemann RM, Gonzalez MC, Menezes AMB. Prevalence of sarcopenia among community-dwelling elderly of a medium-sized South American city: results of the COMO VAI? Study. J Cachexia Sarcopenia Muscle 2015;6(4):1-8.

13. Lebrão ML, Duarte YAO. Saúde, Bem-estar e Envelhecimento: o Projeto Sabe no município de São Paulo: uma abordagem inicial. Brasília, DF: Organização Pan- Americana da Saúde; 2003.

14. Cruz-jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: European consensus on definition and diagnosis. Age Ageing 2010;39(4):412-23.

15. Studenski S, Perera S, Patel K, Rosano C, Faulkner K, Inzitari M, et al. Gait speed and survival in older adults. JAMA 2011;305(1):50-8.

16. Coelho FM, Narciso FM, Oliveira DM, Pereira DS, Teixeira AL, Teixeira MM, et al. sTNFR-1 is an early inflammatory marker in community versus institutionalized elderly women. Inflamm Res 2010;59(2):129-34.

17. Bertolucci PHF, Brucki SMD, Campacci SR. O mini-exame do estado mental em uma população geral: impacto da escolaridade. Arq Neuropsiquiatr 1994;52:1-7.

18. Sousa RL, Medeiros JGM, Moura ACL, Souza CLM, Moreira IF. Validade e fidedignidade da Escala de Depressão Geriátrica na identificação de idosos deprimidos em um hospital geral. J Bras Psiquiatr 2007;56(2):102-7.

19. Marx FC, Oliveira ML, Bellini CG, Ribeiro MCC. Tradução e validação cultural do questionário algofuncional de Lequesne para osteoartrite de joelhos e quadris para a língua portuguesa. Rev Bras Reumatol 2006;46(4):253-60.

20. Imoto AM, Peccin MS, Rodrigues R, Mizusaki JM. Tradução e validação do questionário FAOS – Foot and ankle outcome score para língua portuguesa. Acta Ortop Bras 2009;17(4):232-5.

21. Souza AC, Magalhães LC, Teixeira-Salmela LF. Adaptação transcultural e Análise das propriedades psicométricas da versão brasileira do Perfil de Atividade Humana. Cad Saude Publica 2006;22(12):2623-36.

22. Lino VTS, Pereira SEM, Camacho LAB, Ribeiro Filho ST, Buksman S. Adaptação transcultural da Escala de Independência em Atividades da Vida Diária (Escala de Katz). Cad Saúde Pública 2008;24(1):103-12.

23. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. Gerontologist 1970;19(3):179-86.

24. Menz HB, Morris ME, Lord SR. Foot and ankle risk factors for falls in older people: a prospective study. J Gerontol Ser A Biol Sci Med Sci 2006;61(8):866-70.

25. Bohannon RW. Measurement of Sit-to-Stand among older adults. Top Geriatric Rehabil 2012;28(1):11-6.

26. Bohannon RW. Reference values for the timed up and go test: a descriptive meta-analysis. J Geriatr Phys Ther 2006;29(2):64-8.

27. Zhang YB, Wang WQ. Reliability of the Fukuda Stepping Test to determine the side of vestibular disfunction. J Int Med Res 2011;39(4):1432-37.

28. Kang HG, Dingwell JB. Effects of walking speed, strength and range of motion on gait stability in healthy older adults. J Biomech 2008;41(14):2899-905.

29. Hallal CF, Marques NR, Castro A, Spinoso DH, Rossi DM, Navega MT, et al. Variabilidade de parâmetros eletromiográficos e cinemáticos em diferentes condições de marcha em idosos. Motriz 2013;19(1);141-50.

30. Moreira BS, Sampaio RF, Kirkwood RN. Spatiotemporal gait parameters and recurrent falls in community-dwelling elderly women: a prospective study. Braz J Phys Ther 2015;19(1):61-9.

31. Cruz DT, Ribeiro LC, Vieira MT, Teixeira MTB, Bastos RR, Leite ICG. Prevalência de quedas e fatores associados em idosos. Rev Saúde Pública 2012;46(1):138-46.

32. Borges PLC, Bretas RP, Azevedo SF, Barbosa JMM. Perfil dos idosos frequentadores de grupos de convivência em Belo Horizonte, Minas Gerais, Brasil. Cad Saúde Pública 2008;24(12):2798-808.

33. Thrane G, Joakimsen RM, Thornquist E. The association between timed up and go test and history of falls: The Tromsø study. BMC Geriatr 2007;12:1-7.

34. Kumar A, Carpenter H, Morris R, Iliffe S, Kendrick D. Which factors are associated with fear of falling in community-dwelling older people? Age Ageing 2014;43(1):76-84.

35. Stevens P, Syddall HE, Patel HP, Martin HJ, Cooper C, Aihie Sayer A. Is grip strength a good marker of physical performance among community-dwelling older people? J Nutr Health Aging 2012;16(9):769-74.

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Quality of life and informal labor among elderly persons in an intermediate Colombian city, 2012-2013

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Abstract

Objective: Describe the quality of life of elderly informal workers in an intermediate Colombian city. *Method:* A descriptive study of 320 randomly selected informal workers aged older than 18 from Manizales was performed. A sub-sample of 153 people aged older than 50, representing 47.8 percent of the study population, was performed. Two instruments were applied: one testing demographic variables and the WHOQOL-BREF quality of life questionnaire. Univariate and bivariate analyzes were performed using frequency distributions and the chi-squared test was used to identify association between variables. *Results:* 69.9% of the participants were men, the average age was 59.4 (±7.2) years, 62.0% had no or basic education, 52.0% belonged to social class 1 and 2; 6.5% had no affiliation with the health and social security system. The different dimensions of quality of life were perceived favorably, as was health. More than 50.0% were autonomous, had strong social and family networks, had not experienced negative feelings and found meaning to life. Statistical differences (p<0.05) by gender and age were found for environment, sex life, daily living skills, and satisfaction with work capacity. *Conclusion:* The quality of life of older informal workers is well perceived and is related to a positive assessment of health. From the perspective of human development, work gives meaning to the lives of older people and encourages active, healthy and productive aging.

Key words: quality of life; elderly persons; aging; job satisfaction.

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INTRODUCTION

Work is considered to be a central element of social structure. As a result, it remains essential to the lives of individuals and societies, and is a vital area for the processes of socialization and personal fulfillment and the subjectivity of individuals and groups.[1] It is a transformative activity which allows personal growth through physical and mental activity, particularly in terms of the eminently social conscience of an individual; both as a creator and a circulator of wealth and objects that satisfy human needs, whether tangible or intangible.[2] Work can be understood as the "essential expression of a person" in contrast to approaches that make the worker an element of the production process, which result in the loss of the very essence of human actions.[3]

According to the Programa de Promoción de la Formalización en América Latina y el Caribe (the Program for the Promotion of Formalization in Latin America and the Caribbean) (FORLAC), the idea of informal labor corresponds to relationships of employment that are not covered by the guidelines of protection established in labor or social legislation, whether by fact or by law, and involve limited resources of capital, low productivity and a lack of labor rights.[4] According to Busso,[5] the most comprehensive definition is precarious labor, which covers the informal economy, informal work, unregistered work and particular or specific types of job. Salas,[6] in the 1990s, proposed to abandon the idea of the informal sector, replacing it with the analysis and study of micro-units of labor. Osta[7] argues that informality stems from a purely economic and structural approach, linked to the evolution of both these ideas and to unemployment, and adopts the idea of the informal economy as a complex phenomenon of nature, in which interventions should be implemented to reduce its presence and to incorporate workers and entrepreneurs into the formal sector, to improve working conditions and quality of life. According to Guerra,[8] there are differences in the production types and characteristics of the situations of self-employed workers, which are dedicated to subsistence activities such as street vendors, refuse pickers, shoeshines and scrap dealers.

According to Arias & Bernardini,[9] elderly persons have a range of vulnerabilities related to health, housing, social security, education, and labor issues, among other concerns. Labor issues are particularly important, as often the elderly are marginalized in the areas of the job market through displacement by the younger population. Many find in informal work a source of income and a way of becoming active participants in their family and society, always remembering that this type of social and labor vulnerability represents a structural and economic problem.

Quality of life is generally defined as the well-being, happiness and satisfaction of an individual, providing a certain capacity for action, performance or positive feeling about his or her life; the World Health Organization (WHO) defines it as "individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns".[10]

The term "quality of life" refers to the physical, emotional and social well- being of people and their ability to function and to perform typical activities of daily living.

Dulcey-Ruiz[11] suggests that quality of life should be considered as a continuous construction throughout the life cycle of an individual, with an emphasis on aging, changing and interacting in different dimensions that affect and condition human beings. Quality of life among older people oscillates between two poles: the positive pole when networks of family and social support, health and adequate material conditions for living are in

place; and the negative pole, when the individual becomes dependent, with functional limitations and a lack of social support networks and self-realization.[12]

With regard to productive aging in our societies, there are a variety of opinions based on the phenomenon of aging, associated with negative elements that associate it with a culturally homogeneous group characterized by inactivity, a lack of productivity, and dependency. According to Miralles,[13] reductionist positions that relegate older people to a group whose needs can only be met through care, excluding their productive potential and the day-to-day support they provide to the people who share their lives and the community to which they belong and live, should be reconsidered.

The concept of productive aging is related to the idea of productivity, connected to the collective benefit that older people obtain through their own individual actions and activities, according to the Instituto de Mayores y Servicios Sociales (Institute for the Elderly and Social Services) (IMSERSO).[14] While productivity is important for personal use within this concept, it is essential that it is accompanied by participation in and relationships with the social environment, and support of civic and community activities.

Elderly persons participate in a variety of occupations and work that maintains their productive capacity in everyday life to support the activities of the families and communities in which they live, or work that provides for their financial needs, such as the selling of goods in the streets and other tasks. Productive aging involves the dimensions of paid work, family-domestic work, volunteer work in the community and educational and cultural activities.[13]

In this context, the objective of this paper is to describe the quality of life of over 50 informal workers in an intermediate Colombian city.

METHOD

The study was conducted in Manizales, the capital of Caldas, located in central-western Colombia, which forms part of the Triángulo del Café ("the Coffee Triangle") (Manizales, Pereira and Armenia). In 2012 the city had 391,640 inhabitants, of whom 101,666 (26.0%) were aged older than 50 years.

A descriptive study was conducted of 320 informal workers aged 18 years or over during the period 2012-2013. The subjects were randomly selected from the 1,300 informal workers in the city, after approval by the Ethics Committee of the Universidad de Caldas (the University of Caldas) and subject to the signing of a free and informed consent form (Minsalud, Colombia Resolution 08430 of 1993). This work was based on a total of 153 people aged older than 50, who accounted for 47.8% of the total sample selected for the study. This inclusion criterion was based on Colombia's Política Nacional de Envejecimiento y Vejez 2007-2019 (the National Policy on Old Age and Aging 2007-2019), in which those aged over 50 and in situations of risk, such as informal workers, can be considered as elderly.[15]

Two instruments were used. One registered the sociodemographic variables of gender, age, education, social stratum (in Colombia this refers to the classification of residential property, which serves as a reference for establishing tariffs for public utilities using the categories of 1, 2 and 3 (lower); 4 (medium); and 5 (upper)), and health system affiliation (defined as linking the different modalities of receiving health care, namely contributive, unaffiliated and poor, subsidized and through private healthcare). The other instrument used was the WHOQOL-BREF quality of life questionnaire validated by WHO, an instrument that provides a perception of quality of life in four domains: physical, psychological, interpersonal relationships and environment. It has shown good discriminant validity of content and test-retest reliability.[16]

The information was entered into Excel® and processed using the SPSS software package version 15.0, licensed from the Universidad de Caldas (University of Caldas). Univariate and bivariate analyzes were performed using frequency distributions and the chi-squared statistical test was used to show association between variables.

RESULTS

Table 1 shows that 69.9% of participants were men, the minimum age was 50 years; the average age was 59.4 (±7.2) years; 62.0% had no educational or primary school education only; 52.3% belonged to strata 1 and 2 and 6.5% were not affiliated to the health system.

Table 1. Sociodemographic characteristics of elderly informal workers (N=153). Manizales, Caldas, 2012-2013

Variable	Categories	n	%
Gender	Female	46	30.1
	Male	107	69.9
Age	50–59	88	57.5
	60–69	46	30.1
	70 or older	19	12.4
Education	No education	14	9.2
	Primary education	81	52.9
	Secondary education	55	35.9
	University education	1	0.6
	Other	2	1.3
Social Stratum	1	37	24.2
	2	43	28.1
	3	60	39.2
	4	10	6.5
	Did not know	3	2.0
Healthcare regime	Contributive	51	33.3
	None	10	6.5
	Special scheme	3	2.0
	Subsidized	89	58.2

Time spent working informally varied between one and 59 years with an average of 23 (±13) years; weekly income was between $4,000 and $700,000 Colombian pesos, averaging $92,000 (±$93,000) Colombian pesos.

Regarding social security, 58.2% were affiliated to the subsidized healthcare system (where the state guarantees the right to health care through a subsidy provided to the poorest members of society who do not have the ability to pay). Notably, 99.3% were not affiliated to an Office of Risk Management (ORM). A total of 77.8% did not have a pension plan; although 83.0% owned their own business.

Quality of life was perceived as positive across the different dimensions by the informal workers aged over 50. It is notable that 51.0% rated their health as good to excellent; consistent with the 42.0% who were satisfied with their health. In terms of quality of life, 72.5% rated it between normal and good.

A total of 60.0% said that pain (physical) either did not hinder or hindered them only a little from doing what they needed to do in day to day life; 47.0% did not need medical treatment to function in their daily lives; 77.0% were able to travel from one place to another; 52.0% were satisfied and very satisfied with their sleep; 58.0% were satisfied with their ability to perform activities of daily living and 55.0% were happy with their work (table 2); 82.0% enjoyed life, either to a regular degree or extremely, and 43.0% said life makes sense; 75.0% accepted their physical appearance; 46.0% said they never or rarely had negative feelings, such as sadness, hopelessness, anxiety or boredom (Table 3)

Table 4 shows the characteristics relating to the dimension of surrounding environment, which was considered by 45.0% of participants to be only a little healthy or unhealthy; 69.0% did not have enough or had little money to meet their needs; 58.0% had little or no opportunity for recreation, relaxation or fun; 49.0% were not satisfied with health services.

Table 2. Characteristics of the sample (N=153) related to physical dimension.Manizales, Caldas, 2012-2013.

To what extent do you feel that physical pain prevents you from doing what you need to do?									
Not at all		A little		A moderate amount		Very much		An extreme amount	
n	%	n	%	n	%	n	%	n	%
64	41.8	29	19.0	13	8.5	36	23.5	11	7.2

How much do you need any medical treatment to function in your daily life?									
Not at all		A little		A moderate amount		Very much		An extreme amount	
n	%	n	%	n	%	n	%	n	%
60	39.2	13	8.5	13	8.5	49	32.0	18	11.8

How well are you able to get around?									
Very poor		Poor		Neither poor nor good		Good		Very good	
N	%	N	%	n	%	n	%	N	%
2	1.3	16	10.5	17	11.1	26	17.0	92	60.1

How satisfied are you with your sleep?									
Very dissatisfied		Dissatisfied		Neither satisfied nor dissatisfied		Satisfied		Very satisfied	
N	%	n	%	n	%	N	%	N	%
13	8.5	28	18.3	32	20.9	51	33.3	29	19.0

How satisfied are you with your ability to perform your daily living activities?									
Very dissatisfied		Dissatisfied		Neither satisfied nor dissatisfied		Satisfied		Very satisfied	
n	%	n	%	n	%	n	%	N	%
6	3.9	14	9.2	43	28.1	74	48.4	16	10.5

How satisfied are you with your capacity to work?									
Very dissatisfied		Dissatisfied		Neither satisfied nor dissatisfied		Satisfied		Very satisfied	
n	%	N	%	n	%	n	%	n	%
3	2.0	20	13.1	45	29.4	67	43.8	18	11.8

Table 3. Characteristics of the sample (N=153) related to physiological dimension. Manizales, Caldas, 2012-2013.

How much do you enjoy life?

Not at all		A little		A moderate amount		Very much		An extreme amount	
n	%	n	%	n	%	n	%	n	%
21	13.7	23	15.0	73	47.7	19	12.4	17	11.1

To what extent do you feel your life to be meaningful?

Not at all		A little		A moderate amount		Very much		An extreme amount	
n	%	n	%	n	%	n	%	n	%
4	2.6	6	3.9	77	50.3	41	26.8	25	16.3

How well are you able to concentrate?

Not at all		A little		A moderate amount		Very much		Extremely	
n	%	n	%	n	%	n	%	n	%
6	3.9	19	12.4	45	29.4	69	45.1	14	9.2

Are you able to accept your bodily appearance?

Not at all		A little		Moderately		Mostly		Completely	
n	%	n	%	n	%	n	%	n	%
2	1.3	9	5.9	26	17.0	84	54.9	32	20.9

How often do you have negative feelings such as blue mood, despair, anxiety, depression?

Never		Seldom		Quite often		Frequently	
n	%	n	%	n	%	n	%
34	22.2	37	24.2	40	26.1	27	17.6

How satisfied are you with yourself?

Very dissatisfied		Dissatisfied		Neither satisfied nor dissatisfied		Satisfied		Very satisfied	
n	%	n	%	N	%	n	%	n	%
3	2.0	5	3.3	49	32.0	69	45.1	27	16.6

Table 4. Characteristics of the sample (N=153) related to the environmental dimension. Manizales, Caldas, 2012-2013.

How safe do you feel in your daily life?									
Not at all		A little		A moderate amount		Very much		Extremely	
n	%	n	%	n	%	n	%	n	%
12	7.8	28	18.3	58	37.9	49	32.0	6	3.9

How healthy is your physical environment?									
Not at all		A little		A moderate amount		Very much		Extremely	
n	%	n	%	n	%	n	%	n	%
16	10.5	54	35.3	53	34.6	23	15.0	7	4.6

Have you enough money to meet your needs?									
Not at all		A little		Moderately		Mostly		Completely	
n	%	N	%	n	%	N	%	N	%
26	17.0	80	53.2	40	26.1	4	2.6	3	2.0

How available to you is the information you need in your day-to-day life?									
Not at all		A little		Moderately		Mostly		Completely	
n	%	n	%	n	%	n	%	N	%
17	11.1	16	10.5	52	34.0	54	35.3	14	9.2

To what extent do you have the opportunity for leisure activities?									
Not at all		A little		Moderately		Mostly		Completely	
n	%	n	%	n	%	n	%	N	%
48	31.4	42	27.5	39	25.5	20	13.1	4	2.6

How satisfied are you with the conditions of your living place?									
Very dissatisfied		Dissatisfied		Neither satisfied nor dissatisfied		Satisfied		Very satisfied	
n	%	n	%	n	%	n	%	N	%
3	2.0	18	11.8	38	24.8	73	47.7	21	13.7

How satisfied are you with your access to health services?									
Very dissatisfied		Dissatisfied		Neither satisfied nor dissatisfied		Satisfied		Very satisfied	
n	%	n	%	n	%	n	%	n	%
46	30.1	30	19.6	36	23.5	31	20.3	10	6.5

How satisfied are you with your transport?									
Very dissatisfied		Dissatisfied		Neither satisfied nor dissatisfied		Satisfied		Very satisfied	
n	%	n	%	n	%	n	%	n	%
9	5.9	14	9.2	56	36.6	58	37.9	16	10.5

Table 5, which corresponds to the dimension of interpersonal relationships, found that 65.0% were very satisfied with their personal relationships and 45.0% were very satisfied with the support of friends. It is noteworthy that the item with the lowest positive assessment in this dimension was satisfaction with sex life.

Table 5. Characteristics of the sample (N=153) related to the interpersonal dimension. Manizales, Caldas, 2012-2013.

How satisfied are you with your personal relationships?

Very dissatisfied		Dissatisfied		Neither satisfied nor dissatisfied		Satisfied		Very satisfied	
n	%	n	%	n	%	n	%	n	%
2	1.3	13	8.5	38	24.8	75	49.0	25	16.3

How satisfied are you with your sex life?

Very dissatisfied		Dissatisfied		Neither satisfied nor dissatisfied		Satisfied		Very satisfied	
n	%	n	%	n	%	n	%	n	%
22	14.4	16	10.5	62	40.5	40	26.1	13	8.5

How satisfied are you with the support you get from your friends?

Very dissatisfied		Dissatisfied		Neither satisfied nor dissatisfied		Satisfied		Very satisfied	
n	%	n	%	n	%	n	%	N	%
12	7.8	27	17.6	44	28.8	53	34.6	17	12.1

There were statistically significant differences by gender for attitudes towards the environment, satisfaction with sex life and negative feelings ($p<0.05$). Men were more satisfied with these dimensions. Age was associated with the environment, ability for daily living, satisfaction with capacity to work and satisfaction with sex life ($p<0.05$). Older adults between 50 and 59 years performed better in these variables (Table 6).

Table 6. Report of quality of life of elderly informal workers (N=153) by gender and age. Manizales, Caldas, 2012-2013.

Variable	Statistics and p value	Calidad de vida				
		How healthy is your physical environment?	How satisfied are you with your ability to perform your daily living activities?	How satisfied are you with your capacity to work?	How satisfied are you with your sex life?	How often do you experience negative feelings such as blue mood, despair, anxiety and depression?
Gender	X^2	5.306	-	-	9.607	8.326
Female	*p* value	0.07	-	-	0.008	0.016
Male	Phi	0.186	-	-	0.251	0.233
Age range	X^2	14.001	16.892	13.485	18.223	-
50–59	*p* valor	0.007	0.002	0.009	0.001	-
60–69	Contingency coefficient	0.303	0.332	0.285	0.326	-
70 and older						

DISCUSSION

A number of studies have explored the quality of life of elderly persons and found common factors with respect to this characteristic in the overall population. Scientific evidence of the relationship between quality of life and informal work among the older population, however, is scarce.

As Manizales has reduced its population growth rate and the population has grown older, there has been a subsequent increase in the dependency ratio, as the income of active workers must support a greater number of older adults.[17] Regarding sociodemographic characteristics, 69.9% of the present study were men, in contrast to the study by Estrada et al.,[18] in which 59.4% were women, and similar to that described in a study by Rivas et al.[19], where 75.0% were men. The average age in the present study was 59.4 (±7.2) years. Estrada et al.[18] reported an average age of 79.2 (±8) years. The results were similar in both studies in terms of educational level and social strata.[18,19]

The maximum time spent working in the informal sector in the study population was 59 years, with an average of 23 years, similar to that described by Rivas et al.[19], where it was clear that the population was dedicated to self-employment, being involved in some kind of modality of informal work from an early age. In terms of matters relating to social security, about 60% of participants were affiliated to the subsidized health regime and a high percentage had no affiliation with an Office of Risk Management or the pension system, similar to the findings of Rivas et al.[19] However, in the study by Estrada et al.,[18] 58.3% of the participants said they were members of a pension scheme and 46.3% were affiliated to the subsidized health regime.

83% of the older people owned their own businesses. These were related to the sale of sweets, fruits and flowers, activities that require little capital investment. Rivas et al.[19] found that a high percentage of participants were self-employed.

More than 50.0% of participants positively assessed their quality of life and health. Studies by Navarro et al.[20] and Millán,[21] highlighted three elements that corresponded to the well-being of elderly persons: feeling satisfied with their lives, having the capacity and competence to achieve and maintain control of their environment, and

conditions of life, fundamental aspects for human self-realization and development.

The older adults did not consider their work place to be very healthy, as the majority of their labor activities took place in public streets and exposed to the dangers of such locations. Zamarrón[22] stated that the actions of an individual within his or her environment and in that of the workplace are the main factors behind the way in which he or she ages.

Being autonomous was evaluated positively by the participants, and included such aspects such as information for activities of daily living, having money to pay one's day-to-day expenses, the opportunity to take part in leisure, recreation and relaxation activities and the capacity to move from one place to another. In this context, Martí et al.[23] found that autonomy is relevant to the individual's evaluation of his or her quality of life, in that it facilitates adaptation to the surrounding environment.

Satisfaction was expressed with activities of daily life, social support and feelings and emotions, which may be explained by the fact that the work of the participants is carried out in a public environment, in contact with the various actors present in such locations including customers, police authorities, passers-by and others working in the same labor conditions, in contrast to other elderly persons who tend to be institutionalized in spaces such as the home and care facilities, restricting their autonomy and in detriment to their social connections and therefore their affective life. Similar findings were reported in a study by Urzúa et al.,[24] in which individuals who were not sick significantly valued social support and their purpose in life. The same situation was also described by Osorio et al.[25] and by Rivas et al.[19], who concluded that "social relations and support networks represent the heart of the social interaction of the elderly".

The statistical differences by gender and age in dimensions such as environment, work capacity, ability to perform activities of daily living and sex life were notable; studies such as that by Estrada et al.[18] found significant differences by gender, age and intimacy while Galán et al.[26] identified an association between age and environmental quality and satisfaction with life.

Although this study was concluded successfully, it should be noted that the participants agreed to respond to the WHOQOL-BREF quality of life questionnaire on a voluntary basis. However, there were limits for the carrying out of the survey, some interruptions due to the work tasks of the participants, such as attending customers, as well as the conditions of the surrounding environment such as noise and climate.

CONCLUSION

The quality of life elderly informal workers is viewed favorably and is related to a positive evaluation of health. Work is a factor that stimulates healthy, active and productive aging and the social interaction of many elderly workers favors their quality of life. Furthermore, from the perspective of human development, it gives meaning to the lives of the elderly, allowing them to extend their capacities as an active and productive individual, and contributes to self-realization and social recognition.

These findings can be explored in greater depth by evaluating the effect of the type of work on elderly individuals, through studies with a qualitative focus that lead to the installation of, from a theoretical perspective, public policies that result in relevant and concrete interventions for this growing population group in Latin America.

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REFERENCES

1. Castel R. El ascenso de las incertidumbres: trabajo, protecciones y estatuto del individuo. México: Fondo de Cultura Económica; 2010.
2. De La Garza E. Hacia un concepto ampliado del trabajo, de control, de regulación y de construcción social de la ocupación: los otros trabajos. Rev Iztapalapa 2009;30(66):22-36.
3. Organización Internacional del Trabajo. Declaración de Lima. 18ª Reunión Regional Americana. Lima: OIT; 2014.
4. Organización Internacional del Trabajo, Programa de Promoción de la Formalización en América Latina y el Caribe. Experiencias recientes de formalización em países de América Latina y El Caribe: notas sobre formalización [internet]. Lima: OIT; 2014 [acesso em 12 nov. 2015]. Disponível em: http://www.ilo.org/wcmsp5/groups/public/---americas/---ro-lima/documents/publication/wcms_245613.pdf
5. Busso M. Cuando una crisis amenaza: un estudio sobre vivencias y percepciones de artesanos argentinos en períodos de crisis socioeconómicas. Ciênc Soc Unisinos 2011;47(3): 292-9.
6. Salas C. ¿Pequeñas unidades económicas o sector informal?". Cotidiano 1992;8(45):1-13. Gómez A. Análisis socio laboral de los vendedores estacionarios en el sector turístico de Bocagrande de la ciudad de Cartagena. Rev Aglala 2010;1(1):1-17. (Esta ref. Possui 2 artigos distintos. que devem ser desmembrados: 1: Salas C e 2: Gòmez) Ambos estão normalizados.
7. Osta KM. Desempleo e Informalidad en América Latina: definiendo políticas públicas para Venezuela. Rev Venez Gerenc 2007;12(38):262-78.
8. Guerra AE. Consideraciones teóricas acerca de la economía informal, el Estado y la gerencia [monografía en internet]. Barquisimeto: Universidad Centrooccidental Lisandro Alvarado Biblioteca Virtual de Derecho, Economía y Ciencias Sociales; 2007 [acesso em 23 out. 2013]. Disponível em: http://www.eumed.net/libros/2009a/517/Informalidad%20para%20la%20Organizacion%20Internacional%20del%20Trabajo.htm
9. Arias S, Bernardini D. Retos económicos del envejecimiento. Voces fénix [Internet] 2014 [acesso em 13 nov. 2015];1(36):126-31. Disponível em: http://www.vocesenelfenix.com/sites/default/files/numero_pdf/fenix36%20baja.pdf
10. Orley J, Saxena S. What Quality of Life? World Health Forum 1996;17:354-5. Preparado em nome da WHOQOL GROUP.
11. Dulcey-Ruiz E. Calidad de vida y derecho al reconocimiento en la vejez. Oñati Socio-Legal Ser [Internet] 2011 [acesso em 23 jan. 2014];1(8):9-11. Disponível em: http://opo.iisj.net/index.php/osls/article/view/86
12. Estrada A, Cardona D, Segura AM, Chavarriaga LM, Ordóñez J, Osorio JJ. Calidad de vida de los adultos mayores de Medellín. Biomédica 2011;31:492-502.
13. Miralles I. Envejecimiento productivo: las contribuciones de las personas mayores desde la cotidianidad. Trab soc 2011;15(16):137-61.
14. Instituto de Mayores y Servicios Sociales. Envejecimiento activo: Libro blanco [Internet]. Madrid: IMSERSO; 2011 [acesso em 13 nov. 2015]. Disponível em: http://www.imserso.es/InterPresent1/groups/imserso/documents/binario/8088_8089libroblancoenv.pdf
15. República de Colombia. Ministerio de Protección Social. Política Nacional de Envejecimiento y Vejez 2007-2019. [Local desconhecido]: Ministerio de Protección Social; 2007 [acesso em 23 Jan. 2014]. Disponível em: http://www.minsalud.gov.co/Documentos%20y%20Publicaciones/POL%C3%8DTICA%20NACIONAL%20DE%20ENVEJECIMIENTO%20Y%20VEJEZ.pdf
16. World Health Organization. WHOQOL-BREF: Introduction, administration, scoring and generic version of the assessment. Field Trial Version December 1996. Geneva: WHO; 1996 [acesso em 6 jul. 2013]. Disponible en: http://www.who.int/mental_health/media/en/76.pdf

17. Alcaldía de Manizales. Plan de desarrollo 2012-2015 "Gobierno en la Calle" [Internet]. Minizales: [publicador desconhecido]; 2012 [citado 4 nov. 2015]. Disponível em: http://www.manizales.gov.co/RecursosAlcaldia/20150505213105570 9.pdf

18. Estrada A, Cardona D, Segura AM, Chavarriaga, LM, Ordóñez J, Osorio JJ. Calidad de vida de los adultos mayores de Medellín. Biomédica 2011;31(4): 492-502.

19. Romero AV, Rivas AC, Vásquez M, Ramos de la Cruz E, González T, Acosta DP. Calidad de vida del adulto mayor inscrito en los comedores del programa nacional de alimentación para el adulto mayor Juan Luis Londoño De La Cuesta ICBF, 2010-II. DUAZARY [Internet] 2013 [acesso em 22 jan 2014];10(1):26-32. Disponível em: http://investigacion.unimagdalena.edu.co/revistas/index.php/duazary/article/viewFile/203/181

20. Navarro E, Meléndez JC, Tomás JM. Relaciones entre variables físicas y de bienestar en la calidad de vida de las personas mayores. Gerokomos [Internet] 2008 [acesso em 30 jan. 2014];19(2):17-21. Disponível em:http://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1134-928X2008000200002&lng=es.

21. Millán JC. Envejecimiento y calidad de vida. Rev Galega Econ [Internet] 2011 [acesso em 30 jan. 2014];20(supl):1-13. Disponible en: https://www.usc.es/econo/RGE/Vol20_ex/castelan/art5c.pdf

22. Zamarrón MD. Envejecimiento activo: un reto individual y social. Soc Utopía 2013;(41):449-63.

23. Martí J, Martínez F, Martí M, Marí R. Responsabilidad Social Universitaria: acción aplicada de valoración del bienestar psicológico en personas adultas mayores institucionalizadas. Polis 2007;18:1-13.

24. Urzúa A, Bravo M, Ogalde M, Vargas C. Factores vinculados a la calidad de vida en la adultez mayor. Rev Med Chile 2011;139(8):1006-14.

25. Osorio P, Torrejón MJ, Anigstein MS. Calidad de vida en personas mayores en Chile. Rev Mad, Univ Chile 2011;24:61-75.

26. Galán JD, García MD, Betancort M. Calidad de vida en personas mayores y su relación con el sentido de vida. Inf Invest Educ 2011;25(1):35-50.

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The perception of elderly riverside residents of the Amazon region: the empirical knowledge that comes from rivers

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Abstract

Objective: To study and identify the perception of elderly riverside people of the Amazon region regarding old age. *Method:* An exploratory, descriptive, qualitative study was performed. Data was collected through interviews with 14 elderly riverside residents of the city of Cametá, Pará, Brazil. A script consisting of characterization data and an interview with semi-structured questions was used, guided by the following questions: *"What is aging for you?"* and *"Is aging good or bad?"*. The participant observation technique was also used, through a field diary. For data analysis, we opted for thematic-categorical content analysis. *Results:* Generally, the elderly had a heterogeneous perception of old age. However, all saw it as a process anchored to the naturalness of life, as well as death. Some of the elderly persons associated old age with a phase of life with negative repercussions due to the appearance of functional disorders and limitations and especially the reduction of availability for work. It can be conferred that the majority, even with while displaying some limitations in this stage of life, have clear and well defined coping strategies, such as the recognition of their limitations or family and religious support. *Conclusion:* The study found that aging is the shared result of the experiences and knowledge of the interaction of the elderly persons with the riverside environment around them, resulting in their cultural differentiation.

Key words: Aging; Elderly; Perception; Riverside Population.

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INTRODUCTION

An understanding of the aging process is anchored in multiple knowledge dimensions.[1] The scientific representations of the nuances of this process, from a biopsychosocial perspective, are well documented in conceptual terms, and have emerged as important guidelines in the field of gerontology, providing tools for research and reinforcing healthcare.

Discussions on this theme have widened, leading to a subsequent growth in interest in researching and understanding the specifics of the process, including from other angles, such as the perspective of aging itself.[2-8]

What has been discovered through these approaches goes beyond the previously standardized and scientifically recognized dimensions on aging, resulting in extension in other directions, bringing scientific and popular knowledge closer together. Aging is now understood as *"a series of morphological, physiological, biochemical and psychological changes that determine the progressive loss of an individual's adaptability to the environment",*[9] representing a universe of different valuations, representations and confrontations. Thus, new discussions and the possibility of a deeper reanalysis have emerged.

In this context it is worth mentioning some important theoretical frameworks on the aging process and how the elderly individual is perceived within it. In the view of Rodrigues & Neri,[10] aging implies a greater risk for the development of biological, socioeconomic and psychosocial vulnerabilities. In this context, it is associated with deficient conditions of education, income and health throughout life. To a greater or lesser degree, these vulnerabilities generate the possibility of illness and result in difficulties of access to the protective resources made available by society.

Moimaz et al.[2] state that the elderly interpret the aging process in different ways and this is strongly influenced by the life history of each individual. In this way, Lima & Murai[7] and Paschoal[11] corroborate and add that, as aging is not a homogeneous experience, each person experiences this phase of life in his or her own way, according to different standards, norms, expectations, desires, values and principles, taking into consideration the structural aspects of their lives, such as health, education and economic conditions.

Rodrigues & Rauth[12] go further, stating that "every person and every generation experiences old age differently, depending on a constellation of biological and environmental factors." In Brazil, it is also necessary to emphasize the importance of regional differences with regard to levels of health, education, opportunities and even life expectancy. For the authors "there is no single old age in Brazil, but rather a variety of old ages".[12]

In this context, the lack of studies on these perceptions involving the discourses of populations considered "vulnerable", such as riverside communities, represents a gap in literature. Little is known about old age in this context, which is typical of the Amazon region and is of considerable scientific interest. The aging process as experienced in these isolated environments, which have low levels of human development and poor healthcare and social protections, should be the subject of studies, as it is based on rich and extremely differentiated functional, social and cultural realities.

Given the above, it was considered necessary to discover how the aging process takes place in the remote riverside communities of the Amazon region, seeking to give greater visibility to this section of the population. This therefore study aimed to identify and analyze the perception of elderly riverside dwellers of the Amazon region regarding the aging process.

METHOD

An exploratory-descriptive study with a qualitative approach was carried out. The aim of the exploratory-descriptive study is to improve

ideas, and it therefore features a highly flexible design which allows the investigation of various factor. The qualitative approach is concerned with the universe of meanings, reasons, aspirations, attitudes, beliefs and values, corresponding to a deep understanding of the relationships, processes and phenomena experienced by human beings.[13,14]

To ensure a deeper investigation of the subject, the instrumentation process was based on the interchange between the "semi-structured interview" and "participant observation" procedures. The semi-structured interviews were conducted by two researchers in the home of the elderly individuals. The interview script consisted of two parts: the first contained the demographic data of the respondent (gender, age, nationality, marital status, education, income, number of children and makeup of family); the second part contained semi-structured questions, directed by the following guiding questions: *"What is aging for you?" "And is growing old good or bad?"*. The participant-observation technique involved creating a field diary record and allowed the explanatory dimensions of the data to be explored, and was carried out throughout each interview.

Data collection was performed in January 2015 and the defined field of study was the town of Cametá, located in the northeastern state of Pará, Brazil, 144 km in a straight line from the state capital of Belém. This city is the oldest and most historic urban area of the Lower Tocantins River, whose course is geographically shaped by around 90 river islands. According to the IBGE, the municipality has a population of 120,896 inhabitants, 3,800 of whom are aged over 60 years.[15] The ecological context of the study involved two districts (the District of Juaba and the District of Carapajó), including seven islands that are remote from the town center and are accessible only by river transport (Tem-Tem, Mutuacá, Mutuacá de Baixo, Mutuacá de Cima, Mutuacazinho, Gama and Mapeuá).

The participants were 14 elderly residents native to the riverside communities, who were introduced to the researchers by two representatives (a native resident and a Community Health Agent). The criteria for the number of participants was the saturation of the speech content.

The elderly persons were approached individually and the research proposal and interest in hearing their opinions was explained. After they had accepted and signed Forms of Free and Informed Consent the interviews were conducted. It is worth noting that the interviews were carried out calmly, displaying interest and availability (without time limits) to the respondents, whilst also observing their non-verbal characteristics (Figure 1). The interviews were recorded with the aid of an audio-recorder and subsequently transcribed and typed in their entirety in Windows Word 2008.

Thematic analysis was chosen, with emphasis on the analysis of the thematic-categorical content. This analysis technique focuses on the meanings of communication, which serves as a basis for the inference of attributes or logical deductions and, finally, the categorization of themes.[16] Operationally, three stages were followed: a) *pre-analysis*; consisting of the initial reading, which allowed thorough contact with the collected material. The material was organized to respond to questions of validity, such as exhaustiveness, representativeness, homogeneity and relevance. At this stage, it was possible to determine the units of analysis (sentences), the hypotheses, the theoretical framework in which the results would be analyzed and the form of categorization; b) *exploration of material;* at this stage categorization was carried out. Sections of text in units of analysis were used and the data was aggregated, with the choice of the probable categories; c) *processing and interpretation of results:* a diagram featuring the categories of evidence was constructed to allow analysis and interpretation to be carried out and inferences to be drawn about the object of study – the perception of Amazonian riverine elderly persons on aging.

The research project was approved by the Ethics Research Committee of the Núcleo de Medicina Tropical da Universidade Federal do Pará (the Tropical Medicine Center of Para Federal University), under registration n° 926.744/2014 (CAAE: 36972714.2.0000.5172). The elderly persons participated voluntarily and the study complied with Resolution nº 466/2012 of the Ministry of Health.

RESULTS AND DISCUSSION

The study included 14 elderly riverside residents, aged between 64 and 96 years, with a mean age of 72.7 (±9.1) years. The majority were male, married/cohabiting and had no schooling. All lived in their own homes, with an average of 6.5 children, and cohabited mainly with their spouses, children and grandchildren (table 1).

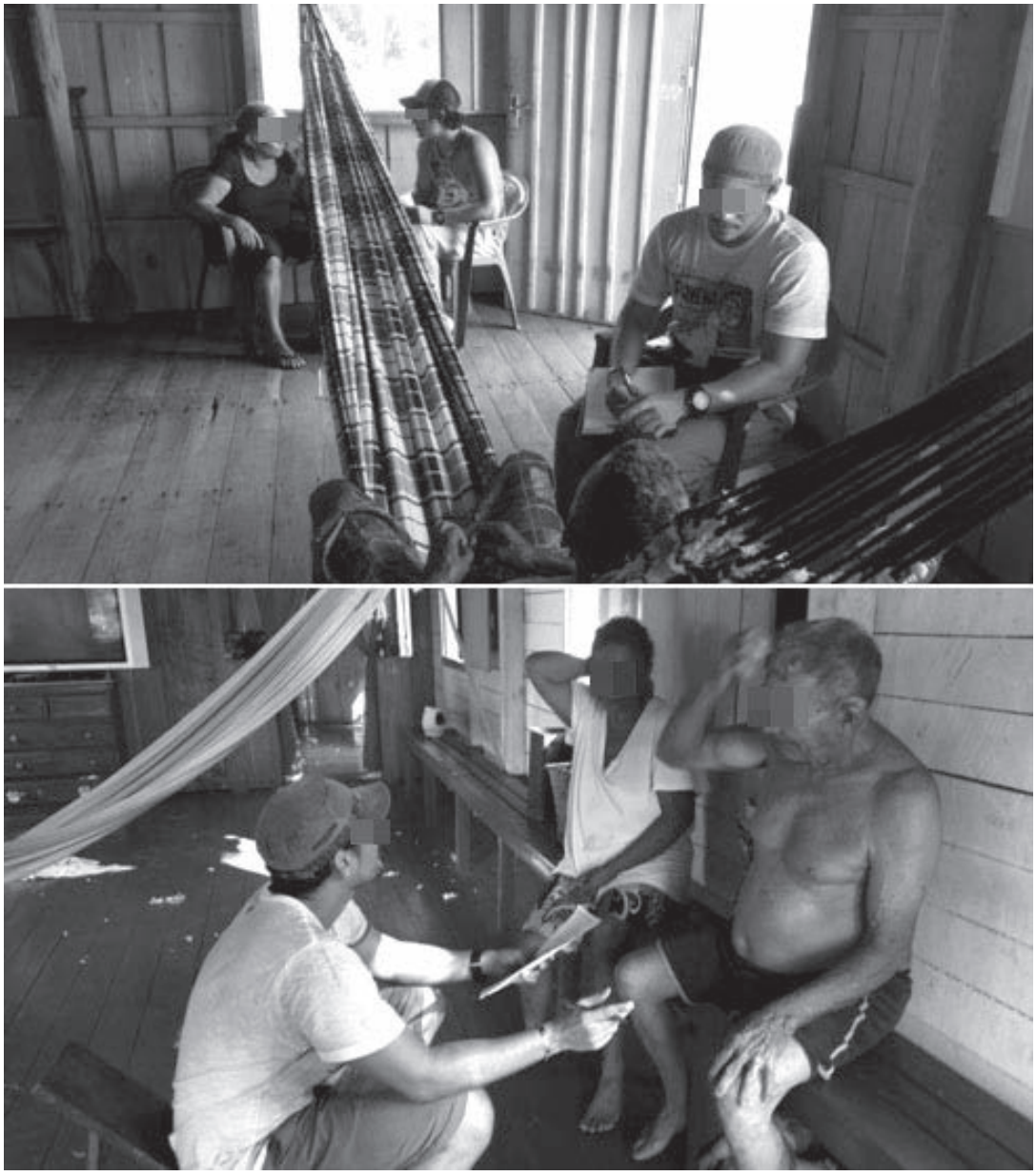

Figure 1. Photographs showing interviews with elderly individuals involved in the study. Cametá, Pará, 2015.

Table 1. Sociodemographic profile of elderly riverside dwellers in the Amazon region. Cametá, Pará, 2015.

Characteristics	n	%	CI95%
Gender			
Female	6	42.9	17.7-71.1
Male	8	57.1	28.9-82.3
Marital status			
Married/cohabiting	7	50.0	23.0-77.0
Single	4	28.6	8.4-58.1
Widowed	3	21.4	4.7-50.8
Education			
None	8	57.1	28.9-82.3
1 to 3 years	4	28.6	8.4-58.1
4 to 7 years	2	14.3	1.8-42.8
Children			
Yes	12	85.7	57.2-98.2
No	2	14.3	1.8-42.8
Family composition			
Lives alone	1	7.1	0.2-33.9
Spouse with children/grandchildren	6	42.9	17.7-71.1
Children/grandchildren	4	28.6	8.4-58.1
Other relations	3	21.4	4.7-50.8

Historically, all the elderly persons were rural workers focused on family-based production, mainly through extractive farming and as fishermen. Their economic income was homogeneous, with the majority of respondents receiving income through the rural pension scheme, equivalent to the minimum wage, as well as potential additional income generated from extractive activities, such as selling fruit, especially açaí, and from animals reared and/or captured in the riverine environment (fish, shrimp, chicken and pigs).

Self-awareness of aging: giving a voice to elderly riverside dwellers

In general, talking about aging and old age with the elderly riverside dwellers was a very easy process. At first, the impression given was that everything was satisfactory, due to timid-sounding responses such as "*It's fine*" and "*It's not too bad*" even with regard to the functional limitations and adversities of the environmental context where they lived. But as the conversations

continued, the difficulties of their daily lives and their manners of coping were revealed wisely and in a very individual manner.

It should be noted that the various verbalized approaches in the discourses reflected the cultural influences of a long life in a shared environment that differs greatly from large urban centers, which reflected their differing needs, converging for the construction of the elderly biopsychosocial human being while retaining their individuality.

In accordance with the proposal of the study and following speech analysis, 179 units of analysis (sentences) emerged that allowed the categorization of topics and subtopics for evaluation. Through this process, it was possible to identify the meaning of old age for the elderly riverside dwellers through the references provided by them.

A. The perception that old age is anchored in a natural process: "Yes, it's good, parente (relative)", "You can't go back!"

When asked about their perceptions, different answers emerged, however, most of the elderly strongly and empirically indicated that aging was a natural process. This discourse, which employed a certain tone of conformism and/or acceptance, was of great interest to the researchers. Nevertheless, there were also echoes of nostalgia and comparisons with youth:

> *"[...] We don't have any choice, do we? But it's ok, if you have your health you have all you need". (E11)*

> *"Well, it's the way of getting old, isn't it? It's the way it is... You can't go back to your youth, can you?". (E3)*

Souza et al.[17] indicated that aging should be understood as a process of life. We grow old because we live, and often without realizing it. To Moimaz et al.,[2] what determines our capacity of acceptance and the manner in which we grow old is the individual behavior of each person. In the perception of the riverside elderly persons surveyed, aging is a part of human nature and is just a natural stage of life they are experiencing. They believe everyone will go through the same experience, regardless of the will of the individual, as verbalized by some:

> *"[...] I get by, it's good. It's one of those things, isn't it?". (E14)*

> *"It's good, because we can't say it's bad, can we [laughs]. It's a phase we have to go through. We have to go through it... Even if we don't want to". (E5)*

Lima & Murai[7] observe that this process is universal, precisely because it is natural. For the authors, it is critical to understand that every living being is born, develops, grows, grows old and dies. Added to this perspective, it is also important to see old age as another phase of the process of human development rooted in transformations, challenges and confrontations, just as the other phases of the life cycle.[7]

From the perspective of Zimerman,[18] the elderly acquire a greater awareness of what they are experiencing when they accept and realize that aging is a natural process of the life cycle. Older people are then more likely to see old age positively, as a phase where they have accumulated the experience and maturity to allow them to be themselves, as well as freeing them of certain responsibilities.

However, although the elderly individuals surveyed perceived themselves as mature and experienced people, the imaginary meanings inferred in most of the discourses had negative echoes. The value allocated to activities that required good body functionality, such as working in agriculture and travelling in river vessels revealed the importance of their use and of being useful to the family and the community. Elderly persons, when they realize that their limitations, mainly resulting from physical aging, can free themselves from such responsibilities, may suffer a decline in their functionality and, therefore, their value as productive individuals.

B. Perception anchored in the repercussions of old age

B1. Processes of senility: "Avortado (Excess) of disease"

The discourse of respondents revealed an aging marked by the onset of many diseases. Some of these were perceived by the elderly as the result of their own senility, in particular those linked to the locomotor, visual, gastrointestinal and cardiovascular systems. Others, however, denoted an unsuccessful aging process amid unfavorable social and economic conditions. For some of these elderly persons, old age is a time of living with pain and a feeling of incompetence in movement, which is expressed in their discourse with a certain sense of the mournful. The interface between old age and illness is sometimes so close that this stage of life is perceived as a pathological process itself, as noted:

> *"Look, old age is an illness....". (E3)*

One peculiarity perceived in the statements of the elderly riverside dwellers is the strong association between diseases and functional and social repercussions. Thus, discussing the emergence of a pathological process was almost always accompanied by an increased focus on the limitations and on every day and occupational losses. Among the diseases mentioned, discourses in relation to changes in visual acuity, the gastrointestinal system and rheumatic processes, stood out, as shown in the following reports.

> *"[...] these days I can't do many things at night because of my vision. When the motor stops, I can't even see with a lamp [...]". (E13)*

> *"[...] I have dinner at 17.30 or 18h, because I can't eat at night, I have stomach trouble, so I have to have dinner early". (E12)*

> *"[...] I don't wash clothes because of rheumatism, my daughter does it. I can't sweep or clean the house, she does it [...]". (E10)*

The emergence of new paradigms and values attributed to the aging process is closely linked to the environmental, socioeconomic and cultural context of the study. The riverside reality is strongly conditioned by physical strength and body resistance because of a life of long journeys and family subsistence labor, unlike the urban ecological context. Respondents revealed the impact of this burden, mainly related to a loss of strength and limitations in walking.

> *"[...] there are illnesses that mean you can't even walk [...] I used to be able to do a lot of things, but now I can't". (E1)*

> *"[...] I haven't stepped on the ground for almost two years now. My legs aren't good". (E8)*

> *"[...] before, when I could, I'd go out, to visit my relatives. Before this my legs were strong [...]". (E13)*

> *"So now people tell me I can only get up to eat, I can't use too much strength, you know? That's what I'm telling you...It's not good because I can't do anything". (E12)*

Moimaz et al.[2] correctly highlighted that the terms movement and aging are closely linked. The importance of being able to move is not only related to the discovery of whether or not one is healthy, but also to autonomy, knowing one's own body and the aging process.

Salmaso et al.[19] described sarcopenia, understood to mean a reduction in mass, muscle strength and power, as an important natural consequence of aging. Rizzoli et al.[20] also added that this condition often correlates with functional decline and disability, and is considered one of the variables used to define the syndrome of frailty.

B2. Functional limitations: "As much as you can"

The verbal reports in this study reinforce the idea that old age, combined with pathological processes, can sometimes result in a fear of the individual losing overall functionality and control

over his or her own existence. It is therefore worth highlighting the emergence of some symbolic representations of this situation:

> *"Well, as long as I can keep living and still know what I'm doing, you know? Because being stuck in a corner... There are people like that, aren't there? Who just want to stay alive! Aren't there? Who aren't dead yet, they're still alive, but they don't know what's going on, they can't do anything. To live like that, I don't think it's... no, it's not good". (E2)*

According to Moraes,[21] well-being and functionality are equivalent; they represent the existence of autonomy (the individual capacity to make decisions and have control over one's actions, establishing and following one's own rules) and independence (ability to perform an activity by one's own means), allowing the individual to take care of themselves and their lives.

Reflecting on health and functionality, Moraes[21] says that the elderly can continue to perform their social roles even when suffering from illness. The focus of health is strictly related to the overall functionality of the individual, defined as the ability to manage their own lives or take care of themselves. The elderly are considered healthy when they are able to carry out their activities alone, independently and autonomously, even if they have diseases.

In response to questioning about whether getting old is good or bad, two respondents referred to the degree of dependence and investment in care in old age, even in a somewhat stereotypical form.

> *"For us "poor old people", everything is fine. It all depends on what the younger people want". (E1)*

The first (E1) refers to the reduction of functional capacity in a resigned and dependent form. According to the empirical knowledge of the elderly, the compromises that arise with advancing chronological age make them more fragile, and therefore decision-making and even the activities that they were once able to perform are assigned to younger members of the community.

> *"In some ways I think it's bad... Because I'm going through what my mother told me about. When we're born we get special treatment by everyone, go, go, you're a teenager, you're young... When you start getting old, you go back to being a child. Isn't that right? You go back to being a child!". (E13)*

It is well known that the progressive functional decline that accompanies longevity brings a greater need for care, as E13 describes. However, it is worth reflecting further on this as part of this line of analysis, so that, as Almeida[22] points out, "the practice of care provided to the elderly does not turn into an infantilizing process, it must be differentiated, humane and respectful".

B3. Gradual reduction in the ability to work: "You just can't work anymore, can you?"

The perception of the elderly riverside dwellers revealed a particular representation of the value assigned to the physical performance of labor. Unlike in urban communities, riverine work is essentially manual and is not restricted by the retirement process itself, but more to the capacity of an individual to work and his or her contribution to the family and community as a labor source. Work for these people is a great revealer of their individual quality, and this perception was expressed in some discourses:

> *"I don't have the strength to work. Do you know what I mean?". (E1)*

> *"It's not great because there are some jobs I can't do, do you, do you know what I mean? [...] Because we live in the country, you see? So it's heavy work". (E8)*

A study by Silva et al.,[5] conducted in a social center for the elderly, found that aging was concretely perceived and associated with the decline of physical strength, which led to the loss of working capacity. Considering the great value assigned to work in riverine communities, responsible in turn for feelings of productivity and utility, this perspective can be seen in the reports

of the elderly persons in reference to the decline in working capacity related to aging.

> *"Because, in my opinion as we get older, we aren't able to do anything, no work, right? There are people who are still healthy, they still work, do a lot of jobs, like me, before this. Pick açaí, or palm hearts, all kinds of thing ... Now people say I just want to get up to eat [...]". (E12)*

In the same context, when asked about their perceptions of work, one of the interviewees recognized their limitations and, as a result of these, described optimizing their functional capabilities, unveiling an optimistic, healthy and successful aging process.

> *"Let's say ten years ago I was working. If I had to carry something heavy, I'd carry something even heavier, wouldn't I? But not today. But I can't stop, can I? I can't stop working, but I have to find a smarter way of doing it. And that's how I feel good about myself, I'm still working, still pushing myself, but I'm not neglecting myself [...]". (E7)*

According to Teixeira & Neri,[23] successful aging is linked to the personal perception of the possibilities of adaptation to changes resulting from aging, and associated conditions. Thus, the elderly must adapt to changes both at a biological and psychological level, finding solutions to their living conditions.

C. Perception anchored to coping strategies: "We have to respect old age"

Regarding the adjustment to this new phase of life, in their discourses the elderly riverside dwellers referred to respect, in the sense of being cautious and readjusting their lives when faced with their perceived limitations, to achieve a healthy old age.

> *"[...] what we have to have is ... a little bit of care and respect for our old age. Because if we, for example, don't look after ourselves, we get older and we die sooner[...]". (E14)*

> *"Getting old is normal, now, I've told my friends, we have to respect old age. If we abuse it, we'll suffer the consequences [...]". (E7)*

Reading between the lines of dialogue it was possible to identify the difficulty the elderly felt in being seen as people with limitations, mainly physical. Considering the environment that surrounds them and the ingrained everyday riverine activities that are performed during a lifetime and that require physical fitness, this idea is natural. In terms of this adjustment, Silva et al.[5] highlighted the value of a family support network. For the authors, family support for the elderly is very important for the maintenance of functional capacity, and to prevent damage and accidents, while maintaining a good quality of life.

D. Respect for the mainstays of old age

D1. Family support network: "I stay here and wait for them to come back"

With regard to the family support model in this phase of life, it was noted that some of the elderly persons attributed difficulties in aging because of the distance and the absence of their relatives, as can be seen*:*

> *"Getting old is hard for us, because, you know, my daughters are far away. And my daughter-in-law has her things to do here, so it's difficult for me". (E4)*

Other knowledge verbalized by the elderly reinforced the importance of family and indicated that their family members, especially children, sons and daughters-in-law, and grandchildren, worry about and care for them with love and care. They therefore feel protected and supported, as can be seen in this statement:

> *"Thanks to God and Our Lady my old age has been good. I have my children and grandchildren, and they live here in front or beside me… They really take care of me, I'm so happy to be near my children, but even if they lived far away, I have my husband, who has already taken care of me a lot and still does it today". (E13)*

According to Almeida et al.,[4] in old age, the role of the family is of fundamental importance for the support of the elderly, in terms of providing both affection and protection. Silva et al.[5] reinforced the idea that maintaining interpersonal coexistence contributes to the avoidance of loneliness and social isolation, which often affects the old age of individuals.

D2. Religious and spiritual dimension: "I thank God for all I have"

In the majority of the dialogues, the elderly riverside dwellers demonstrated that religion is an essential component that permeates their everyday life. The representation of the religious/spiritual is often incorporated into their discourse, giving value to divine blessing and thanksgiving, which reinforces how important it is to believe in something higher in this stage of life.

"The life we have here isn't enough. I thank God a lot, you know? I thank God above everything, because we receive everything from his hand. Because he has given me these 60 years. I never thought I'd live to 60, because in my life I've had a few scrapes". (E9)

"My old age, thanks to God, has been good [...]". (E13)

Contrastingly, the religiosity of these elderly persons also shaped the way the process of growing old is perceived, assuming a role of providing guidance in life, as observed:

"We grow old the way God wants!". (E9)

This religious support has a major influence in this phase of life, as all the elderly persons surveyed demonstrated affinity and/or engagement with some kind of religious activity or practice in the riverside community, whether of the catholic or evangelical protestant faith. The culture of religious practice is extremely strong among these people, and includes values such as keeping Sunday sacred, a value cultivated within families from childhood to the present day.

Corroborating the findings of other studies,[7,8,24] it was noted that old age has an intimate relationship with religiosity in various dimensions, and is particular to each life context. Regarding this issue, Sarmiento & Lima Filho[25] described how elderly persons acquire and strengthen their spirituality in a long life of chores and labor, of sacrifice and suffering. Therefore, in general, the religious-aging binomial represents a very important aspect in the lives of the elderly and therefore should not be neglected.

E. Respect for the end of life: "We go as far as we can, and then we die"

In the view of Polleto et al.,[26] human life is made up of possibilities, choices, and conceptions of the world, but has a limit. According to the authors, it is constructed and developed over the years, although an awareness of its finitude is always present.

According to Py & Trein,[27] aging and death are unique life experiences, specific to each person. However, they are regulated by social and cultural patterns that define the significance of each of these human experiences, in the specificity of a time and a place in the history of humanity.

In the discourse of the elderly riverside dwellers, it became clear that death, as well as aging, is considered to be a natural process. In the discourse of two participants, for example, an authentic knowledge was revealed that showed that the elderly persons perceived and accepted death as a certainty.

"... It's like death. Ah, because I'm not going to die! You're always going to die. Aren't you?". (E6)

"[...] because we can't go back, [...], we keep getting older until we die". (E10)

Due to the relevance of this subject to the panorama of gerontological studies and considering the results achieved, it is hoped that this study will contribute to a broadening of the scientific understanding of the aging process, as it is based

in empirical knowledge constructed from the everyday experience of the elderly living in a variety of traditional contexts.

On the other hand, it is worth noting some limitations that may be addressed in future investigations into the subject, such as the type of sample used and the small sample size. As it is a non-probabilistic convenience sample the study does not allow the generalization of the results to all riparian elderly persons in the Amazon region. Therefore, further research using a larger number of elderly people, including the inhabitants of other Amazonian riverside communities, is recommended.

FINAL CONSIDERATIONS

The interest in conducting the present study was based on a scientific concern, with the aim of discovering the perception of Amazonian riverine elderly persons of the aging process. The action of giving voice to the riverside population determined the scope of the proposed objective of this study and allowed important empirical knowledge about this process to emerge, involving socio-cultural characteristics which differ from the urban context.

Overall, the group analyzed described aging in a heterogeneous manner. However, all saw it as a process anchored to the naturalness of both life and death. Of the 14 elderly respondents, six associated old age with a stage of life with negative repercussions due to the appearance of functional disorders and limitations, and especially the reduction of availability for work. It can even be seen that the majority, even with some limitations resulting from old age, have clear and well-defined coping strategies, such as the recognition of their limitations and family and religious support.

From the results achieved in this study, it was concluded that the elderly riverside dwellers have an individual perception of the subject, adjusted to their context. This suggests that the aging process along the riverbanks is perceived as the shared result of the experiences and empirical knowledge acquired and the environment that surrounds them. If on one hand territorial isolation, poverty, low educational levels and distance from social and health resources predominate; on the other, these individuals enjoy privileges such as greater contact with a bountiful natural environment in peace and tranquility and without strict standards of routine (characteristic of urban contexts); a network of wider social support, mainly represented by family relations, and a slower pace of life more favorable to older people, such as in rural communities.

Critical and reflective awareness of this issue must be encouraged. Finally, it is hoped that this study represents a step towards encouraging new research into riverside-dwelling elderly persons and can also contribute to health care based on the realities of these traditional populations.

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REFERENCES

1. Beauvoir S. A velhice. São Paulo: Difusão Européia do Livro; 1990.
2. Moimaz SAS, Almeida MEL, Lolli LF, Garbin CAS, Saliba NA. Envelhecimento: análise de dimensões relacionadas à percepção dos idosos. Rev Bras Geriatr Gerontol 2009;12(3):361-75.
3. Teixeira JS, Corrêa JC, Rafael CBS, Miranda VPN, Ferreira MEC. Envelhecimento e percepção corporal de idosos institucionalizados. Rev Bras Geriatr Gerontol 2012;15(1):613-24.
4. Almeida PM, Mochel EG, Oliveira MSS. O idoso pelo próprio idoso percepção de si e de sua qualidade de vida. Rev Kairós 2011;13(2):99-113.

5. Silva EV, Martins F, Bachion MM, Nakatani AYK. Percepção de idosos de um centro de convivência sobre envelhecimento. REME Rev Min Enferm 2006;10(1):46-53.

6. Jardim VCFS, Medeiros BF, Brito AM. Um olhar sobre o processo do envelhecimento: a percepção de idosos sobre a velhice. Rev Bras Geriatr Gerontol 2006;9(2):25-34.

7. Lima CKG, Murai HC. Percepção do idoso sobre o próprio processo de envelhecimento. Rev Enferm UNISA 2005;6:15-22.

8. Biolchi CS, Portella MR, Colussi EL. Vida e velhice aos 100 anos de idade: percepções na fala dos idosos. Estud Interdiscip Envelhec 2014;19(2):583-98.

9. Papaléo Netto M. Gerontologia. São Paulo: Atheneu; 2002.

10. Rodrigues NO, Neri AL. Vulnerabilidade social, individual e programática em idosos da comunidade: dados do estudo FIBRA, Campinas, SP, Brasil. Ciênc Saúde Coletiva 2012;17(8):2129-39.

11. Paschoal SMP. Qualidade de vida na velhice. In: Freitas EV, Py L. Tratado de geriatria e gerontologia. Rio de Janeiro: Guanabara Koogan; 2011. Cap. 06. p. 99-106.

12. Rodrigues NC, Rauth J. Os desafios do envelhecimento no Brasil. In: Freitas EV, Py L. Tratado de geriatria e gerontologia. Rio de Janeiro: Guanabara Koogan; 2011. Cap. 12. p. 106-110.

13. Gil A. Como elaborar projetos de pesquisa. 4ª ed. São Paulo: Atlas; 2007.

14. Minayo MCS, organizadora. Pesquisa social: teoria, método e criatividade. 29ª ed. Petrópolis: Vozes; 2010.

15. Instituto Brasileiro de Geografia e Estatística. Síntese de indicadores sociais: uma análise das condições de vida da população brasileira [Internet]. Rio de Janeiro: IBGE; 2010 [acesso em 16 jan. 2015]. Disponível em: www.censo2010.ibge.gov.br

16. Bardin L. Análise de conteúdo. Lisboa: Edições 70; 2000.

17. Souza RF, Matias HA, Brêtas ACP. Reflexões sobre envelhecimento e trabalho. Ciênc Saúde Coletiva 2010;15(6):2835-43.

18. Zimerman GI. Velhice: aspectos biopsicossociais. Porto Alegre: Artmed; 2000.

19. Salmaso FV, Vigário PS, Mendonça LMC, Madeira M, Netto LV, Guimarães MRM, et al. Análise de idosos ambulatoriais quanto ao estado nutricional, sarcopenia, função renal e densidade óssea. Arq Bras Endocrinol Metab 2014r;58(3):226-31.

20. Rizzoli R, Reginster JY, Arnal JF, Bautmans I, Beaudart C, Bischoff-Ferrari H, et al. Quality of life in sarcopenia and frailty. Calcif Tissue Int 2013;93(2):101-20.

21. Moraes EN. Atenção à saúde do Idoso: aspectos conceituais. Brasília, DF: Organização Pan-Americana da Saúde; 2012.

22. Almeida RSS. Representações sociais do idoso institucionalizado e influência na comunicação dos profissionais ajudantes de e ação direta [dissertação]. Castelo Branco: Instituto Politécnico de Castelo Branco, Escola Superior de Educação; 2014.

23. Teixeira IN, Neri, AL. Envelhecimento bem-sucedido: uma meta no curso da vida. Psicol USP 2008;19(1):81-94.

24. Frumi C, Celich KLS. O olhar do idoso frente ao envelhecimento e à morte. Rev Bras Cienc Envelh Hum 2006;3(2):92-100.

25. Sarmiento S, Lima Filho JB. A terceira idade na Pastoral da Criança: de bem com a vida. Curitiba: Pastoral da Criança; 2000.

26. Polleto S, Santin JR, Bettinelli LA. Dilemas do enfrentamento da morte de paciente Idoso. UNOPAR Cient Ciênc Juríd Empresariais 2014;13(2):49-55.

27. Py L, Trein F. Finitude e infinitude: dimensões do tempo na experiência do envelhecimento. In: Freitas EV, Py L. Tratado de geriatria e gerontologia. Rio de Janeiro: Guanabara Koogan; 2011. Cap. 121, p. 1350-58.

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Fear of falling associated with sociodemographic and lifestyle variables and clinical conditions in elderly people registered with the Family Health Strategy in Campo Grande, Mato Grosso do Sul

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Abstract

Objective: To investigate the prevalence of fear of falling among the elderly and its association with sociodemographic and lifestyle variables, morbidities, balance, mobility and a history of falls (HF). *Method:* A cross-sectional study was performed in nine family health units in the southern district of Campo Grande, Mato Grosso do Sul. An interview was conducted to obtain data relating to the sociodemographic and clinical variables and the history of falls. The Falls Efficacy Scale-International-Brazil (FES-I-Brazil) and the Timed Up and Go (TUG) test were also applied. Statistical analysis was performed using the Pearson linear correlation test (FES-I-Brazil related to TUG score), the Student's t-test (FES-I-Brazil related to lifestyle, comorbidities and HF) and ANOVA one way, followed by Tukey post-hoc (FES-I-Brazil related to HF and TUG score). *Results:* Two hundred and one elderly persons with an average age of 70.85 (±7.72) years were included. On the FES-I-Brazil scale, the overall score was 28.80 (±0.82) points. The average TUG time was 12.00 (±0.57) seconds. There was a significant positive linear correlation between the FES-I-Brazil score and the TUG time ($p<0.001$) and the variables of gender ($p=0.008$), hypertension ($p=0.002$), FH ($p=0.005$) and frequency of falls ($p=0.011$). *Conclusion:* There is a high frequency of fear of falling among the studied population, as the majority reported fear of falling in at least one of the sixteen FES-I-Brazil tasks. Such fear was significantly associated with hypertension, diabetes mellitus, history of falls, perception of always suffering falls and low scores for mobility and balance.

Key words: Health of the Elderly; Accidental Falls; Public Health.

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INTRODUCTION

The current increase in the elderly population has brought to the fore an important discussion regarding incapacitating events, particularly falls, among this age group. According to the World Health Organization (WHO), a fall is defined as "inadvertently coming to rest on the ground, floor or other lower level, excluding intentional change in position to rest in furniture, wall or other objects."[1]

From 65 years of age onwards, more than a third of people suffer a fall each year, and in half of these cases the accidents are recurrent,[2] with consequences such as fractures, emotional trauma and reduced mobility, potentially triggering morbidities which can result in a condition of dependence and possible institutionalization for the elderly individuals concerned,[3] as well as high levels of expenditure on care, making this an important public health issue the world over.[4]

In addition to loss of function caused by physical and psychological trauma, falls can lead to a reduction of both functionality and the performance of activities of daily living due to the fear of repeat incidents.[3] Earlier studies have found that most people with a fear of falling have the following in common: a history of falls; low scores in functional tests; a greater need for help with the performance of activities of daily living (ADLs); greater perception of fragility in relation to their health;[5] a less active social life; a limited level of physical activity; a high risk of falling[6] and a reduced quality of life.[7]

There is a current trend for elderly people to seek active aging by remaining more socially active, as well as a growing interest on the part of public authorities in developing favorable policies in order to preserve the autonomy and independence of elderly people.[4]

Considering the fact that fear of falling is linked to fragility and to risks of falling, it is important to understand how common this fear and associated factors are among the elderly population. Such knowledge is relevant to managers, health professionals and the elderly individuals themselves, all of whom can take ownership of vulnerable groups and devise strategies to promote active aging in order to prevent falls and their physical, mental and social consequences.

In light of the foregoing, the present study sought to investigate fear of falling among the elderly population and its association with sociodemographic and lifestyle variables, morbidities, balance, mobility and history of falls.

METHOD

A cross-sectional study was performed which sought to discover the frequency of fear of falling among the elderly and its association with other variables. This is an extremely important component for the functional health of elderly individuals.

Data collection occurred between August 2012 and August 2013. The study was conducted in nine of the ten Unidades Básicas de Saúde da Família - USF (Basic Family Health Units) located in the Southern District of the municipality of Campo Grande in the state of Mato Grosso do Sul. These units were chosen as this southern district is the designated area for research, teaching and extension learning of the Universidade Federal de Mato Grosso do Sul (the Federal University of Mato Grosso do Sul) and is therefore an area of particular interest in terms of the integration of the university with the community through the mediums of investigation and intervention.

The elderly individuals were approached in their homes and informed about the objectives and methodology of the research before being invited to participate in the study, with emphasis given to the fact they were free to refuse and would not be penalized for doing so. The composition of the study sample was based on convenience. Researchers attended USFs on pre-scheduled dates and were informed by community health workers (CHW) as to which of the individuals who had agreed to take part met the conditions

for doing so. These conditions required the elderly persons to not suffer from difficulties with comprehension and verbal communication or functional limitations that would prevent the performance of the required tests, as well as not use a wheelchair or equipment to aid walking. These criteria were further confirmed by the researcher at the time of each visit.

In terms of data collection, a structured pre-prepared interview was carried out, with the aim of extracting data regarding sociodemographic and lifestyle factors, health problems and frequency and history of falls (HF) over the past 12 months. The definition of a fall of the WHO was used for evaluating HF.[1] Next came the application of the Falls Efficacy Scale-International-Brazil (FES-I-Brazil), using a version adapted and validated by Camargos et al.[8] for the Brazilian population based on the Falls Efficacy Scale-International (FES-I) developed by Tinetti et al.[5] The Brazilian version evaluates fear of falling during the execution of 16 social/external activities, including: cleaning the house; answering the phone; making meals; taking a bath/shower; going shopping; attending church; attending social events; walking on a slippery or bumpy surface and walking up or down ramps. For each activity a score of between 1 and 4 is awarded based on the level of unease expressed by an individual regarding the possibility of suffering a fall: (1) the individual is "not worried" about falling; (2) is "a little worried"; (3) is "moderately worried"; and (4) is "very worried". Total scores can range from 16 to 64 points, with 16 points indicating a lack of concern and 64 points being extremely worried about the possibility of falling whilst carrying out activities.

In order to evaluate mobility and balance, the Timed Up and Go (TUG) test was performed. The test required each individual to sit in a chair with arm rests with their back supported and with the seat and arm rests at a height of approximately 46cm and 65cm respectively, before being instructed to stand up, walk three meters in a straight line to a point marked on the floor, then turn round and return to sit down with their back resting in the same chair. The subjects are advised not to talk during the test and to perform the task safely at their automatic and habitual speed. The test begins with a starting signal from the evaluator who bends his left arm and gives the verbal command "go" (with the timer starting immediately). The timer is stopped only when the individual is back in their starting position, sitting with their back supported by the chair.

As regards the evaluation of the results, the individuals who were unable to provide all of the information necessary were not included in the inferential statistics. Linear correlation between scores on the FES-I-Brazil scale and the variables of age, body mass index (BMI), years of study and score on the TUG test was performed using the Pearson linear correlation test. With regard to the relationship between scores attained in the FES-I-Brazil test and the following variables: smoking, alcohol consumption, physical activity, hypertension, dyslipidemia and diabetes mellitus, correlation was performed using the Student's t-test. Comparison between patients with different frequencies of falling in relation to FES-I-Brazil scores was performed by means of the ANOVA one-way test, followed by the Tukey post-hoc test. The same test was used to compare the individuals from different score ranges on the FES-I-Brazil scale in relation to the variables of age, BMI, years of study and TUG score. Finally, the chi-test square was used to evaluate the association between score ranges in the FES-I-Brazil scale and the variables of gender, smoking, alcohol consumption, physical activity, systemic arterial hypertension (SAH), dyslipidemia, diabetes mellitus and HF. Results related to the other variables evaluated in this study were presented in the form of descriptive statistics or as tables and graphics. Statistical analysis was performed using SPSS software, version 17.0, with 5% taken as the significance level.[9]

This research project of the study was approved by the Ethics Committee of the Federal University of Mato Grosso do Sul, under protocol no. 1895/2010, and all of the ethical criteria for the study were met, including the signing of the free and informed consent form by all participants.

RESULTS

The present study evaluated 201 elderly individuals aged between 60 and 96 years, with a mean age of 70.85 (±7.72) and a mean BMI of 28.46 (±0.45) kg/m^2. Results for the following variables: gender, ethnicity, marital status, cohabitation, employment and education are detailed in Table 1. In general, most of the individuals were women, with mixed-race and white the most common ethnic groups. Most cohabited and did not work, while the figure for average years of study was 3.25 (±0.26) years.

Table 1. Distribution of elderly individuals according to sociodemographic variables. Campo Grande, Mato Grosso do Sul, 2013.

Variables	n (%)
Gender	
Female	133 (66.2)
Male	68 (33.8)
Ethnicity	
Mixed race	100 (49.8)
White	77 (38.3)
Black	22 (10.9)
No information	2 (1.0)
Civil status	
With partner	109 (54.2)
Single	92 (45.8)
Lives with other people	
Yes	164 (81.6)
No	37 (18.4)
Employed	
No	173 (86.1)
Yes	26 (12.9)
No information	2 (1.0)
Literate (among those who never studied n= 65)	
No	31 (47.7)
Yes	26 (40.0)
No information	8 (12.3)

Table 2 shows the distribution of the elderly individuals in accordance with the habits of smoking, alcohol consumption and physical activity, as well as SAH, dyslipidemia and diabetes mellitus morbidities and information related to HF. Most individuals did not smoke or drink alcohol, did not take part in physical activity and suffered from SAH. In general, most individuals had not suffered any falls or resultant hospitalization in the past 12 months, as detailed in table 3.

Table 2. Distribution of elderly individuals in accordance with lifestyle and morbidities. Campo Grande, Mato Grosso do Sul. 2013.

Variables	n (%)
Smoker	
No	171 (85,1)
Yes	30 (14.9)
Alcohol consumption	
No	187 (93.0)
Yes	14 (7.0)
Physical activity	
No	158 (78.6)
Yes	43 (21.4)
Arterial hypertension	
No	50 (24.9)
Yes	151 (75.1)
Cardiac	
No	164 (81.6)
Yes	37 (18.4)
Dyslipidemia	
No	141 (70.1)
Yes	59 (29.4)
No information	1 (0.5)
Diabetes *mellitus*	
No	136 (67.7)
Yes	65 (32.3)

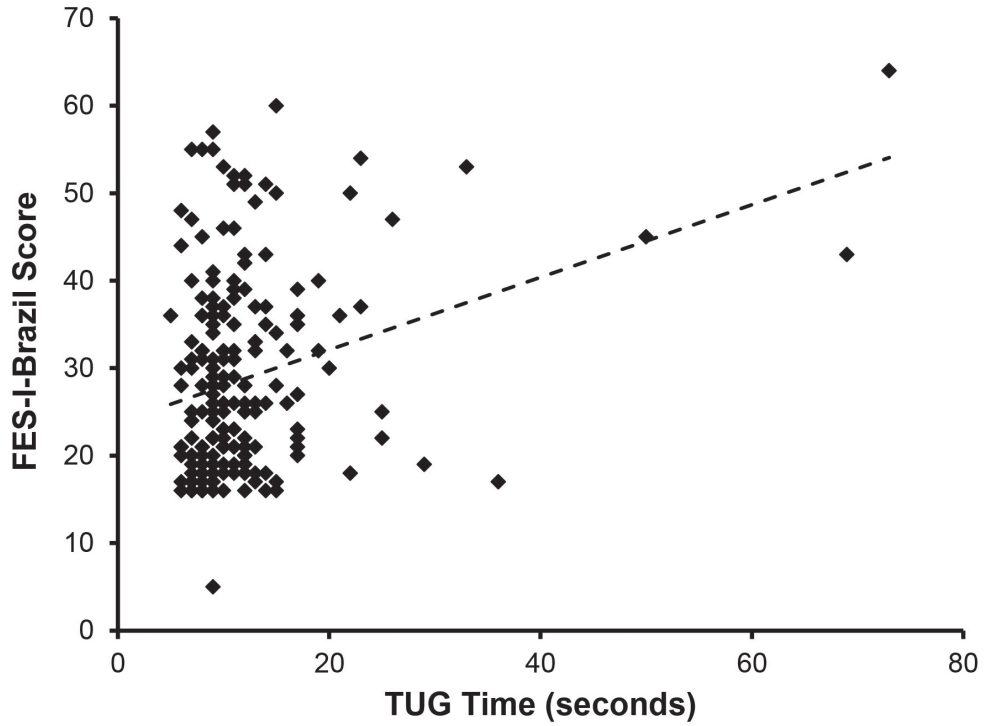
Table 3. Distribution of elderly individuals in accordance with history and frequency of falls and related hospital admissions. Campo Grande, Mato Grosso do Sul, 2013.

Variables	n (%)
History of falls	
No	146 (72.6)
Yes	53 (26.4)
No information	2 (1.0)
Frequency of falls	
Never	111 (55.2)
Sometimes	75 (37.3)
Yes	10 (5.0)
No information	5 (2.5)
Hospitalization for falls in the last 12 months	
No	179 (89.1)
Yes	18 (9.0)
No information	4 (2.0)

Most of the elderly respondents did not have private health insurance (65.2%) while the vast majority (96.0%) reported being visited by professionals from the family health team, of whom all (100.0%) were visited by a CHW. Only 36 (18.6%) of the individuals reported receiving visits from doctors and/or nurses, with only seven (3.6%) having been visited by a social worker and just two (1.0%), by a dentist. Among men (n=68), most had undergone a prostate examination (77.9%), and among women (n=133) most had undergone a clinical breast exam (71.4%) and a Pap smear test (69.2%).

The FES-I-Brazil scale score was 28.80 (±0.82) points, with 39.8% of elderly individuals showing little concern about falling, 23.4% moderately worried and 34.3% extremely worried. In the TUG test, the average time registered was 12.00 (±0.57) seconds, equivalent to the level expected for disabled or fragile elderly persons with partial independence and a low risk of falling.

There was no linear correlation between FES-I-Brazil scale scores and variables of age (Pearson linear correlation test, $p=0.455$; $r=0.054$, $r^2=0.003$), BMI ($p=0.409$; $r=0.059$, $r^2=0.004$) or education ($p=0.754$; $r=0.023$, $r^2=0.001$). However, there was a significant positive linear correlation between scores on the FES I-Brazil scale and TUG test times, as shown in Figure 1 ($p<0.001$; $r=0.296$; $r^2=0.087$).



Each symbol represents a score on the FES-I-Brazil scale and a time on the TUG test for one elderly individual. The dotted line represents the linear regression line.

Figure 1. Dispersion graph of linear correlation between FES-I-Brazil scores and TUG test times among the elderly individuals evaluated. Campo Grande, Mato Grosso do Sul, 2013.

No difference was noted among the individuals with different FES-I-Brazil scale score ranges in terms of age, BMI or years of study (ANOVA one-way, *p* value ranging between 0.149 and 0.684). On the other hand, the TUG test results among the individuals with FES-I-Brazil scores between 32-64 points were significantly higher than for individuals with scores ranging between 16 and 22 points and between 23 and 31 points (ANOVA one-way, $p=0.006$; Tukey post-hoc, $p<0.05$).

Table 4 shows the distribution of individuals according to their FES-I-Brazil score range in relation to gender, lifestyle, morbidities and HF. There was no significant association between FES-I-Brazil score range and the variables of smoking, physical activity, dyslipidemia and diabetes mellitus (chi-square test, p value ranging between 0.058 and 0.840). On the other hand, there was a significant association between FES-I-Brazil score range and variables of gender ($p=0.008$), SAH ($p=0.002$), HF ($p=0.005$) and frequency of falls ($p=0.011$).

Table 4. Distribution of elderly individuals in accordance with score range on the FES-I-Brazil scale and the variables of gender, lifestyle, morbidities and history of falls. Campo Grande, Mato Grosso do Sul, 2013.

Variables	Score on the FES-I-Brazil scale - n (%)			Value of *p*
	16 to 22 points	23 to 31 points	32 to 64 points	
Gender*				
Female	43 (33.1)	36 (27.7)	51 (39.2)	0.008
Male	37 (56.1)	11 (16.7)	18 (27.3)	
Smoker*				
No	69 (41.3)	42 (25.1)	56 (33.5)	0.447
Yes	11 (37.9)	5 (17.2)	13 (44.8)	
Alcohol consumption*				
No	73 (40.1)	45 (24.7)	64 (35.2)	0.637
Yes	7 (50.0)	2 (14.3)	5 (35.7)	
Physical activity*				
No	64 (41.0)	34 (21.8)	58 (37.2)	0.305
Yes	16 (40.0)	13 (32.5)	11 (27.5)	
Arterial hypertension*				
No	28 (58.3)	13 (27.1)	7 (14.6)	0.002
Yes	52 (35.1)	34 (23.0)	62 (41.9)	
Dyslipidemia **				
No	58 (42.3)	28 (20.4)	51 (37.2)	0.276
Yes	22 (37.9)	18 (31.0)	18 (31.0)	
Diabetes *mellitus**				
No	59 (44.7)	34 (25.8)	39 (29.5)	0.058
Yes	21 (32.8)	13 (20.3)	30 (46.9)	
Fallen in the past 12 months***				
No	65 (46.1)	35 (24.8)	41 (29.1)	0.005
Yes	13 (24.5)	12 (22.6)	28 (52.8)	
Frequency of falls ****				
Never	54 (50.0)	21 (19.4)	33 (30.6)	0.011
Sometimes	23 (31.1)	23 (31.1)	28 (37.8)	
Always	1 (10.0)	2 (20.0)	7 (70.0)	
Hospitalization for fall in the past 12 months****				
No	74 (42.3)	44 (25.1)	57 (32.6)	0.240
Yes	5 (29.4)	3 (17.6)	9 (52.9)	

* Information not available for five individuals; ** Information not available for six individuals; *** Information not available for seven individuals; **** Information not available for nine individuals.

DISCUSSION

Findings from current literature show important differences in the frequency of fear of falling amongst elderly populations, ranging from 24% to 92.5%.[10-14] Studies of older people living in developed countries found that frequency ranged between 24% and 43%,[10,11,13]. Where the population assessed was elderly Brazilians, however, this number has always been high (59.7 to 92.5%),[12,14,15] as it was in this study, where fear of falling was an issue for almost all the individuals encountered. This difference possibly arises from the fact that appropriate physical environments lead to greater independence for the elderly, whereas when barriers in the physical environment are encountered elderly individuals tend to leave home less and are more inclined to isolation, depression, reduced fitness, and more problems with mobility with a consequent increase in the fear of falling.[16]

The results showed that HF is not a necessary component for fear of falling, as fewer than a third of individuals who reported fear had a HF. The chance of this fear being present, however, increases among those with HF,[17,18] since all the individuals with HF encountered in this study showed a fear of falling in at least one task proposed by the FES-I-Brazil. A study by Lopes et al.,[17] who evaluated 111 elderly individuals, showed similar results, with 54.42% of individuals having HF and 96.25% of these reporting a fear of falling. Another study showed that among elderly individuals who had already suffered falls, 84.16% had a fear of falling; while among those with no history of falls the figure was just 63.16%.[18]-

Another finding from the present study was that women presented higher scores for fear of falling compared to men, corroborating the results of several other studies.[19-22] Authors have suggested that lower levels of fear of falling for males may be related to the fact that men do not tend to admit to this fear, with the quantification of fear of falling using the FES-I-Brazil scale dependent on honest responses by individuals to a series of questions.[23-25] Moreover, Fletcher & Hirdes[26] believe that women overestimate the risk and consequences of falls whereas men underestimate them. Another factor that could justify the higher levels of fear amongst women is that they suffer more than men from a decline in the muscular system and in functionality compared to men.[26-29]

The study also showed that worry about falling was greater among individuals with hypertension and diabetes mellitus, as was also the case in the study by Antes et al.[21] However it was not possible to establish a correlation between these diseases and frequency of fear of falling.

Fear of falling is strongly associated not only with decreased balance, but also with reductions in mobility, physical activity,[30] socialization and independence as well as with increases in morbidity, mortality and number of falls.[30] This suggests a vicious circle, in which the risk of falling leads to reductions in balance and mobility and to fear of falling and functional decline, all of which result in more fear.[31] On the other hand, physical activity positively influences muscle strength and balance, helping reduce the level of fear in order to break this cycle.[32] This study found no significant correlation between fear of falling and physical activity. In contrast, one aspect that stands out is the high rate of sedentary elderly individuals (78.6%), which is significant given the knowledge that physical activity contributes to healthier aging, with higher fitness levels being related to a lower risk of morbidity and mortality and to the prevention of falls.[1] Physical activity has the additional benefit of being a low-cost pursuit.

Regarding the FES-I-Brazil scale, the findings of this study were similar to the study by Rodrigues et al.,[33] which indicated an average of 31 points, although the scores were higher than those of a validation study of the same scale in Brazil, where the average score was 23.55.[8] In two further Brazilian studies,[17,34] the average score on the FES-I-Brazil scale was 24.01 and 26.5, respectively. There were no factors identified which could have possibly influenced the difference in levels of fear of falling of the elderly persons included in this study as compared to those investigated in the other research.[8,17,34]

As regards the TUG test, the average result returned corresponds to a level expected from disabled or fragile elderly individuals, with partial independence and a low risk of falling. This reflects the results of a case control study by Pimentel & Scheicher[14] which evaluated the TUG times of a group with HF and another group without HF, with the former group returning an average time of 11.6 seconds and the latter 11.49. A study by Lopes et al.[17] found an average time of 17.73 (±7.78) seconds, which also corresponds to the timeframe expected for disabled or fragile elderly persons with partial independence and a lower risk of falling. To maintain balance while walking, elderly individuals act with caution, creating strategies to reduce the risk of falls. For example, reducing the time spent in the swing phase, which is the phase of greatest instability, and decreasing momentum, knee extension and the length and height of step, consequently reducing the speed of walking. In fact, however, a normal level of speed allows for greater stability.[35]

A significant relationship was encountered ($p=0.006$), when comparing the score range of individuals on the FES-I-Brazil scale in relation to their TUG results, indicating that less mobile individuals are more afraid of falling, which indicates that this fear may be based on lower functional ability and balance. However, it is known that the fear of falling leads to functional decline,[32] so it is not possible to determine whether fear of falling has led to restriction of mobility or vice versa.

We are currently witnessing a rapid transition in global demographics and epidemiology, with an observable disharmony between the speed of this transition and the inception of actions aimed at improvements in primary health care and health promotion. In these circumstances, the importance of everyday physical activity in order to combat physical decline and consequently improve quality of life should not be underestimated. Nowadays, many USFs develop walking and exercise programs for the elderly, but in many cases there are difficulties in ensuring the adherence of targeted individuals, thus explaining the need for changes or improvements in the strategies aimed at this population.

This study was the first of its kind to be carried out with the elderly population of Campo Grande, Mato Grosso do Sul, and as such it is important with regards to future research in this area. In addition, only a few studies[14,15,17] were found in Brazilian literature which correlated fear of falling as measured on the FES-I-Brazil scale with mobility and balance measured using the TUG test.

In terms of the limitations of this study, it should be mentioned that the sample used was for purposes of convenience, chosen with the assistance of CHWs. However, these professionals have strong links and regular contact with the elderly population treated at the USFs. In addition, no prior survey was performed in order to discover the number of physically active elderly individuals registered at each USF, making it impossible to create a proportional sample. Finally, as this was a cross-sectional study it was not possible to prove any temporal correlation or relationship of cause and effect.

CONCLUSION

In conclusion, there was a highly significant fear of falling among the population studied, with the vast majority of individuals reporting such a fear in at least one of the 16 tasks of the FES-I-Brazil scale. This fear was shown to be strongly associated with the variables of systemic arterial hypertension, diabetes mellitus, history of falls, the perception of individuals that they always fall and low scores for mobility and balance.

REFERENCES

1. World Health Organization. Global report on falls prevention in older age [Internet]. Genebra: WHO; 2007 [acesso em 17 nov. 2015]. Disponível em: http://www.who.int/ageing/publications/Falls_prevention7March.pdf?ua=1
2. Gillespie LD, Robertson MC, Gillespie WJ, Sherrington C, Gates S, Clemson LM, et al. Interventions for preventing falls in older people living in the community. Cochrane Database Syst Rev 2012;9:1-5.
3. Gallardo MA, Asencio MMJ, Sanchez JCC, Sojo BS, Perez JC, Fernandez AM, et al. Instruments for assessing the risk of falls in acute hospitalized patients: a systematic review and meta-analysis. BMC Health Serv Res 2013;13:122.
4. Veras R. Envelhecimento populacional contemporâneo: demandas, desafios e inovações. Rev Saúde Pública 2009;43(3):548-54.
5. Tinetti ME, Richman D, Powell L. Falls efficacy as a measure of fear of falling. J Gerontol 1990;45(6):239-43.
6. Park JH, Cho H, Shin JH, Kim T, Park SB, Choi BY, et al. Relationship among fear of falling, physical performance, and physical characteristics of the rural elderly. Am J Phys Med Rehabilit 2014;93(5):379-86
7. Hartholt KA, Van Beeck EF, Polinder S, Van der Velde N, Van Lieshout EM, Panneman MJ, et al. Consequences of falls in the older population: Injuries, healthcare costs, and long-Term reduced quality of life. J Trauma 2011;71(3):748-53
8. Camargos FFO, Dias RC, Dias JMD, Freire MTF. Adaptação transcultural e avaliação das propriedades psicométricas da Falls Efficacy Scale – International em idosos brasileiros (FES-I-BRASIL). Rev Bras Fisioter 2010;14(3):237-43.
9. Shott S. Statistics for health professionals. London: W.B. Saunders Company; 1990.
10. Lach HW. Incidence and risk factors for developing fear of falling in older adults. Public Health Nurs 2005;22(1):45-52.
11. Murphy SL , Williams CS , Gill TM. Characteristics associated with fear of falling and activity restriction in community-living older persons. J Am Geriatr Soc 2002;50(3):516-20.
12. Ricci NA, Gonçalves DFF, Coimbra IBC. Fatores associados ao histórico de quedas de idosos assistidos pelo Programa de Saúde da Família. Saúde Soc 2010;19(4):898-909.
13. Tinetti ME, De Leon CFM, Doucette JT, Baker DI .Fear of falling and fall-related efficacy in relationship to functioning among community-living elders. J Gerontol 1994;49(3):140-7.
14. Pimentel I, Scheicher ME. Comparação da mobilidade, força muscular e medo de cair em idosas caidoras e não caidoras. Rev Bras Geriatr Gerontol 2013;16(2);251-57.
15. Silva A, Faleiros HH, Shimizu WAL, Nogueira LM, Nhãn LL, Silva MF, et al. Prevalência de quedas e de fatores associados em idosos segundo etnia. Ciênc Saúde Coletiva 2012;17(8):2181-90.
16. World Health Organization. Envelhecimento ativo: uma política de saúde. Suzana Gontijo, tradutor. Brasília, DF: Organização Pan-Americana da Saúde; 2005.
17. Lopes KT, Costa DF, Santos LF, Castro DP, Bastone AC. Prevalência do medo de cair em uma população de idosos da comunidade e sua correlação com mobilidade, equilíbrio dinâmico, risco e histórico de quedas. Rev Bras Fisioter 2009;13(3):223-9.
18. Fernandes MGM, De Oliveira FMRL, Barbosa KTF. Avaliação do medo de cair em idosos em atendimento ambulatorial. Rev Enferm UFPE on line 2013; 7(4):1160-6.
19. Delbaere K, Crombez G, Vanderstraeten G, Willems T, Cambier D. Fear-related avoidance of activities, falls and physical frailty: a prospective community-based cohort study. Age Ageing 2004;33(4):368-73
20. Kempen GI, Van Haastregt JC, McKee KJ, Delbaere K, Zijlstra GA. Socio-demographic, health-related and psychosocial correlates of fear of falling and avoidance of activity in community-living older persons who avoid activity due to fear of falling. BMC Public Health 2009 2;9:1-14.
21. Antes DL, Schneider IJC, Benedetti TR, D'orsi E. Medo de queda recorrente e fatores associados em idosos de Florianópolis, Santa Catarina, Brasil. Cad Saúde Pública 2013;29(4):758-68.
22. Legters K. Fear of falling. Phys Ther 2002;82(3):264-72.
23. Tinetti ME, Williams CS. The effect of falls and falls and fall infuries on functioning in community-dwelling older persons. J Gerontol 1998;53(2):112-9.
24. McAuley E, Mihalko SL, Rosengren K. Self-efficacy and balance correlates of fear of falling in the elderly. J Aging Phys Act 1997;5:329-340.

25. Malini FM, Lopes CS, Lourenço RA. Medo de quedas em idosos: uma revisão da literatura. Rev HUPE 2014;13(2):38-44.

26. Fletcher PC, Hirdes JP. Restriction in activity associated with fear of falling among community-based seniors using home care services. Age Ageing 2004;33:273-9.

27. Myers AM, Powell LE, Maki BE, Holliday PJ, Brawley LR, Sherk W. Psychological indicators of balance confidence: relationship to actual perceived abilities. J Gerontol 1996;51:37-43.

28. Lachman ME, Howland J, Tennstedt S, Jette A, Assmann S, Peterson EW. Fear of falling and activity restriction: the survey of activities and fear of falling in the elderly (SAFE). J Gerontol Ser B Psychol Sci Soc Sci 1998;53(1):43-50

29. Martin FC, Hart D, Spector T, Doyle DV, Harari D. Fear of falling limiting activity in young-old women is associated with reduced functional mobility rather than psychological factors. Age Ageing 2005;34(3):281-7.

30. Suzuki M, Ohyama N, Yamada K, Kanamori M. The relationship between fear of falling, activities of daily living and quality of life among elderly individuals. Nurs Health Sci 2002;4:155-61.

31. Gillespie SM, Friedman SM. Fear of falling in new long-term care enrollees. J Am Med Dir Assoc 2007;8(5):307-13.

32. Mazo GZ, Liposcki DB, Ananda C, Prevê D. Condições de saúde, incidência de quedas e nível de atividade física dos idosos. Rev Bras Fisioter 2007;11(6):437-42.

33. Rodrigues IG, Costa GA, Pinto RMC. Qualidade de vida e senso de auto-eficácia para quedas em idosos participantes do Projeto AFRID/UFU. Efdesportes.com [Internet] 2009 [acesso 20 nov.2013];13(129):1-6. Disponível em: http://www.efdeportes.com/efd129/qualidade-de-vida-e-senso-de-auto-eficacia-para-quedas-em-idosos.htm

34. Silva SLA, Vieira RA, Arantes P, Dias RC. Avaliação de fragilidade, funcionalidade e medo de cair em idosos atendidos em um serviço ambulatorial de geriatria e gerontologia. Fisioter Pesqui 2009;16(2):120-5.

35. Moreira MA, Oliveira BS, Moura KQ, Tapajós DM, Maciel ACC. A velocidade da marcha pode identificar idosos com medo de cair?. Rev Bras Geriatr Gerontol 2013;16(1):71-80.

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Semantic and cultural equivalence of the Intergenerational Exchanges Attitude Scale (IEAS)

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Abstract

Introduction: Understanding the multidimensionality of attitudes originating from exchanges between different generations is fundamental for the establishment of intergenerational cooperation and the reduction of stereotypes and prejudices. *Objective:* To obtain the semantic and cultural equivalence of the Intergenerational Exchanges Attitude Scale (IEAS). *Method:* Two translators translated the scale from English into Portuguese. A third translator synthesized these two translations. The synthesized version was back-translated into English. From the observations of the initial and back translations, a semantic version of the scale was consolidated, which was applied to 32 professionals who developed intergenerational activities (elderly/children) and activities directed at elderly persons only. Following application, a version of the scale that was culturally adapted for the Portuguese language was obtained. *Results:* The scale was alterered due to cultural refinement, with differences in the following items: 4) around and near; 6) overprotective and highly protective; 8) be around and to want to get close to; 11) earn and obtain; 13) have warm relationships and to relate affectionately; 17) affection and fondness; 18) form a good team and are good companions; 20) feel sick and get irritated. The responses used are evaluative statements of positive or negative attitudes about the exchanges that take place between children and the elderly, based on a Likert scale of just five points. *Conclusion:* The Intergenerational Exchanges Attitude Scale (IEAS) has been adapted and validated for the Brazilian population and is known as the "Escala de Atitudes em relação a Trocas Intergeracionais" (Scale of Attitudes in Relation to Intergenerational Exchanges) (EATI). It can be a useful tool for programs featuring activities involving children and the elderly, as well as for professionals working and developing strategies in this field.

Key words: Validation Studies; Intergenerational Relations; Attitude; Child; Elderly.

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INTRODUCTION

In the most commonly accepted view of human development, old age is the opposite of childhood. The former is characterized as a phase of loss, weakness, distancing and disease, while the latter is a stage of growth and opportunities.[1] Although changes in the traditional paradigms and engagement of the elderly are evident in a number of situations, there is a strong association with dependency, isolation, lack of productivity, impairment, disability, decline and death.[2-4] This dichotomy regarding aging is mediated by individual and social attitudes and beliefs.[5,6]

Attitudes regarding old age form part of a conceptual field that includes believes, prejudices and stereotypes.[6] Attitudes are learnt socially and serve to predict, explain, guide and regulate the thoughts, feelings and individual and collective actions of people, groups and social situations.[7-9] These attitudes manifest themselves through neutral, negative or positive assesments of varying intensity.[10] Negative attitudes against people from other groups, caused by a lack of information and an absence of social contact, are important determinants.[2]

Beliefs can refer to biased perceptions, intuitions, illusions and cognitive distortions. When these beliefs exist, they are associated with prejudices and stereotypes, which are expressed by means of generalization and simplification.[6,10-12] Such simplification is manifested as real or perceived characteristics that are selected or highlighted as they are the only attributes that define a certain group.[6] In the process of generalization, characteristics observed in a few individuals are assigned to the members of a category and are then treated as typical of the whole group.[6,7]

Understanding the multidimensionality of attitudes towards intergenerational exchanges and the relationships that exist between the precursors of behavior and their multiple causes is critical to establishing good relations between children and the elderly.

In Brazil, scientific investment in investigating attitudes towards children, the elderly and the relationships between them is scarce. To measure attitudes toward aging, the most commonly used instrument is the Escala de Crenças e Atitudes em Relação à Velhice (Beliefs and Attitudes About Old Age Scale); consisting of 30 items, each based on two opposed adjectives.[13] To evaluate the attitudes of children in relation to old age, the Avaliação de Atitudes de Crianças em Relação a Idosos (the Evaluation of Attitudes of Children in Relation to The Elderly), a semantic differential scale consisting of 14 bipolar adjectives, is used.[1]

However, there are no Brazilian instruments that identify attitudes to the exchanges that occur between the elderly and children, such as the *Intergenerational Exchanges Attitude Scale* (IEAS). This scale was created by Stremmel et al.[14] in the USA to measure attitudes towards intergenerational exchanges. Containing 24 items allocated into five orthogonal factors, the IEAS includes: 1) 10 items regarding the relationship between the elderly and children (example: *"Children and older adults make good companions"*); 2) four items about the perception children have of older adults (example: *"Children think older adults are boring"*); 3) four items about the attributes of children (example: *"Children are too selfish to be around older adults"*); 4) four items about the attributes of older adults (example: *"Older adults are not tolerant of messy children"*); 5) three items about control and power (examplo: *"Children cheat older adults at games"*). The responses to the items of the scale are evaluative statements of positive or negative attitudes about intergenerational exchanges. The Likert format response categories allocate points from 7 (completely agree) to 1 (completely disagree) and vary from 24 to 168 points. High scores indicate a more positive attitude in relation to intergenerational exchanges.[14]

The IEAS has been used in research conducted in the USA since 1996.[14-17] The pioneering study was carried out by the group of scholars who created the scale and assessed the attitudes of 36 managers of day centers for the elderly and 300 preschool administrators towards intergenerational exchanges.

The IEAS has achieved high total scale internal consistency based on Cronbach's alpha coefficient (0.89). In terms of individual factors, the Cronbach's alpha coefficient was 0.60 for control and power; 0.65 for children's attributes, 0.66 for older adult's attributes; 0.70 for the perception of children about older adults; and 0.86 for the relationship between children and older adults. The degree of variance was approximately 13%, and the correlation between the items of the factors of the scale varied from 0.31 to 0.55.[14,15]

The scale was validated for the Japonese language by Murayama et al in 2011.[18] In this study, the reliability between the IEAS evaluators was established based on the kappa coefficient (0.60~0.90) only for the factors attributes of older adults and relationship between children and older adults.[16]

When comparing the data from the Japanese survey with the US study, it was observed that the attributes of older adults and the relationship between children and older adults factors had similar coefficients.[14-16] It should be noted that the attributes of older adults factor is related to the reflection of stereotypes and prejudices regarding this group and the relationship between children and older adults factor is directly aimed at intergenerationality.

Given the importance of measuring attitudes towards intergenerational exchanges and the absence of a specific Brazilian instrument to assess the exchange between older adults and children, the semantic and cultural equivalence of the IEAS into Portuguese is necessary.

The objective of the present study was to achieve semantic and cultural equivalence between the *Intergenerational Exchanges Attitude Scale* (IEAS)[14] and its Brazilian counterpart, the Escala de Atitudes em relação a Trocas Intergeracionais (the Scale of Attitudes in Relation to Intergenerational Exchanges - EATI).

METHODS

Cultural adaptation is a process that considers linguistic and cultural questions in order to adapt a scale for use in different contexts. Making the protocols suitable for each culture and cultural adaptation are necessary to produce effects similar to the original instrument.[19,20] The items cannot simply be linguistically translated, but should be adapted for the culture in question, considering different languages and symbols. The objective is to maintain the validity of the instrument in a different scenario from where it originated. To achieve equivalence between the original source and the version in another language, the transcultural adaptation of a questionnaire requires the use of unique, specific and rigorous method.[19-21]

The guidelines proposed by Beaton et al.[19] have been perfected from other procedures and techniques and are widely used for the cultural adaptation of measures of health and from other knowledge fields. The cultural and semantic equivalence of the IEAS was carried out from December 2012 to March 2014. The following five stages were performed during the research.

In the first stage, the scale was translated into Brazilian Portuguese. Two translations were carried out by independent translators, who did not exchange information with one other. One was familiar with the theme of the scale and the other had no prior knowledge of the elderly or intergenerational issues, beliefs and attitudes. One translator was a female Brazilian anthropologist and Portuguese-English bilingual. The other was a male Brazilian linguist, English teacher and translator of technical texts.

In the second stage, a synthesis of the first version in Brazilian Portuguese of Brazil was produced. Using the original scale and the two translations, a third person, a Brazilian Gerontologist who was

Portuguese-English bilingual, created a synthesis of the two translations. A detailed report has been prepared with the description of the discrepancies that occurred and the reasons for the choices made.

With the synthesized Portuguese version prepared, the third stage involved completion of the back-translations. Two versions were prepared by two back-translators, whose mother tongue was English, the same language of the original scale, without access to the published version of the scale. One back-translator was a British architect who had lived in Brazil for more than ten years. The other back-translator was a linguist from the USA who had also lived in Brazil for over ten years.

The fourth stage was the consolidation of a semantically acceptable version of the scale in Brazilian Portuguese. This step was performed by a committee of experts which reviews all such translations and reaches a consensus on any discrepancies. Due to the short period of time involved and the limited possibilities of reuniting the group, an expert linguist in English-Portuguese translations, who was given all the versions of the scale, produced a report which resulted in the adapted, semantically equivalent version, following the approval of all involved.

The last stage was the pre-test, usually applied in a group of 30 to 40 people, in order to test the validity and quality of the content.[19] After completing the scale, each subject was interviewed and asked about the meaning of each item and the chosen answer. This process ensures that the version will also be equivalent in terms of its application.

The final version culturally adapted to Brazilian Portuguese was submitted to a convenience sample composed of 32 professional volunteers. Twenty of these subjects worked with elderly persons while 12 developed intergenerational activities involving the elderly and children. Twenty-three were female and seven male, and age varied from 24 to 64 years. All were university graduates. In a single, individual interview, respondents were invited to read and comment on each item of the scale.

The present study was approved by the Ethics Research Committee of the Medical Sciences School of the Universidade Estadual de Campinas (Campinas State University) (CAAE: 30881414.9.0000.5404). All the participants were made aware of the study and signed a Free and Informed Consent Form, as determined by Resolution nº 466/2012 of the Conselho Nacional de Saude (the National Health Council).

RESULTS

The data obtained is shown in table 1, which describes the steps involved in the semantic-cultural adaptation of the IEAS, aimed at obtaining an equivalent Brazilian version, the Escala de Atitudes em relação a Trocas Intergeracionais (Scale of Attitudes in Relation to Intergenerational Exchanges) or EATI. This table shows the original items of the IEAS; the synthesis of the translations that comprised the first version in Brazilian Portugueseç the two complete back-translations; the consolidation of the semantically acceptable version and the EATI, which represents the final version culturally adapted to Brazilian Portuguese.

Table 1. Results of the progress of semantic and cultural validation of the *Intergenerational Exchanges Attitude Scale* (IEAS) for Brazilian Portuguese. Campinas, São Paulo, 2014.

Items	Original text	Synthesis of first version in Brazilian Portuguese	Back-translation 1	Back-translation 2	Consolidation of semantically acceptable version in Brazilian portuguese	Final version culturally adapted for Brazilian Portuguese
1	Older adults are not tolerant of messy children.	Idosos não são tolerantes com crianças bagunceiras.	Older adults are intolerant of unruly children.	The elderly are not tolerant of messy children.	Idosos não são tolerantes com crianças bagunceiras.	Idosos não são tolerantes com crianças bagunceiras.
2	Older adults are responsive to the needs of young children.	Idosos são sensíveis às necessidades de crianças pequenas.	Older adults are sensitive to the needs of young children.	The elderly are sensitive to the needs of small children.	Idosos são sensíveis às necessidades de crianças pequenas.	Idosos são sensíveis às necessidades de crianças pequenas.
3	Older adults share wisdom with children.	Idosos compartilham sua sabedoria com crianças.	Older adults share their wisdom with children.	The elderly share their wisdom with children.	Idosos compartilham sua sabedoria com crianças.	Idosos compartilham sua sabedoria com crianças.
4	Children are too selfish to be around older adults.	Crianças são muito egoístas para ficar ao redor de idosos.	Children are too selfish to be around older adults.	Children are too selfish to stay around the elderly.	Crianças são muito egoístas para ficar ao redor de idosos.	Crianças são muito egoístas para ficarem perto de idosos.
5	Older adults are gentle and kind to children.	Idosos são gentis e bondosos com as crianças.	Older adults are kind and nice to children.	The elderly are kind and generous to children.	Idosos são gentis e bondosos com as crianças.	Idosos são gentis e bondosos com as crianças.
6	Older adults are too protective of children.	Idosos são superprotetores de crianças.	Older adults are highly protective of children.	The elderly are overprotective of children.	Idosos são superprotetores de crianças.	Idosos protegem muito as crianças.
7	Children stimulate older adults' interest.	Crianças estimulam o interesse de idosos.	Children stimulate the interest of older adults.	Children stimulate the interest of the elderly.	Crianças estimulam o interesse de idosos.	Crianças estimulam o interesse dos idosos.

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Continuation of Chart 1

Items	Original text	Synthesis of first version in Brazilian Portuguese	Back-translation 1	Back-translation 2	Consolidation of semantically acceptable version in Brazilian portuguese	Final version culturally adapted for Brazilian Portuguese
8	Children ask too many questions to be around older adults.	Crianças fazem muitas perguntas para ficar por perto de idosos.	Children ask too many questions to be around older adults.	Children ask too many questions to remain around the elderly.	Crianças fazem muitas perguntas para ficarem por perto de idosos.	Crianças fazem muitas perguntas a fim de se aproximarem de idosos.
9	Older adults are too lenient with children when they misbehave.	Idosos são tolerantes demais com crianças quando elas se comportam mal.	Older adults are over tolerant with children when they misbehave.	The elderly are far too tolerant of children when they behave badly.	Idosos são tolerantes demais com crianças quando elas se comportam mal.	Idosos são tolerantes demais quando crianças se comportam mal.
10	Children cheat older adults at games.	Crianças trapaceiam os idosos nos jogos.	Children cheat older adults on games.	Children cheat when playing games with the elderly.	Crianças trapaceiam os idosos nos jogos.	Crianças trapaceiam os idosos nos jogos.
11	Older adults have difficulty earning a child's respect.	Idosos têm dificuldades em ganhar o respeito de uma criança.	Older adults find it hard to gain the respect of a child.	The elderly find it difficult to earn the respect of a child.	Idosos têm dificuldades em ganhar o respeito de uma criança.	Idosos têm dificuldade em conseguir o respeito de crianças.
12	Older adults and children help each other.	Idosos e crianças ajudam uns aos outros.	Older adults and children help each other.	The elderly and children help each other out.	Idosos e crianças ajudam uns aos outros.	Idosos e crianças ajudam uns aos outros.
13	Older adults and children have warm relationships.	Idosos e crianças têm relacionamentos afetuosos.	Older adults and children have affectionate relationships.	The elderly and children have affectionate relationships.	Idosos e crianças têm relacionamentos afetuosos.	Idosos e crianças se relacionam de forma afetuosa.
14	Children feel insecure around older adults.	Crianças sentem-se inseguras perto de idosos.	Children feel insecure around older adults.	Children feel insecure close to the elderly.	Crianças sentem-se inseguras perto de idosos.	Crianças se sentem inseguras perto de idosos.
15	Children think older adults are boring.	Crianças acham que os idosos são chatos.	Children think older adults are boring.	Children think the elderly are boring.	Crianças acham que os idosos são chatos.	Crianças acham que os idosos são chatos.

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Continuation of Chart 1

Items	Original text	Synthesis of first version in Brazilian Portuguese	Back-translation 1	Back-translation 2	Consolidation of semantically acceptable version in Brazilian portuguese	Final version culturally adapted for Brazilian Portuguese
16	Older adults enjoy activities with children.	Idosos gostam de atividades com crianças.	Older adults enjoy activities involving children.	The elderly like to join in with children's activities.	Idosos gostam de atividades com crianças.	Idosos gostam de atividades com crianças.
17	Children and older adults naturally feel affection toward one another.	Crianças e idosos naturalmente sentem afeição uns pelos outros.	Children and older adults have a natural affection for each other.	Children and the elderly naturally feel affection for one another.	Crianças e idosos naturalmente sentem afeição uns pelos outros.	Crianças e idosos sentem naturalmente afeto uns pelos outros.
18	Children and older adults make good companions.	Crianças e idosos fazem boa parceria.	Children and older adults get along well together.	Children and the elderly make a good team.	Crianças e idosos fazem boa parceria.	Crianças e idosos são bons companheiros.
19	Children and older adults have fun together.	Crianças e idosos se divertem juntos.	Children and older adults have fun together.	Children and the elderly have fun together.	Crianças e idosos se divertem juntos.	Crianças e idosos se divertem juntos.
20	Older adults get sick around children.	Idosos ficam doentes perto de crianças.	Older adults fall ill around children.	The elderly get sick when close to children.	Idosos passam mal perto de crianças.	Idosos ficam nervosos quando estão perto de crianças.
21	Children think older adults are ugly.	Crianças acham que os idosos são feios.	Children think older adults are ugly.	Children think the elderly are ugly.	Crianças acham que os idosos são feios.	Crianças acham que os idosos são feios.
22	Children are too active for older adults.	Crianças são muito agitadas para os idosos.	Children are too agitated for older adults.	Children are too excitable for the elderly.	Crianças são muito agitadas para os idosos.	Crianças são muito agitadas para os idosos.
23	Older adults are too frail to be around young children.	Idosos são muito frágeis para ficar por perto de crianças pequenas.	Older adults are too frail to be around young children.	The elderly are too frail to remain around small children.	Idosos são muito frágeis para ficarem por perto de crianças pequenas.	Idosos são muito frágeis para ficarem perto das crianças pequenas.
24	Children think older adults are dumb.	Crianças acham os idosos bobos.	Children think older adults are silly.	Children think the elderly are stupid.	Crianças acham os idosos bobos.	Crianças acham que os idosos são bobos.

Items 1, 4, 9, 10, 11, 14, 15, 20, 21, 22, 23 and 24 should be inverted for analysis.

The first version of the EATI consists of the synthesis, grouping and rejection of concepts and words used in the first two translations. The following divergent items and terms were identified, along with the concept chosen: 2) between *responsáveis* (responsive) and *sensíveis* (sensitive), *sensiveis* was chosen; 5) between *amorosos* (loving) and *bondosos* (kind), *bondosos* was chosen; 9) between *complacentes* (accomodating) and *tolerantes* (tolerant), *tolerantes* was chosen; 11) between *ganhar* (earn) and *obter* (obtain), *obtain* was chosen; 13) between *caloroso* (warm), *cordias* (cordial) and *afetuoso* (affectionate), *afetuoso* was chosen; 17) between *afeição* (affection) and *afeto* (affective), *afeição* was chosen; 18) between *companheiros* (companions) and *parceria* (team), *team* was chosen; 22) between *ativas* (active) and *agitadas* (excitable), *agitadas* was chosen.

With respect to the back-translations, it was noted that the expressions older adults and elderly have the same meaning as *idoso* or *velho* in Portuguese. Between *idoso* and *velho*, *idoso* was chosen, as in many contexts the word *velho* has a more negative connotation than the word *idosos*. Divergencies were identified in the text of nine items (1; 6; 9; 11; 16; 18; 20; 22; 24) by two independent back-translators. However, following joint analysis of these items, it was concluded that there was no semantic divergence, or in other words, the terms were equivalent.

Based on the suggestions of the committee of professionals, a number of alterations were made aimed at cultural refinement. The items which changed were: 4) *ao redor* (around) and *perto* (near) – *perto* was chosen; 6) *superprotetores* (overprotective) and *protegem muito* (highly protective) – *protegem muito* was chosen; 8) *ficarem por perto* (be around) and *a fim de se aproximarem* (to want to get close to) – *a fim de se aproximarem* was chosen; 11) *ganhar* (earn) and *conseguir* (obtain), *conseguir* was chosen; 13) *tem relacionamentos afetuosos* (have warm relationships) and *se relacionam de forma afetuosa* (relate affectionately) – *se relacionam de forma afetuosa* was chosen; 17) *afeição* (affection) and *afeto* (fondness) – *afeto* was chosen; 18) *fazem boa parceria* (form a good team) and *são bons companheiros* (are good companions) – *sao bons companheiros* was chosen; 20) *passam mal* (get sick) and *ficam nervosos* (get irritated) – *ficam nervosos* was chosen.

The professionals considered the EATI to be a general scale, with statements that depend on the context, profile, values and interests of the participants and professionals. Some professionals highlighted the following terms as biased/ prejudiced: item 4 (*egoista* - selfish); 14 (*inseguras* - insecure); and item 21 (*feios* - ugly). These items were not altered as it was considered that while it was possible to agree that such content is prejudiced, these are common terms in which many people refer to children and the elderly.

Following the suggestions of the professionals, a seven point Likert scale was adopted instead of the seven points of the original scale, in order to facilitate understanding of the respondents regarding the EATI measurements. As a result, the score could now range from 24 to 120 points. Higher scores indicate more positive attitudes towards intergenerational exchanges.

DISCUSSION

The equivalence of the EATI was indicated by the semantic and cultural assessments that were carried out in different stages, which enabled the translation and adaptation of the Brazilian version, entitled the Escala de Atitudes em relação a Trocas Intergeracionais (Scale of Attitudes in Relation to Intergenerational Exchanges - EATI).[14]

The cross-cultural adaptation evaluated and achieved the equivalence of the EATI in the following fields: semantic and idiomatic, corresponding to the same meaning of words and the use of expressions; conceptual, which verified the theoretical construct; cultural, which considered the situations presented in the scale; and in terms of criteria, which evaluated the normative interpretation of the items of the scale under study.[19-21]

During the procedure of semantic and cultural adaptation of the EATI, there was some reflection on the use of the term for people over 60 years of age by the back-translators and the consensus of the linguist. In other languages and cultures, the discussion around the words *velho* (elderly) and *idoso* (older adults) is ongoing. A number of euphemisms are used to describe this age range.[3]

The negative attitudes in relation to the older adults referred to in the EATI express physical conditions, intolerance, ugliness and aspects of mood and personality, as exemplified in items: 1) Older adults *are not tolerant* of messy children; 21) Children think older adults are *ugly*; 23) Older adults are *too frail* to be around young children; and 24) Children think older adults are *dumb*. Recent bibilographic reviews published by Guerra & Caldas[22] and by Spielman[8] have shown that beliefs and negative attitudes towards older adults are associated with physical fatigue, decreased physical beauty, mental degeneration, disease, inactivity, disability, dependence and worthlessness.

A survey of 70 older adults conducted in Rio de Janeiro registered the presence of negative attitudes to old age. Through the free recall of test words, the elements of disease, prejudice, sadness, difficulty, abandonment, discrimination, loneliness, peevishness, exclusion, being oldfashioned and tired were used to refer directly or peripherally to older adults. On the other hand, in the same study, experience was invoked as a central element that characterized older adults and wisdom, love and dedication were also present.[23]

In the EATI, a positive attitude in relation to experience, knowledge and wisdom is present in item 3 ("Older adults share *wisdom* with children"). A study of 35 older adults from Kwahu-Tafo, in Gana, found wisdom, prudence, discipline and selflessness to be the main virtues of the elderly, as wisdom and life experience allow counseling in certain situations and problems. These characteristics also describe more positive attitudes toward aging.[24]

The positive attitudes described in the EATI (item 5 - "Older adults are *gentle and kind* with children") are similar to data found in a study on this topic in Brazil. Research by Todaro[1] with 248 children aged 7 to 10 years, submitted to post-test intervention, indicated more positive attitudes of children toward aging, especially in terms of social and personal relations, that is, being considered good-humored, accepting, valued, nice, friendly and generous. A more recent study in São Carlos in the state of São Paulo with 54 children aged seven to ten years, found that they considered older adults "nice" and felt they were friendly and generous.[25] A study in Italy of 32 older adults and 114 children identified that, after an intervention with intergenerational activities, the attitudes of children toward older adults were more positive, especially regarding functionality, considering them to be more active and stronger and in terms of social representations, seeing them as wiser, more friendly and respectful.[26]

Other EATI items also tend to express more positive attitudes, such as: 2) Older adults are *responsive to the needs* of small children and 6) Older adults *protect children*. Older people, particularly grandmothers, are seen as protectors of children, especially in terms of support and help when parents are absent. A study conducted in the United States with 124 grandparents confirmed these positive attitudes toward aging, especially in characteristics associated with attention, protection and also the concern that grandparents have for their grandchildren, especially in matters relating to custody, health and education.[27]

Regarding the positive attitudes towards the exchanges that occur between the elderly and children, Brazilian and international surveys have highlighted the idea that children and the elderly can interact and live together in a caring manner. A study in Tokyo, Japan, of older adults aged 71-101 years and children 5 and 6 years found that during and after taking part in culturally traditional activities practiced together, there were differences in the facial expression, involvement and behavior of the participants, who started to interact in a more affectionate way with smiles and constructive dialogue.[17] A study by Lima,[28] in the Serviço Social do Comércio (Commercial Social Services - SESC), with 42 participants, among them older adults, adults, adolescents and children, found that when cooperative interaction is maximized during intergenerational activities, participants tend to help each other towards common goals.

Positive attitudes between children and older people are present in EATI items: 7) Children stimulate older adults' interest; 12) Older adults and children help each other; 13) Older adults and children have warm relationships.; 16) Older

adults enjoy activities with children; 17) Children and older adults naturally feel affection toward one another; 18) Children and older adults make good companions; 19) Children and older adults have fun together. Negative attitudes are described in the following attitudes of the EATI: 4) Children are too selfish to be around older adults; 8) Children ask too many questions to be around older adults; 10) Children cheat older adults at games; 11) Older adults have difficulty earning a child's respect; 15) Children think older adults are boring; 22) Children are too active for older adults. A study by Ferrigno,[29] carried out at SESC São Paulo involving people aged from 10 to 68 years, identified the need for strategies to deal with certain conflicts, such as disrespect and intolerance. Reality must not be masked and conflict cannot be denied. Agreements should be encouraged and the flexibility of everyone involved sought. It is vital to stimulate a culture of solidarity through dialogue.[29]

The present study identified limitations, such as the scarcity of Brazilian literature on the subject, especially with regard to the perceptions of older people in relation to the younger generation. Finally, the need to investigate the validity of the EATI by correlating it with a consolidated equivalent instrument widely used in Brazilian Portuguese should be stressed. It is also necessary to carry out an assessment of the psychometric properties of the instrument, so that the validation process can reflect such elements.

FINAL CONSIDERATIONS

It can be concluded that the Intergenerational Exchanges Attitude Scale (IEAS) has been adapted for the Brazilian population and entitled the Escala de Atitudes em relação a Trocas Intergeracionais (Scale of Attitudes in Relation to Intergenerational Exchanges) (EATI) after the semantic and cultural equivalence of the scale was carried out. However, there is still a lack of results in relation to the psychometric properties and other validation steps.

The EATI can be a useful tool for Geriatrics and Gerontology with regard to the awareness of perceptions of attitudes in relation to intergenerationality and the relationship between different generations. This instrument can be used in programs that feature activities among children and the elderly, as well as in the work of professionals who develop strategies of this type.

It is expected that the semantic and cultural equivalence of the EATI will foster new studies on attitudes relating to intergenerational exchanges, thus increasing scientific knowledge on this subject. Reflection and debate on intergenerational relationships offers an interesting opportunity to demystify old age and the aging process.

REFERENCES

1. Todaro MA. Desenvolvimento e avaliação de um programa de leitura visando à mudança de atitudes de crianças em relação a idosos [tese]. Campinas: Faculdade de Educação da Universidade Estadual de Campinas; 2008.
2. Gluth S, Ebner NC, Schmiedek F. Attitudes toward younger and older adults: the German aging semantic differential. Int J Behav Dev 2010;34(2):147-58.
3. Fonseca GG. Acercamiento cultural intergeneracional: propuestas desde la comunicación para la interrelación entre jóvenes y adultos mayores en Segovia [dissertação]. Espanha: Universidade de Valladolid; 2011.
4. Randler C, Vollmer C, Wilhelm D, Flessner M, Hummel E. Attitudes towards the elderly among german adolescents. Educ Gerontol 2014;40(3):1-9.
5. Neri AL, Cachioni M, Resende CM. Atitudes em relação à velhice. In: Freitas EV, Py L. Tratado de geriatria e gerontologia. Rio de Janeiro: Guanabara Koogan; 2002. 2002. p. 972-80.
6. Neri AL. Atitudes em relação à velhice: questões científicas e políticas. In: Freitas EV, Py L. Tratado de geriatria e gerontologia. Rio de Janeiro:Guanabara Koogan; 2006. p. 1316-23.

7. Neri AL. Idosos no Brasil: vivências, desafios e expectativas na terceira idade. São Paulo: Editora Perseu Abramo. 2007. Atitudes e preconceitos em relação à velhice; p.33-46

8. Spielman B. Elderly, social attitudes toward. In: Encyclopedia of Applied Ethics. 2nd ed. London: Elsevier; 2012 p. 56-62.

9. Suh S, Choi H, Lee C, Cha M, Jo I. Association between knowledge and attitude about aging and life satisfaction among older Koreans. Asian Nurs Res 2012;6:96-101.

10. Cachioni M, Aguilar LE. Crenças em relação à velhice entre alunos da graduação, funcionários e coordenadores-professores envolvidos com as demandas da velhice em universidades brasileiras. Rev Kairós 2008;11(2):95-119.

11. Neves CFO. Estereótipos sobre idosos: representação social em profissionais que trabalham com a terceira idade [dissertação]. Covilhã: Universidade da Beira Interior; 2012.

12. Neri AL. Atitudes em relação à velhice: evidências de pesquisa no Brasil. Gerontologia 1997;5(3):130-9.

13. Neri AL. Envelhecer num país de jovens: significados de velho e velhice segundo brasileiros não idosos. Campinas: UNICAMP;1991.

14. Stremmel AJ, Travis SS, Kelly-Harrison P. Development of the Intergenerational Exchanges Attitude Scale. Educ Gerontol 1996;22(4):317-28.

15. Travis SS, Stremmel AJ, Kelly-Harrison P. Attitudes toward intergenerational exchanges among administrators in child and adult day care centers. Educ Gerontol1997;23(8):775-87.

16. Jarrot SE, Morris MM, Burnett AJ, Stauffer D, Stremmel A, Gigliotti CM. Creating Community capacity at a shared site intergenerational program: "Like a Barefoot Climb Up a Mountain". J Intergener Relationsh 2011;9(4):418-34.

17. Morita K, Kobayashi M. Interactive programs with preschool children bring smiles and conversation to older adults: time-sampling study. BMC Geriatr 2013;13(11):1-9.

18. Murayama Y, Fujiwara Y, Yasunaga M, Takeuchi R, Nonaka K, Yajima S, et al. Development of a japanese version of the Intergenerational Exchanges Behavior Scale. J Jpn Soc Intergener Stud 2011;1(1):27-37.

19. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine 2000; 25(24):3186-91.

20. Viana HB. Adaptação e validação da escala ASKAS: aging sexual knowledge and atitudes scale em idosos brasileiros [tese]. Campinas: Universidade Estadual de Campinas, Faculdade de Educação Física; 2008.

21. Almeida ST. Tradução, adaptação cultural e validação da versão em português do Brasil do Selection, Optimization and Compensation Questionnaire (SOCQ) para uso entre idosos sedentários e atletas master [tese]. Porto Alegre: Pontifícia Universidade Católica do Rio Grande do Sul, Instituto de Geriatria e Gerontologia; 2013.

22. Guerra ACLC, Caldas CP. Dificuldades e recompensas no processo de envelhecimento: a percepção do sujeito idoso. Ciênc Saúde Coletiva 2010;15(6):2931-40.

23. Dos Santos VB, Tura LFR, Arruda AMS. As representações sociais de "pessoa velha" construídas por idosos. Saúde Soc 2013;22(1):138-47.

24. Van der Geest S. Grandparents and Grandchildren in Kwahu, Ghana: The Performance Of Respect. Africa 2004;74(1):47-61.

25. Luchesi BM, Dupas G, Pavarini S. Avaliação da atitude de crianças que convivem com idosos em relação à velhice. Rev Gaúcha Enferm 2012;33(4):33-40.

26. Gaggioli A, Morganti L, Bonfiglio S, Scaratti C, Cipresso P, Serino S,et aç. Intergenerational Group Reminiscence: a potentially effective intervention to enhance elderly psychosocial wellbeing and to improve children's perception of aging. Educ Gerontol 2014;40(7):486-98.

27. McGowen MR, Ladd L, Strom RD. On-line assessment of grandmother experience in Raising Grandchildren. Educ Gerontol 2006;32:669-84.

28. Lima CR. Programas Intergeracionais: um estudo sobre as atividades que aproximam as diversas gerações [dissertação]. Campinas: Universidade Estadual de Campinas, Faculdade de Educação; 2007.

29. Ferrigno JC. O conflito de gerações: atividades culturais e de lazer como estratégia de superação com vistas à construção de uma cultura intergeracional solidária [tese]. São Paulo: Universidade de São Paulo, Instituto de Psicologia; 2009.

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Effect of the Mat Pilates method on postural balance and thoracic hyperkyphosis among elderly women: a randomized controlled trial

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Abstract

Objective: To evaluate the influence of the Mat Pilates method on thoracic hyperkyphosis and postural balance among elderly women. *Method:* A randomized longitudinal study was performed involving 31 elderly women who were divided into two groups: the Control Group (n=17) and the Pilates Group (n=14). The Pilates Group underwent training while the Control Group attended lectures. Evaluation consisted of specific balance (one-leg right and left) and thoracic kyphosis (computed biophotogrammetry) tests. The subjects were reassessed at the end of eight weeks. Data was analyzed by the Shapiro-Wilk test for normality, and the paired Student's t, the unpaired Student's t, the Wilcoxon, and the Mann-Whitney statistical tests, with a significance level of 5% (p<0.05). *Results:* The Pilates group maintained balance levels (p>0.05) and had a mean thoracic kyphosis reduction of 6 degrees (p<0.001). There was no significant difference (p>0.005) in any of the variables in the Control Group. *Conclusion:* The present study found that the Mat Pilates method contributed to a reduction in thoracic kyphosis and the maintenance of balance in the elderly women investigated. REBEC: RBR-6jd8nq

Key words: Balance Postural; Kyphosis; Physical Therapy Modalities; Elderly.

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INTRODUCTION

The elderly suffer from a reduced balance capacity, which is caused by alterations in the relationship between sensory data acquisition and motor activity.[1] The sensory and motor systems, in conjunction with the nervous system, comprise the framework for postural control[2], whose functional purpose is to maintain postural balance and orientation.[3]

A loss of postural balance can be explained by a failure in the proper functioning of the Central Nervous System (CNS), which receives information from the visual, vestibular and somatosensory systems. The failure send this signal to the CNS causes a loss of balance.[4]

An additional aim of postural control is what is known as postural orientation, which consists of the interaction between the positioning of one's body and vision, gravity, support surfaces and internal references.[3] Disorders in postural orientation are common among the elderly.[5] One of these disorders is thoracic hyperkyphosis, which is defined as postural misalignment involving a pinching of the vertebra at the thoracic height of the sagittal plane, allowing the clinical observation of an increase in the thoracic curvature.[6]

Engaging in regular physical exercise is an important factor in the reduction of alterations in posture[7] and balance[8] caused by aging.[7,8] Exercise imparts positive benefits with respect to the aging process, and studies have revealed the positive impacts of exercise on postural control.[9]

The Pilates Solo techniques represent a form of exercise that bolsters physical conditioning, postural alignment and improvements in motor coordination,[10,11], which is why it is frequently prescribed by physical rehabilitation professionals and recommended for those that are thinking of beginning an exercise regimen.[12]

This method was created based on progressive exercises that involve stretching and strength training,[13], and has the aim of offering a total body workout, while maintaining harmony between the body and the mind.[10]

The Mat Pilates training method focuses on the postural alignment of the spine and of the scapular and pelvic belt.[14,15] It is believed that both strength training and postural alignment help to improve thoracic hyperkyphosis.

Considering that thoracic hyperkyphosis can interfere with bodily oscillation, making static balance more difficult and increasing the probability of the elderly individual falling down, the search for initiatives that reduce these changes that arise from the aging process is extremely important.

As a result, this study aims to evaluate the impact of the Mat Pilates method on thoracic hyperkyphosis and balance among elderly women.

METHODOLOGY

Study environment and scope

A randomized, longitudinal study was conducted between the months of January and September, 2011. Experimental procedures were conducted at the Faculdade de Filosofia e Ciências of the Universidade Estadual Paulista Júlio de Mesquita Filho (the School of Philosophy and Science of the Júlio de Mesquita Filho Paulista State University - UNESP), at its campus located in Marília, São Paulo.

Participants

Participant recruiting began with the distribution of notifications regarding the study in locations that offered some form of assistance to elderly people. Thirty-one women, between the ages of 60 and 75, participated in the study. They were divided into two groups by means of a simple random selection process: the Pilates Group (PG) and the Control Group (CG). In terms of eligibility criteria, it was stipulated that the volunteers must be at least 60 years of age; have

an angle of at least 40 degrees in the curvature of their spines at the thoracic height of the sagittal plane; be present for at least 75% of the training sessions and lectures; and not present neurological or motor sequelae, cognitive deficits,[16] signs of nerve compression,[17] ankylosing spondylitis, rheumatoid arthritis, vertebral tumors, vertebral fractures or cauda equina syndrome. [18]

Experimental Procedures

An initial evaluation, which was conducted for both groups, consisted of compiling a log for each participant containing their personal information, general data regarding their state of health, specific tests involving balance and measurements of angles of thoracic kyphosis. Upon conclusion of the initial evaluation, the PG group began training with the Mat Pilates method, while the CG group attended lectures. The training and the lectures lasted for eight weeks. At the end of the eight weeks, both groups were re-evaluated. The CG group, after re-evaluation, was submitted to eight weeks of Mat Pilates classes. The evaluations of the volunteer participants were performed by a certified physical therapist.

Computerized bio-photogrammetry

Computerized bio-photogrammetry is a method of measuring thoracic kyphosis.[19] For this study, only angles of thoracic hyperkyphosis of 40 degrees or more were considered.[20]

The backs of the volunteers were exposed and cylindrical markers were placed over the spinous processes of the seventh cervical vertebra (C7) and the twelfth thoracic vertebra (T12). One at a time, the volunteers were positioned in an orthostatic position with their right side facing the wall and their left facing the camera. A 12 megapixel Fujifilm® camera was positioned at a distance of 2.8 meters from the volunteers at a height of 75 centimeters from the ground.

In order to measure the degree of thoracic kyphosis, *AutoCad* 2007® software was used, which made it possible to trace two lines running parallel to the C7 and T12 markers; the intersection of those lines formed the angle that denoted the degree of thoracic kyphosis.[19]

Unipodal Test

A unipodal test was conducted in which volunteers were asked to look straight ahead while standing one meter from the wall. Volunteers were then asked to raise one leg while keeping their eyes closed. The amount of time the volunteer was able to maintain the position was timed on a stopwatch.[21] Three attempts were made with each leg with a time limit of 30 seconds. The attempt with the longest duration was recorded for each volunteer and used in the study.[22] Each of the volunteers began the test by elevating their right leg.

Mat Pilates Training

The volunteers were trained in the Mat Pilates methodology over a period of eight weeks. They attended one hour sessions twice a week over a total of 16 sessions. Training groups were kept to a maximum of nine volunteers.

The Mat Pilates exercises implemented are shown in chart 1. Each exercise was undertaken progressively, evolving from beginner exercises through to advanced level exercises. In order to advance a level of difficulty, each volunteer had to conduct the exercises according to all of the principles set forth in the Mat Pilates method, which were taught at the beginning of the training period. The exercises were administered by two physical therapists with knowledge of the discipline of Mat Pilates.

Chart 1. Mat Pilates methodology exercise program. Marília-SP, 2011.

Purpose	Exercise	Duration
Strengthening of the hips and stabilization of the torso	*Hundred* level 1, *One leg stretch*, *One leg circles*	Sets: 5 minutes x 2 Rest interval: two minutes
Strengthening of the hips, stabilization of the torso, stability and stretching of the torso	*Hundred* level 2, *One leg stretch, Saw Neck pull, Single leg lift*	Sets: 4 minutes x 2 Rest interval: one minute
Strengthening of the hips, stabilization of the torso, stability and stretching of the hip and torso muscles	*Roll-up*, Leg stretch, *Scissors, Swan, Side twist, Hundreds in standing*, Table	Sets: 2 minutes and 30 seconds x 2 Rest interval: one minute
Strengthening of the hips, stabilization of the torso, stability and stretching of the hip muscles	Leg stretch while producing opposing force, *Breast stroke*, *Double leg stretch, Spine stretch forward, Shell stretch, Standing scissors*, *Standing* star series, *Standing* hamstring contraction and extension series, *Slices*	Sets: 2 minutes x 2 Rest interval: one minute

Lectures

The control group attended four lectures in which the following subject matter was discussed in sequence: Changes due to the aging process and the act of falling down; changes due to aging and its effects on posture; physical activity, quality of life and overall health for the elderly. The lectures lasted approximately 45 minutes and were administered by the two physical therapists that administered the training sessions.

Data analysis

Exploratory statistical techniques were applied to analyze the data. After applying the Shapiro-Wilk test to verify the normality and homogeneity of the data, the paired Student's t test and the Wilcoxon test were applied to analyze the data in order to evaluate intra-group variables. The Mann-Whitney test was adopted for analysis of the inter-group variables. A significance level of 5% (p<0.05) was adopted to interpret the data.

Ethical aspects

The study was approved by the Research Ethics Committee of the School of Philosophy and Science of the Universidade Estadual Paulista Júlio de Mesquita Filho, case number 0341/2011. Each of the participants was briefed about the study and signed an Informed Consent Form, in accordance with Resolution No. 196/96 of the National Health Council.

RESULTS

Fifty-four elderly women were selected for the study, of which 15 were excluded for not having satisfied the stipulated selection criteria. As a result, thirty-nine participants were admitted to the present study. The elderly female participants were then randomly separated into two groups: CG [n=22; 65.4 (±4.03) years] and PG [n=17; 67.71(±3.24) years]. Over the duration of the study, five volunteers decided to opt out of the CG group (22.7%) and three from the PG group (17.6%). As such, 31 elderly women, 17 in the CG group and

14 in the PG group, participated in the entirety of the study. Table 1 shows the anthropometric characterization of the groups, which were homogenous with respect to age (p=0.097), height (p=0.604), body mass (p=0.328) and body mass index (p=0.181).

Table 1. Characterization of the Pilates Group (PG) and the Control Group (CG) Marília-SP, 2011.

	PG (n=14)		CG (n=17)	
	Mean	CI 95%	Mean	CI 95%
Age (years)	67.00	65.38-68.62	64.88	62.80-66.96
Height (m)	1.58	1.54-1.62	1.60	1.55-1.64
Body mass (Kg)	76.66	69.83-83.47	72.40	66.28-78.50
BMI(Kg/m²)	30.68	27.82-33.54	28.38	26.21-30.54

CI 95% = 95% confidence interval; BMI = body mass index.

The PG group participants were not present for 14.70% of the duration of the training period, whereas the CG group did not participate in 25.00% of the lecture series. The volunteers in the PG group were able to learn the principles of the method during the first week of training, in addition to finishing the simultaneous exercise program.

The results of the right unipodal support test did not reveal a significant difference between the evaluation and the re-evaluation phases in both the PG group (p=0.300, test power of 62.08%) and the CG group (p=0.653, test power of 66.01%). With respect to inter-group comparison, no difference was detected for the right unipodal support test regarding the evaluation (p=0.421, test power of 57.10%) and the re-evaluation phases (p=0.597 test power of 50%), as shown in table 2.

The results of the left unipodal support test did not reveal a difference regarding intra-group analysis with respect to the PG group (p=0.109, test power of 57.76%) and the CG group (p=0.653, test power of 50.37%); the same is true for inter-group analysis during the evaluation (p=0.769, test power of 53.00%) and the re-evaluation phases, as shown in table 2.

Table 2. Results of the right and left unipodal tests of the Pilates (PG) and Control (CG) Groups. Marília-SP, 2011.

		RUT (s)		LUT (s)	
		Mean	CI 95%	Mean	CI 95%
PG (n=14)	Evaluation	4.44	3.53-6.31	3.76	2.64-7.05
	Re-evaluation	4.28	2.18-12.91	5.27	3.70-7.78
CG (n=17)	Evaluation	4.85	4.06-7.63	4.74	3.97-9.80
	Re-evaluation	5.73	4.76-9.93	4.05	4.34-8.95

RUT = right unipodal test; LUT= left unipodal test; (s)= seconds; CI 95%= 95% confidence interval.

The PG group showed a decrease in thoracic hyperkyphosis (p<0.001, test power of 71.12%) after the training, whereas the thoracic hyperkyphosis levels of the CG group remained the same (p=0.303, test power of 56.95%). With respect to the inter-group analysis, no significant differences were detected between the groups regarding thoracic hyperkyphosis either during the evaluation period (p=0.554, test power of 53.86%) or the re-evaluation period (p=0.723, test power of 51.00%), as shown in table 3.

Table 3. Thoracic hyperkyphosis results for the Pilates (PG) and Control (CG) groups. Marília-SP, 2011.

	Evaluation (in degrees)		Re-evaluation (in degrees)	
	Mean	CI 95%	Mean	CI 95%
PG (n=14)	59.50	51.12-67.88	53.43*	45.93-60.93
CG (n=17)	56.76	51.72-61.81	54.88	50.49-59.28

*Statistically significant intra-group difference (p<0.05); CI 95%= 95% confidence interval.

DISCUSSION

The results of the present study indicate an improvement in thoracic hyperkyphosis and a maintenance of static balance after eight weeks of training with the Mat Pilates methodology.

One of the aims of the Mat Pilates method is to promote central stabilization and a strengthening of the body's core muscles (abdominal muscles, pelvic floor and the lumbar region)[8, 23] and the muscles of the scapular and pelvic belt.[14]

A study conducted by Cruz-Ferreira et al.[15] evaluated the effect of the Mat Pilates method on the postural alignment of adult women, whose training in the discipline lasted six months. Results indicated a significant improvement in the sagittal alignment of the cervical and thoracic spine, corroborating the results of the present study, which indicated reductions in the degree of thoracic hyperkyphosis among study participants.

This reduction in thoracic hyperkyphosis through the application of the Mat Pilates methodology was also described as positive in elderly individuals that undertook 10 weeks of Mat Pilates classes; the results indicated improvements in thoracic hyperkyphosis when in an orthostatic position, as observed in five second video footage of each participant.[24]

The Mat Pilates method promotes the strengthening of the body's core muscles [13,23] and of the muscles of the scapular and pelvic belt[14], which govern the posterior stability of the torso, counteracting the force of gravity on the body and generating the resistance that makes it possible to maintain oneself in an orthostatic position. The method also improves dynamic stability among the elderly,[6] in addition to improving the control and precision of upper and lower extremity movements.[14]

The individual aims to maintain his or her center of gravity within its limits of balance in order to maintain body stability, which is determined by postural control capability when there is no change in the support base.[3] From that point, the Mat Pilates method results in improvements in balance[13] and postural stability[25] by executing a contraction of the postural and abdominal muscles.[13]

The mean of the stability values indicated a higher value for the PG group when the evaluations were compared. This difference, however, was not deemed statistically significant. Such an occurrence could be due to the small size of the sample, as reflected in the low degree of sample power. In addition, a review of the literature, undertaken by Francisco et al.[26], which aimed to evaluate the efficacy of the Mat Pilates method among elderly individuals, concluded

that this type of exercise program has proved to be highly efficacious at improving the static and dynamic balance of elderly women.

Studies[27,28] have shown that the Mat Pilates method brings about static balance improvements among the elderly. The Romberg test was administered with the participants' eyes open, and the length and velocity of bodily oscillation were measured[27]. The force platform test was also conducted, in which participants alternated opening and closing their eyes, while also alternating standing on a stable and unstable (foam) surface for 30 seconds.[28] These tests showed that the Mat Pilates method is effective at improving static balance. However, during this study, the unipodal support test did not return statistically significant results. Researchers concluded, therefore, that this may have occurred because the test was not sensitive enough to identify improvements in stability.

The Mat Pilates method, when practiced regularly, contributes to a reduction of thoracic hyperkyphosis and an improvement in balance when the postural, abdominal and paravertebral muscles are exercised, increasing stability and postural conscience as a result.[10,25] In addition to promoting the strengthening and stretching of the body's muscular framework, Mat Pilates improves postural alignment[11] and develops the motor coordination and balance of elderly individuals, reducing the risk of falling down.[10]

The present study was limited by the following factors: small sample size, the non-implementation of a dynamic stability evaluation, the non-implementation of a post-training evaluation of the group and the non-implementation of a group that trained with conventional exercise techniques.

CONCLUSIONS

The data acquired during this study allowed researchers to conclude that the Mat Pilates method contributed to reductions in the degree of thoracic hyperkyphosis among elderly female study participants, as well as the maintenance of their balance.

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REFERENCES

1. Burke TN, Franca FJR, Meneses SRF, Cardoso VI, Pereira RMR, Danilevicius CF, et al. Postural control among elderly women with and without osteoporosis: is there a difference? São Paulo med j 2010;128(4):219-24.
2. Duarte M, Freitas SMSF. Revision of posturography based on force plate for balance evaluation. Rev Bras Fisioter 2010;14(3):183-92.
3. Horak FB. Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls? Age Ageing 2006;35(2): 7-11.
4. Kerber KA, Enrietto JA, Jacobson KM, Baloh RW. Disequilibrium in older people: a prospective study. Neurology 1998;51(2):574-80.
5. Rizzi PRS, Leal RM, Vendrusculo AP. Efeito da hidrocinesioterapia na força muscular e na flexibilidade em idosas sedentárias. Fisioter Mov 2010;23(4):535-43.
6. Regolin F, Carvalho GA. Relação entre cifose dorsal, densidade mineral óssea e controle postural em idosas. Rev Bras Fisioter 2010;14(6):464-69.
7. Bandeira FM, Delfino FC, Carvalho GA, Valduga R. Comparação entre a cifose torácica de idosos sedentários e praticantes de atividade física pelo método flexicurva. Rev Bras Cineantropom Desempenho Hum 2010;12(5):381-86.
8. Sá ACAM, Bachion MM, Menezes RL. Exercício físico para prevenção de quedas: ensaio clínico com idosos institucionalizados em Goiânia, Brasil. Ciênc Saúde Coletiva 2012;17(8):2117-27.

9. Tse AC, Wong TW, Lee PH. Effect of low-intensity exercise on physical and cognitive health in older adults: a Systematic Review. Sports Med Open 2015;1(1):1-13.

10. Sacco ICN, Andrade MS, Souza OS, Nisiyama M, Cantuária AL, Maeda FYI, et al. Método pilates em revista: aspectos biomecânicos de movimentos específicos para reestruturação postural - Estudos de caso. Rev Bras Ciênc Mov 2005;13(4):65-78.

11. Ferreira C, Aidar F, Novaes G, Vianna J, Carneiro A, Menezes L. O método Pilates sobre a resistência muscular localizada em mulheres adultas. Motriz 2007;3(4):76-8.

12. Segal NA, Hein J, Basford JR. The effects of Pilates training on flexibility and body composition: an observational study. Arch Phys Med Rehabil 2004;85(12):1977-81.

13. Muscolino JE, Cipriani S. Pilates and the "powerhouse"-I. J Bodyw Mov Ther 2004;8(2):122-30.

14. Pata RW, Lord K, Lamb J. The effect of Pilates based exercise on mobility, postural stability, and balance in order to decrease fall risk in older adults. J Bodyw Mov Ther 2014;18(3):361-67.

15. Cruz-Ferreira A, Fernandes J, Kuo YL, Bernardo LM, Fernandes O, Laranjo L, et al. Does pilates-based exercise improve postural alignment in adult women? Women Health 2013;53(6):597-611.

16. Tozim BM, Furlanetto MG, Lorenzo DM, Morcelli MH, Navega MT. Efeito do método Pilates na flexibilidade, qualidade de vida e nível de dor em idosos. ConScientiae Saúde 2014;13(4):563-70.

17. Ramírez CR, Lemus DMC. Disfunção da articulação sacro-ilíaca em jovens com dor lombar. Fisioter Mov 2010;23(3):419-28.

18. Ferreira MS, Navega MT. Efeitos de um programa de orientação para adultos com lombalgia. Act Ortop Bras 2010;18(3):127-31.

19. Rodrigues ACC, Romeiro CAP, Patrizzi LJ. Avaliação da cifose torácica de mulheres idosas portadoras de osteoporose por meio da biofotogrametria computadorizada. Rev Bras Fisioter 2009;13(3):205-09.

20. Kostuik JP. Adult Kyphosis: the adult spine-principles and practice. New York: Raven Press; 1991.

21. Freitas ERFS, Rogério FRPG, Yamacita CM, Vareschi ML, Silva RA. Prática habitual de atividade física afeta o equilíbrio de idosas? Fisioter Mov 2013; 26(4):813-21.

22. Hauser E, Martins VF, Teixeira AR, Zabaleta AD, Gonçalves AK. Relação entre força muscular e equilíbrio de idosos no programa de equilíbrio. ConScientiae Saúde 2013;12(4):580-7.

23. Willson JD, Dougherty CP, Ireland ML, Davis IM. Core stability and its relationship to lower extremity function and injury. J Am Acad Orthop Surg 2005;13(5):316-25.

24. Kuo YL, Tully EA, Galea MP. Sagittal spinal posture after pilates-based exercise in healthy older adults. Spine 2009;34(10):1046-51.

25. Emery K, Serres SJ, Mcmillan A, Côté JN. The effects of a Pilates training program on arm-trunk posture and movement. Clin Biomech 2012;25:124-30.

26. Francisco CO, Fagundes AA, Gorges B. Effects of Pilates method in elderly people: Systematic review of randomized controlled trials. J Bodyw Mov Ther 2015;19(3):500-8.

27. Hyun J, Hwangbo K, Lee CW. The effects of Pilates Mat Exercise on the balance ability of elderly females. J Phys Ther Sci 2014;26(2):291-93.

28. Bird ML, Hill KD, Fell JW. A Randomize controlled study investigating static and dynamic balance in older adults after training with pilates. Arch Phys Med Rehabil 2012;93(1):43-9.

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Effect of physical exercise program on the balance and risk of falls of institutionalized elderly persons: a randomized clinical trial

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Abstract

The aim of the present study was to evaluate the effect of an exercise program on the postural balance and risk of falls of institutionalized elderly persons. A randomized controlled trial was performed. The study was conducted in two long-stay philanthropic care facilities for the elderly in a city in the north of Rio Grande do Sul, Brazil. Participants were divided into control (G1) and intervention groups (G2). G1 did not receive any type of intervention whereas G2 participated in an exercise program three times a week for twelve weeks. The groups were evaluated by the Berg Balance Scale (BBS) and the Timed Up and Go Test (TUGT). After the intervention, G2 achieved better scores in both BBS and in the TUGT, indicating a significant improvement in body balance and a reduction in the risk of falls compared to G1. The Spearman ordinal correlation revealed that there was a statistically significant association between BBS and TUGT (p<0.001). G1 did not present positive results compared to G2 both at baseline and in post intervention. It can be inferred that the proposed exercise program was effective in improving body balance and the performance of functional tasks, contributing to an improvement in the risk of falls as a result. REBEC: RBR-5XNYJS.

Key words: Randomized Controlled Trial; Homes for the Aged; Postural Balance; Accidental Falls; Exercise.

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INTRODUCTION

The world is experiencing significant demographic change due to the aging process. The growing elderly segment of the population is more susceptible to a decline in health and to falls, which today constitute one of the most widespread and serious public problems.[1]

Falls are often frequent and limiting for elderly persons. A fall can be defined as an unexpected and unintentional event which results in an individual moving to a lower level relative to their initial position, and which occurs as the result of a total loss of postural balance and due to inefficiencies in the mechanisms necessary for the maintenance of postural control.[2,3]

Aging affects the properties of the central nervous and neuromuscular systems, leading to problems with balance and walking.[4] Balance is an important component of physical fitness that must be maintained in order to prevent falls.[1]

With this in mind, prevention of falls constitutes a public health necessity, with more than a third of people aged 65 and over falling each year, leading to injuries, decreased functional capacity and consequently death.[5,6]

In order to implement effective strategies for the prevention of falls it is vital to discover the relevant risk factors,[7] as while some factors are irreversible, others can potentially be dealt with through appropriate interventions,[8] especially in the context of long-term care facilities for the elderly (LTCF).

Residents of LTCFs are more likely to suffer from falls, due to problems with walking, muscle weakness, dizziness, vertigo, cognitive decline, disease and specific medications. They also tend to be ill, dependent and more fragile than those elderly individuals who remain in the community.[9]

When institutionalized, elderly persons are faced with an environment that is notably different from that of their homes, as well as the absence of family, a loss of autonomy and physical inactivity.[10] A decline in functional capacity ensues, predisposing residents to falls, which often recur.[11]

Muscle weakness, balance deficit and instability when walking are common intrinsic risks which lead to falls. However, these may be modifiable through adherence to regular, planned physical exercise.[4,8,12]

The benefits for musculoskeletal health include improvements in balance as well as a reduction in number of falls and in physical conditions such as sarcopenia.[13] Thus, physical exercise has become an important tool for the prevention and control of falls and is gaining significance in public policy proposals for health promotion.[14]

Efforts to reduce the risk of falling therefore help to maintain the well-being of elderly persons and reduce care costs. In order to achieve these effects it is necessary to discover the determining factors which make falls more likely, as the development and implementation of fall prevention strategies is currently a major public health challenge.[5,16] The implementation of interventions is effective in reducing the frequency of falls and thus has the potential to benefit the health of elderly persons.[17]

In light of the above, this study aimed to evaluate the effect of an exercise program on the postural balance and risk of falls of institutionalized elderly persons.

METHOD

A randomized controlled clinical trial was conducted, carried out in two long-stay philanthropic care facilities located in a municipality in the northern region of the state of Rio Grande do Sul in Brazil. The city had an estimated population of 195,620 people[18] and was home to 21 LTCFs, of which 19 were private and two philanthropic, with a total of 471 institutionalized elderly residents.

In the philanthropic LTCFs that were the object of this study, there were 112 elderly residents, 39 of whom were male and 73 of whom were female. These particular institutions were chosen for reasons of convenience, due to a links that have been built up over the years with the Universidade de Passo Fundo (the University of Passo Fundo) (UPF), through the development of undergraduate and graduate projects (*lacto sensu* and *stricto sensu*).

The inclusion criteria were simple: subjects had to be aged 60 years or over and resident in one of the selected LTCFs. The following were chosen as exclusion criteria: serious illness and/or advanced cognitive impairment, inability to perform the evaluations proposed during the follow-up stage of the study, missing 80% of the exercise sessions and/or hospitalization during the study period.

The sample population was established using cluster sampling. Thirty individuals who met the inclusion criteria were selected and allocated to the control group (G1) or the intervention group (G2) at random (by means of a spreadsheet-based draw), then randomized into blocks with an equal number of participants in each group, in accordance with criteria for randomization in studies with small numbers of individuals.[19] G1 consisted of 15 elderly residents from the two LTCFs, eight from one and seven from the other, while G2 was composed of 15 elderly residents all from a single LTCF.

After randomization, an initial evaluation took place where the individuals were interviewed in order to collect data such as gender, age, marital status, education, previous occupation and time spent institutionalized; as well as clinical data of interest: disease, drugs, polypharmacy, history of falls and fractures. All information was checked against the medical records of the subjects and with the responsible nursing professional in the respective LTCFs.

Next, the individuals completed the Timed Up and Go Test (TUG) and the Berg Balance Scale (BBS), the objective of which was to evaluate their dynamic balance and risk of falls.

The TUG was developed in order to evaluate balance, risk of falls and functional capacity in the elderly. It involves the observation of an individual as he/she gets up from a chair, walks three meters in a straight line then returns to the chair and sits down again. This route is timed in seconds and each individual's performance is graded according to how long they take to perform the task.[20] Total TUG time was used to compare the groups and the cut-off score proposed by Podsiadlo & Richardson.[20] Total TUG time was used in order to compare the groups, using the cut-off score proposed by Podsiadlo & Richardson.[20] These authors advise that a time of less than 10 seconds should be considered as normal for healthy, independent adults not at risk of falls, 11-20 seconds for frail or disabled elderly individuals with partial independence and a low risk of falls, while a time of above 20 seconds would indicate significant problems with physical mobility and a significant risk of falls.[20]

The BBS is used to evaluate balance and risk of falls in the elderly. In the present study, the Brazilian version was adopted, fully validated and adapted into Portuguese.[21] Before the test was carried out, the evaluator demonstrated the activities which make up the evaluation. The test consists of 14 common tasks related to activities of daily living: 1. moving from a seated to a standing position; 2. remaining standing without support; 3. remaining seated without back support, but with feet on the floor or on a stool; 4. moving from standing to a sitting position; 5. transfers; 6. remaining standing without support and with eyes closed; 7. remaining standing without support with feet together; 8. holding arms out in front of the body while standing up; 9. picking an object up from the floor from a standing position; 10. turning round and looking over the right and left shoulders while standing; 11. rotating 360 degrees; 12. putting each foot alternately up on a step or stool while remaining standing without support; 13. remain standing without support with one foot forward; 14. remaining standing on one leg. Each item on the scale is scored with one of five marks

ranging from zero to four points, with zero being awarded where an individual is unable to perform the task and four where he or she can perform it safely. Total scores range from 0 to 56 points, with a maximum score equivalent to an excellent performance in the test and scores of lower than 50 indicative of a likelihood of falls.[21]

The tests were applied by six pre-trained team members. Two members of the research team were responsible for the evaluations and the follow-up. They were not made aware of which individuals were part of the G1 and G2 groups and had not been in contact with the subjects during the three months of the intervention. Both the baseline and the 12 week evaluations were performed without the evaluators knowing which individuals were from which group.

After the baseline evaluations participants selected for G1 did not take part in any kind of intervention. However, those in G2 participated in a regular and organised exercise program for 12 weeks, three times a week on alternate days, with 36 sessions in total, each of which lasted approximately 45 minutes. Participants in both the G1 and G2 groups did not perform any additional physical activity alongside the usual activities of the institutions during the study period.

The exercise program took place between May and August 2014, with the interventions carried out in the institutions themselves in rooms specifically designed for these type of activities. The rooms had good lighting, ventilation and appropriate surfaces. Before each session the blood pressure of the participants was measured (BP) in order to preserve their safety and comfort. In instances where BP was above or below the normal level, individuals were asked to wait a few moments before having the measurement retaken. Where the abnormality persisted they were given a leisure activity to carry out or given an appropriate referral where necessary, and their participation in the exercise session was suspended.

The exercise program included mixed activities. Each session involved:

- Warm up (eight to 10 minutes): walking, dance and ball game activities.
- Main part (15 to 20 minutes): functional exercises of aerobic endurance, muscle strength and endurance, flexibility, static and dynamic balance, agility and motor coordination.
- Stretching and Relaxation (eight to 10 minutes): exercises stretching the major muscle groups utilized during the session, alongside breathing exercises (breathing pattern: fractionated breathing in two periods).

The following items were utilized in the exercise program; chairs with back supports; handballs; rubber balls; steps; elastic bands; bats; hula hoops; adhesive tapes; plastic bowling sets; a stereo; a blood pressure device and a drawing of the Subjective Perceived Exertion Scale.

Team members systematically completed a field diary in order to maintain control over the sessions.

After three months, both the G1 and G2 groups were reassessed with TUG and BBS.

Information regarding history of falls was obtained for the 12 month period preceding the study (baseline), as well as for the three months of the intervention (post-test) and the three months after the study (follow up).

The data was given to the lead researcher who coded and formatted the database in Excel 2010. For analysis of the data, statistical software Statistical Package for Social Sciences for Windows (SPSS), version 22.0® was used.

Numerical variables were expressed as mean and standard deviation or median (25th percentile – 75th percentile), whether or not they conformed to normal distribution. The categorical variables were expressed in terms of absolute and relative frequency. To verify whether there was a statistically significant difference between the independent variables, the Student's t-test was used in the case of normal data and the Mann-Whitney U test was used where the data was abnormal. In order to detect differences between the measurements collected at baseline and those taken after 12 weeks of intervention, the Student's t-test for paired samples (for data with normal distribution) and the Wilcoxon test for paired samples (for data with abnormal distribution) were performed. Associations between categorical variables were evaluated using Pearson's chi-square test with continuity correction where appropriate. The association between risk of falling and BBS score was assessed using logistic regression, while for the correlation between BBS and TUG scores Spearman's ordinal correlation was used, since both scales produce qualitative results, requiring a correlation test appropriate for nonparametric data. Tests with a probability value of <0.05 were considered statistically significant.

The study was approved by the Ethics Committee for Research involving human beings at the Universidade de Passo Fundo (University of Passo Fundo) (CEP/UPF), under protocol number 572.113/2014 (CAAE: 24627913.6.0000.5342). All who agreed to participate signed a Free and Informed Consent Form based on Resolution No. 466/12 of the National Health Council. The research was included in the Registro Brasileiro de Ensaios Clínicos (the Brazilian Registry of Clinical Trials) (REBEC) and can be located using the indicator RBR- 5XNYJS.

RESULTS

All 30 study participants completed all of the assessments and interventions, and they were divided into two groups (G1 and G2) containing 15 participants each. The average age of participants was 76.2 years (±7.9), while 19 (63.3%) were female.

In terms of the sociodemographic characteristics of the groups, the average age of G1 members was 77.3 (±9.3) years while for G2 it was 75.1 (±6.5) years. There was no statistically significant difference between the groups, $p=0.459$. Females were predominant in G1 (60.0%) and G2 (66.7%), $p=0.710$. In terms of marital status, both groups had a high proportion of widowed individuals, who made up 40.0% of G1 and 60.0% of G2, $p=0.222$. Regarding education, elementary was the most common level in both groups at 46.7%, $p=0.879$. Regarding occupation prior to institutionalization, both groups showed a predominance of manual activities, or in other words, activities that require physical exertion, with these individuals making up 66.7% of G1 and 11.5% of G2, $p=0.195$. The median value for period of institutionalization was 24 months among G1 members and 29 months in G2, $p=0.967$.

Table 1 presents information regarding comorbidities, medication, polypharmacy, falls and fractures.

These results show that the elderly persons who did not participate in the exercise program (G1) continued to fall during and after the study period. The individuals who participated in the program (G2), however, did not fall during the three months in which they regularly took part in physical exercises.

Table 2 presents average results for the TUG and BBS, including both baseline and post-intervention data.

Table 1. Comorbidities, medications, polypharmacy, falls and fractures among elderly residents of LTCFs. Rio Grande do Sul, 2014.

Variables	G1 (n=15)	G2 (n=15)	*P*
Comorbidities*			
Neurologic	11 (73,3)	7 (46.7)	0.264
Cardiovascular	2 (13.3)	---	0.143
Psychiatric	1 (6.7)	3 (20.0)	0.283
Orthopaedic	1 (6.7)	2 (13.3)	0.543
N° of medications**	6.3 (±3.4)	5.2 (±2.8)	0.360
Polypharmacy*	11 (73.3)	12 (80.0)	0.666
Falls (last 12 months)*	6 (40.0)	7 (46.7)	0.717***
Fractures (last 12 months)*	1 (6.7)	2 (13.0)	0.543

G1= control group; G2= intervention group; p= probability value; *Data presented as absolute and relative frequency (in brackets); **values express mean and standard deviation. Using the student's t-test; ***Mann-Whitney U test for independent samples.

Table 2. Average scores on TUG and on BBS, pre and post-intervention among elderly residents in LTCFs. Rio Grande do Sul. 2014.

Variables	G1 (n=15)	G2 (n=15)
TUG*		
Baseline	17.0 (13.0–22.0)	17.0 (14.0–28.0)
Post	19.0 (13.0–33.0)	9.0 (7.0–19.0)
P	0.010***	0.000**
BBS*		
Baseline	49.0 (43.0–51.0)	49.0 (43.0–53.0)
Post	46.0 (34.0–49.0)	52.0 (48.0–54.0)
P	0.002***	0.008**

G1= control group; G2= intervention group; p= probability value; BBS= Berg Balance Scale. The results were presented as points; TUG= Timed Up and Go Test. The results were presented in seconds; *Mid values express median (p25–p75); **student's t-test for related samples (data with normal distribution); ***Wilcoxon test for related samples (for data with abnormal distribution).

In relation to the tests and the frequency of falls, the correlation between the baseline scores on the TUG and BBS was statistically significant, rs=-0.80, $p<0.001$.

The chances of an individual having fallen during the past year was not significantly statistically associated with the BBS baseline results, *OR*=0.96 (CI95% 0.87–1.5) for each one-unit increase on the BBS. Post-intervention, results from the BBS and TUG showed a statistically significant correlation, rs=-0.63, $p<0.001$.

The probability of suffering from falls after the intervention was not significantly correlated with post-intervention BBS scores, OR=0.98

(CI95% 0.86 to 1.12) for each one-unit increase on the BBS. Therefore, despite the statistically significant changes between baseline and post-intervention results on the BBS and TUG tests, there was not sufficient evidence to demonstrate an association with a reduction in frequency of falls when compared with the history of the individuals over the three months following the study.

DISCUSSION

One of the main findings of this study was the comparison of the baseline and post-intervention results for the G1 group, which presented negative results with a reduction in body balance and an increased risk of falls after the three months of the study. Members of the G2 group however, showed an improved performance in both the TUG and BBS compared with their initial results after taking part in the intervention exercises.

Studies such as this further demonstrate the well-documented fact that falls occur among elderly persons living in LTCFs.[13,15,22] These residents probably develop a functional clinical and psycho-cognitive profile highly associated with risk factors for falls.[23] Postural instability, a geriatric syndrome with symptoms which directly influence episodes of falls, is particularly common.[24] Due to structural and functional changes that occur as part of the natural aging process, the systems responsible for balance also suffer from changes which greatly impact the lives of the elderly. The systems responsible for postural stability are also affected, with reductions in responsiveness and compensation, resulting in increased instability.[25]

This results of the present study showed that after three months of intervention, the G2 group achieved better scores in both the BBS and TUG, indicating a significant improvement in balance and a reduction in the estimated risk of falls when compared to G1.

According to Buranello et al.,[26] balance and risk of falls are closely related, suggesting that the chance of an elderly person suffering from a fall is connected to the maintenance of balance, with greater maintenance lowering the risk of falls. The effectiveness of physical exercise in reducing the risk of falls has been addressed previously in studies.[16,27,28]

In the study by Soares & Sacchelli,[29] it was possible to verify the effect of a program of kinesiotherapy on the balance of elderly individuals, with the results obtained showing an increase of three points on the BBS following the program. There was also a statistically significant improvement in terms of risk of falls, with the training program including components such as strength, flexibility and somatosensory, vestibular and visual aspects,

Regular physical exercise performed by a group of active elderly women and another group of sedentary elderly women showed that such activity has a positive influence on the maintenance of balance, meaning that the chances of suffering a fall are lower for active elderly women.[26]

The results of a study by Salma et al. [30] indicated that the proposed program, which aimed to stimulate the cognitive and motor factors of elderly people through resistance exercises, stretching, play activities, games, circuits, dance and relaxation, was effective in reducing the risk of falls.

Falls can be prevented through exercise programs, the aim of which is to normalize or restore muscle strength, restore balance and reduce the use of medications.[31]

The present study found significant negative correlations between BBS and TUG, with a strong pre-intervention correlation and a more moderate association afterwards, with individuals with higher scores on BBS performing the TUG more quickly, indicating, according to Gonçalves et al.,[32] that a greater ability to maintain balance leads to better performance in functional tasks and a lower risk of falls.

It worth noting that the TUG and BBS tests are effective tools for assessing the physical functional

performance and balance of elderly persons, as well as being effective instruments for the analysis of the risk of falls in this population.[33] These two variables were correlated in the study by Sabchuk et al.,[34] which showed a moderate negative correlation (r=-0.57) and revealed that it is possible to use simple inexpensive tests to assess this physical functional capacity along with balance, with the TUG and BBS tests the most preferable options.

In terms of the frequency of falls over the 12-month period prior to the study, no significant association with balance, as measured by the BBS, was found, probably due to the low number of falls observed.

It was also evident that the elderly persons continued to suffer from falls after the survey period, since the proposed program was not continued and the changes achieved between baseline and post-intervention in the BBS and TUG tests were not enough to lead to a continued reduction in falls.

Falls occur for many reasons and knowledge of their risk factors is essential when it comes to planning preventive measures. The objectives of these measures, both individual interventions and public policy, are the avoidance of falls or the reduction in their number, as well as the preservation of functionality and improvement in quality of life.[25]

Physical exercise represents a key strategy for the prevention of falls among the institutionalized elderly. However, professionals working in LTCFs must also be more attentive to the factors that predispose the elderly to falls and to develop preventive strategies aimed at improving functional capacity and consequently quality of life.

In terms of the limitations of this study, the difficulty in obtaining a larger sample due to the conditions of the residents should be noted. Indeed, a wider range of individuals would allow for better representation.

CONCLUSION

In this study, the elderly persons from the intervention group (G2) obtained better scores in both the Timed Up and Go Test (TUG) and the Berg Balance Scale (BBS), indicating a significant improvement in balance and a reduction in the estimated risk of falls compared to the individuals in the control group (G1). It can therefore be inferred that postural balance and the risk of falls in institutionalized elderly both before and after the exercise program were interconnected, indicating that individuals with better capacity for the maintenance of balance performed better in functional tasks and consequently had a lower risk of falls.

For Long-term Care Facilities for the Elderly (LTCFs), the importance of the physical exercise program utilized in this study has been clearly demonstrated. This fact should make those responsible for these institutions consider the presence of a Physical Education professional to work as part of their multidisciplinary teams.

The relevance of this study lies in the fact that the proposed exercise program was effective in increasing balance and particularly in reducing the estimated risk of falls among institutionalized elderly persons.

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REFERENCES

1. Gschwind YJ, Kressig RW, Lacroix U, Muehlbauer T, Pfenninger B, Granacher L. A best practice fall prevention exercise program to improve balance, strength / power, and psychosocial health in older adults: study protocol for a randomized controlled trial. BMC Geriatr 2013;105:01-13.
2. Sociedade Brasileira de Geriatria e Gerontologia. Quedas em Idosos: Prevenção.Bela Vista: Associação Médica Brasileira e Conselho Federal de Medicina; 2008. Projeto Diretrizes.
3. Alves NB, Scheicher ME. Equilíbrio postural e risco para queda em idosos da cidade de Garça. Rev Bras Geriatr Gerontol 2011;14(4):763-8.
4. Granacher U, Muehlbauer T, Gruber M. A qualitative review of balance and strength performance in healthy older adults: impact for testing and training. J Aging Res 2012;7:1-16.
5. Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age Ageing 2006;35(2):37-41.
6. Gillespie LD, Robertson MC, Gillespie WJ, Lamb SE, Portas S, Cumming RG. Interventions for preventing falls in elderly people living in the community. Cochrane Database Syst Rev 2012;9:1-6.
7. Axer H, Axer M, Sauer H, Witte OW, Hagemann G. Falls and gait disorders n geriatric neurology. Clin Neurol Neurosurg 2010;112(4):265-74.
8. American Geriatrics Society. British Geriatrics Society, American Academy of Orthopaedic Surgeons Panel on Falls Prevention: Guideline for the prevention of falls in older persons. J Am Geriatr Soc 2001;5:664-72.
9. Almeida LP, Brites MF, Takizawa MGMH. Quedas em idosos: fatores de risco. Rev Bras Ciênc Envelhec Hum 2011; 8(3):384-91.
10. Uchida JEF, Borges SM. Quedas em idosos institucionalizados. Rev Kairós 2013;16(3):83-94.
11. Alvares LM, Lima RC, Silva RA. Ocorrência de quedas em idosos residentes em instituições de longa permanência em Pelotas, Rio Grande do Sul, Brasil. Cad Saúde Pública 2010;26(1):31-40.
12. Franklin RC, Boehm J, Rei J, Newitt R, Grant T, Kurkowski B, et al. A framework for the assessment of community exercise programmes: a tool to assist in modifying programmes to help reduce falls risk factors. Age Ageing 2013;42(4):536-40.
13. Silveira SC, Faro ACM, Oliveira CLA. Atividade física, manutenção da capacidade funcional e da autonomia em idosos: revisão de literatura e interfaces do cuidado. Estud Interdiscipl Envelhec 2011;16(1):61-77.
14. Brasil. Agência Nacional de Saúde Suplementar. Manual técnico para promoção da saúde e prevenção de riscos e doenças na saúde suplementar. Rio de Janeiro: ANS; 2011.
15. Rebelatto JR, Castro AP, Chan A. Quedas em idosos institucionalizados: características gerais, fatores determinantes e relações com a força de preensão manual. Acta Ortop Bras 2007;15(3):151-4.
16. Klein DM, Rapp K, Küpper M, Becker C, Fischer T, Büchele G, et al. A population-based intervention for the prevention of falls and fractures in home dwelling people 65 years and older in south germany: protocol. J Med Internet Res 2014;3(1):1-19.
17. Hewitt J, Refsshauge KM, Goodall S, Henwood T, Clemson L. Does progressive resistance and balance exercise reduce falls in residential aged care?: Randomized controlled trial protocol for the SUNBEAM program. Clin Interv Aging 2014;9:369-76.
18. Instituto Brasileiro de Geografia e Estatística. Estimativa da população residente no Brasil e unidades da federação com data de referência em 1º de julho de 2014 [Internet]. Rio de Janeiro: IBGE; 2014 [acesso em 12 mar 2015] . Disponível em: http://www.ibge.gov.br/home/estatistica/populacao/estimativa2014/estimativa_tcu.shtm
19. Medronho RA. Epidemiologia. 2ª ed. São Paulo: Atheneu; 2008.
20. Podsiadlo D, Richardson S. The Timed Up and Go: a test of basic functional mobility for frail elderly person. J Am Geriatr Soc 1991;2:142-8.
21. Miyamoto ST, Lombardi L Jr, Berg KO, Ramos LR, Natour J. Brazilian Version of Berg Balance Scale. Braz J Med Biol Res 2004;37(9):1411-21.
22. Menezes RL, Bachion MM. Estudo da presença de fatores de risco intrínsecos para quedas, em idosos institucionalizados. Ciênc Saúde Coletiva 2008;13(4):1209-18.
23. Mignardot JB, Deschamps T, Barrey E, Auvinet B, Berrut G, Cornu C, et al. Gait disturbances as specific predictive markers of the first fall onset in elderly people: a two-year prospective observational study. Front Aging Neurosci 2014;6:1-13.

24. Paradela EMP. A avaliação clínica do idoso que cai. Rev HUPE 2014;13(2):45-52.

25. Lima DA, Cezario VOB. Quedas em idosos e comorbidades clínicas. Rev HUPE 201;3(2):30-7.

26. Buranello MC, Campos AO, Quemelo PV, Silva Valadares A. Equilíbrio corporal e risco de queda em idosas que praticam atividades físicas e sedentárias. Rev Bras Ciên Envelhec Hum 2011;3:313-23.

27. Antes DL, Schneider IJC, Benedetti TRB, Orsi E. Medo de queda recorrente e fatores associados em idosos de Florianópolis, Santa Catarina, Brasil. Cad Saúde Pública 2013;29(4):758-68.

28. Bento PCB, Rodacki ALF, Homann D, Leite N. Exercícios físicos e redução de quedas em idosos: uma revisão sistemática. Rev Bras Cineantropom Desempenho Hum 2010;12(6):471-9.

29. Soares MA, Sacchelli T. Efeitos da cinesioterapia no equilíbrio de idosos. Rev Neurociênc 2008;16(2):97-100.

30. Salma SS, Coelho FGM, Gobbi S, Stella F. Efeitos de um programa de atividade física nas funções cognitivas, equilíbrio e risco de quedas em idosos com demência de Alzheimer. Rev Bras Fisioter 2010;14(1):68-74.

31. Constantini A, Almeida P, Portela BS. Rev Eletrôn Polidiscipl Voos 2011;3(2):17-30.

32. Gonçalves DFF, Ricci NA, Coimbra AMV. Equilíbrio funcional de idosos da comunidade: comparação em relação ao histórico de quedas. Rev Bras Fisioter 2009;13(4):316-23.

33. Barros SS, Souza GFM, Uchôa EPBL. Correlação entre inatividade física, polifarmácia e quedas em idosos. ConScientiae Saúde 2012;11(1):37-45.

34. Sabchuk RAC, Bento BCB, Rodacki ARF. Comparação entre testes de equilíbrio de campo e plataforma de força. Rev Bras Med Esporte 2012;18(6):404-8.

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Prevalence and factors associated with physical inactivity among the elderly: a population-based study

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Abstract

Objectives: To determine the prevalence of physical inactivity among elderly individuals in the municipality of Viçosa, Minas Gerais and identify associated factors. *Method:* A cross-sectional population-based study of 621 elderly persons was conducted in Viçosa, Minas Gerais. The dependent variable was physical inactivity, defined by the question "Do you practice some kind of physical activity?" The definition of the term "physical activity" was restricted to activities performed regularly, for at least 20 minutes, three times a week, disregarding domestic, industrial and transportation activities. The independent variables were age; gender; education; self-rated health; functional capacity; history of diabetes, hypertension, dyslipidemia and osteoporosis; overweight; risk of metabolic disorders; smoking; number of medical appointments; history of hospitalizations in the last year and private health insurance. Descriptive analysis and multiple Poisson regression were used. *Results:* The prevalence of physical inactivity was 70.1% (95% CI: 66.0%-74.0%). The associated factors were the male gender, aged over 80 years, less educated, low functional capacity, smokes and did not have private health insurance. *Conclusion:* The high prevalence of physical inactivity and its associated factors indicate the need to develop systematic approaches to improve public policies directed at this age group.

Key words: Physical Inactivity; Associated Factors; Elderly

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INTRODUCTION

Studies have identified a heightened prevalence of physical inactivity among elderly Brazilians.[1-3] In the opinion of the World Health Organization, this tendency represents a major public health problem and a major modifiable risk factor for the development of chronic noncommunicable diseases (CNCD).[4,5]

Physical inactivity is considered the fourth greatest risk factor for mortality, contributing to the death of approximately 3.2 million people every year. People who do not exercise have a 20% to 30% greater risk of mortality from any cause than individuals who perform at least 30 minutes of physical activity on most days of the week.[4]

There are numerous factors that can contribute to physical inactivity among the elderly. Low socioeconomic status; functional impairment; presence of disease; fear of injury; lack of company; an unsuitable local environment or climate and a lack of infrastructure are some of the barriers to physical activity identified by the elderly.[6-8]

In Brazil, 72% of causes of deaths are attributed to CNCDs. In such a climate, a strategic action plan for dealing with chronic noncommunicable diseases (CNCDs) in Brazil 2011-2022 was created. One of the objectives of this plan is the development and implementation of effective public policies for the control of risk factors for CNCDs, which include physical inactivity.[5]

It is therefore important that each municipal region identifies factors associated with the physical inactivity of the elderly, in order to enable the development of local public health policies that encourage physical activity among people in this age group. This study sought to determine the prevalence of physical inactivity among the elderly in Viçosa (Minas Gerais) and identify associated factors.

METHOD

A cross-sectional population-based random sample study was conducted from June to December 2009 in Viçosa, in the state of Minas Gerais in Brazil, of individuals aged 60 or older resident in rural and urban areas. The municipality is located in a mining and forestry region, and in 2007, had a population of 70,404 inhabitants, of whom 7,034 were elderly.

For the establishment of the cadastral base of individuals, the census carried out during the National Vaccination Campaign for the Elderly between April and May 2008 was used. In order to identify non-participants in the vaccination campaign and complement the cadastral base, this database was amalgamated with other available databases, namely: the database of the Servidores da Universidade Federal de Viçosa (e of the Federal University of Viçosa) (active and retired); the records of elderly persons registered with the Estratégia de Saúde da Família (the Family Health Strategy) (ESF), the databases of the municipal physiotherapy service, the women's health center, the psycho-social service, and the HiperDia (Hypertensives and Diabetics) and Polyclinic services. After the amalgamation of the databases, the records of people aged 60 and over totaled 7,980 people, a number that served as the basis for obtaining the sample. Institutionalized elderly persons were excluded.

The sample size calculation considered a confidence level of 95%, an estimated prevalence of 50% and a tolerated error of 4%. Thus, the sample comprised 558 elderly persons, to which 20% was added to cover possible losses, giving a total of 670 elderly persons to be studied. There were losses of information due to refusal (3.6%) and for unavoidable reasons for not participating in interviews (3.7%). The following losses were considered unavoidable: randomly selected individuals who had already died (1.3%), addresses

which were not found (1.2%) and elderly individuals who had moved to difficult to access locations and other municipal regions (1.2%). Thus, 621 elderly people were effectively studied.

The interviews were home-based and preferably pre-scheduled. The information was obtained through a semi-structured questionnaire with mostly closed and pre-coded questions. The questionnaire was applied directly to the elderly individuals and if they had difficulty answering, their closest companion provided assistance.

For anthropometric assessment, weight was measured with a portable scale (digital and electronic), with a capacity of 199.95 kg and a precision of 50 grams. The elderly used light clothing, did not wear shoes or sweaters, and stood in an orthostatic position with arms outstretched and eyes on the horizon.[9] Height was measured with the aid of a portable stadiometer with a length of 2.13 meters, divided into centimeters and subdivided into millimeters. To measure height, the elderly individuals stood without shoes and with their heels together in an upright position, with their backs to the stadiometer, and stared straight ahead at the height of the horizon.[9]

The weight and height measurements of elderly persons with postural problems, amputated legs or who had difficulty standing up were excluded. This corresponded to 11.3% (n=70) and 2.6% (n=16) of the sample, respectively, although other information relating to these individuals was retained for analysis.

Waist circumference was measured by positioning a non-extending and inelastic tape at the midpoint between the lower margin of the last rib and the most protruding point of the iliac crest, on the horizontal plane.[10]

The dependent variable analyzed was physical inactivity, defined by the following question: "Do you do any physical activity?" Physical activity was defined as that which is undertaken regularly for at least 20 minutes, three times a week, disregarding other dimensions of activities carried out at home, at work, or when travelling.

The independent variables analyzed were:

Sociodemographic characteristics: age (60-69 years, 70-79 years and 80 years or more); gender (male, female), education (never studied, studied up to early grades of elementary school, and up to the final grades of elementary school or more). *Indicadores of health and nutrition:* perception of own health (very good/good, regular, or poor/very poor); functional capacity (normal and low); morbidity (history of diabetes, hypertension, dyslipidemia and osteoporosis); overweight (yes/no) and risk of metabolic disorder (yes/no). *Life habits*: smoking (no history of smoking, former smoker, current smoker). *Indicators of use of health service*: number of medical appointments in previous year (one to five times, six times or more); history of hospitalization in 12 months prior to interview (none, one or more) and possessed private health plan (yes/no).

A self-assessment scale with 12 types of activities was used to evaluate functional capacity. These included activities of daily living (ADLs) and instrumental activities of daily living (IADL). For the ADL group, the Katz scale[11] was used, which includes: bathing, dressing, eating, toileting, walking from room to room in the house and getting up from the bed to a chair. The following activities were considered for the IADL: preparing food or cooking; using the phone; leaving the house or taking a bus; taking medication; managing money; shopping; cleaning the house; doing household crafts and washing and ironing clothes.[12] The assessment of the ability to perform the ADL and IADL was divided into the following categories: 1. has no difficulty; 2. has little difficulty; 3. has great difficulty; 4. cannot perform and 5. does not perform. For statistical analysis functional capacity was dichotomized into normal and low, according to the methodology proposed by Fielder & Peres.[13] In this way, individuals who reported

some difficulty in performing six or more activities (categories 2 and 3) or who evaluated themselves as being unable to perform at least three activities of the total of 12 considered (category 4) were considered as having low functional capacity.

Morbidities were investigated by asking whether "a doctor or other health professional has ever diagnosed any particular condition," such as hypertension, diabetes, hyperlipidemia or osteoporosis.

Overweight was classified by body mass index (BMI), which was used to characterize the nutritional status of the elderly into: underweight <22 kg/m², eutrophic between 22 and 27 kg/m² and overweight >27 kg/m², in accordance with Lipschitz.[14]

The risk of metabolic change was classified by cutoff points for waist circumference, with an increased risk for women at ≥80 cm and for men at, ≥94 cm.[15]

Descriptive analysis consisted of frequency distributions for the qualitative variables and the obtaining of estimates of central tendency and dispersion for quantitative variables. The prevalence of physical inactivity was estimated, and a respective confidence interval of 95% was considered.

The differences between proportions were tested using the Pearson Chi-squared test and Chi-squared linear trend test. Poisson regression with robust variance was used to obtain prevalence ratio estimates and their respective 95% confidence intervals for the association between physical inactivity and the variables of interest in the study. Variables associated with the dependent variable with a significance less than 0.20 in bivariate analysis were included in the multiple Poisson model. The variables associated with the dependent variable with a significance level less than 0.05 remained in the final model.

The *Stata* version 13.0 (*Stata Corp., College Station*, USA) software package was used for data analysis. A statistical significance level of ()= 0.05 was adopted for all comparisons for the rejection of the null hypothesis.

The study complied fully with the guidelines for research involving humans of Resolution nº 196/96 of the Conselho Nacional de Saúde (National Health Council). The research project was approved by the Ethics Research Committee of the Universidade Federal de Viçosa (Viçosa Federal University) (nº 027/2008) and all the volunteers involved signed a Free and Informed Consent Form.

RESULTS

Of the 621 elderly persons interviewed, 53.3% (n=331) were female. The average age of the elderly persons was 70.8 (±8.1) years, varying from 60 to 98 years. Around half the elderly persons were aged between 60 and 69 years (50.1%) and 15.0% had 80 years or more. More than half reported having studied until the early grades of elementary school (64.0%) and 15.0% said they had never studied.

The prevalence of physical inactivity was 70.1% (95% CI: 66.0%-74.0%). All the selected sociodemographic variables were significantly associated with physical inactivity, with higher prevalence among men, older elderly persons and those with no education (Table 1).

Table 1. Prevalence and prevalence ratio of physical inactivity based on sociodemographic variables of the elderly. Viçosa-MG, 2009.

Variables	Total n (%)	Prevalence (%)	PR (CI 95%)	Value *p*
Gender				**0.023***
Female	331 (53.3)	66.2	1.0	
Male	290 (46.7)	74.5	1.12 (1.02-1.25)	
Age range (years)				**0.001**#
60 to 69	311 (50.1)	65.3	1.00	
70 to 79	216 (34.8)	71.3	1.09 (0.97-1.22)	
80 and above	94 (15.1)	82.9	1.27 (1.12-1.44)	
Education				**0.000**#
Later grades of elementary school or higher	129 (20.8)	51.2	1.00	
Up to early grades of elementary school	397 (64.0)	73.6	1.44 (1.20-1.72)	
Never studied	94 (15.2)	80.8	1.58 (1.30-1.92)	

*Pearson Chi-squared; #Linear tendency Chi-squared.

As shown in Table 2, a more negative perception of health, the presence of cognitive impairment, low functional capacity and smoking were positively and statistically significantly associated with physical inactivity. On the other hand, there was a lower prevalence of physical inactivity among older adults with a history of dyslipidemia and increased risk of metabolic changes in comparison to their peers, and this association was statistically significant.

Table 2. Prevalence and Prevalence ratio of physical inactivity based on variables of health condition, nutrition and lifestyle of elderly persons. Viçosa-MG, 2009.

Variables	Total n (%)	Prevalence (%)	PR (CI 95%)	Value *p*
Perception of health				**0.001**[#]
Good or very good	272 (45.4)	62.9	1.0	
Regular	289 (48.3)	72.3	1.15 (1.02-1.29)	
Poor or very poor	38 (6.3)	86.8	1.38 (1.18-1.61)	
Functional capacity				**0.000***
Normal	519 (83.8)	66.5	1.0	
Low	100 (16.2)	89.0	1.34 (1.22-1.47)	
History of Diabetes				0.619*
No	482 (77.6)	70.5	1.0	
Yes	139 (22.4)	68.4	0.97 (0.85-1.10)	
History of Hypertension				0.639*
No	146 (23.5)	68.5	1.0	
Yes	475 (76.5)	70.5	1.03 (0.91-1.17)	
History of dyslipidemia				**0.001***
No	267 (43.1)	77.2	1.0	
Yes	353 (56.9)	64.6	0.84 (0.76-0.93)	
History of Osteoporosis				0.579*
No	526 (84.8)	69.6	1.0	
Yes	94 (15.2)	72.3	1.04 (0.91-1.19)	
Smoker				**0.000***
Never smoked	345 (55.7)	67.8	1.0	
Ex-smoker	207 (33.5)	66.7	0.98 (0.87-1.11)	
Smoker	67 (10.8)	91.0	1.34 (1.21-1.49)	
Overweight				0.541*
No	303 (55.0)	69.0	1.0	
Yes	248 (45.0)	66.5	0.99 (0.87-1.12)	
Risk of metabolic disorder[##]				**0.034***
Low	147 (24.6)	66.9	1.0	
High	450 (75.4)	76.1	0.88 (0.78-0.98)	

*Pearson Chi-Squared; [#]Linear Tendency Chi-squared; [##]risk of metabolic disorder: circumference of waist <80 cm for women and <94 cm for men, heightened risk of metabolic disorder: circumference of waist ≥80 cm for women and ≥94 cm for men.

Regarding the variable use of health services, only the variable possessing a private health plan was significantly associated with physical inactivity. In this case, it was observed that physical inactivity among older adults without health plans was 1.28 times more prevalent than those who reported having health insurance (Table 3).

Table 3. Prevalence and prevalence ratio of physical inactivity based on variables of use of health services by the elderly. Viçosa-MG, 2009.

Variables	Total n (%)	Prevalence (%)	PR (CI 95%)	Value *p*
Number of medical appointments in previous year				0.977#
Six times or more	126 (20.3)	76.19	1.0	
One to five times	449 (72.4)	66.81	0.88 (0.78-0.99)	
None	45 (7.3)	86.66	1.14 (0.98-1.32)	
History of hospitalization				0.085*
No	526 (84.8)	68.8	1.0	
Yes	94 (15.2)	77.7	1.13 (0.99-1.28)	
Private health plan				**0.000***
Yes	334 (53.9)	62.0	1.0	
No	286 (46.1)	79.7	1.28 (1.16-1.42)	

*Pearson Chi-Squared; #Linear Tendency Chi-squared.

Multiple regression analysis revealed that the independent factors positively associated with physical inactivity among the elderly studied were: male gender, older age, lack of education, low functional capacity, smoking and non-affiliation to a private health plan. In contrast, a history of dyslipidemia remained negatively associated with physical inactivity (Table 4).

Table 4. Final results of multivariable analysis of factors associated with physical activity among the elderly. Viçosa-MG, 2009.

Variables	PR (CI 95%)	Value *p*
Gender		0.014
Female	1.0	-
Male	**1.15 (1.03-1.29)**	
Age range (years)		0.015
60 to 69	1.00	
70 to 79	1.05 (0.94-1.18)	
80 and above	**1.16 (1.03-1.32)**	
Education		0.000
Later grades of elementary school or higher	1.00	
Up to early grades of elementary school	**1.28 (1.07-1.54)**	
Never studied	**1.30 (1.05-1.60)**	
Functional capacity		0.000
Normal	1.0	
Low	**1.27 (1.15-1.41)**	
History of dyslipidemia		0.053
No	1.0	
Yes	0.91 (0.82-1.00)	
Smoking		
Never smoked	1.0	0.000
Ex-smoker	0.96 (0.85-1.09)	
Smoker	**1.26 (1.11-1.43)**	
Private health plan		**0.008**
Yes	1.0	
No	**1.15 (1.04-1.28)**	

DISCUSSION

The final multivariate analysis results indicated that elderly men aged 80 and older who were less educated, had low functional capacity, and were smokers without a private health plan had a higher prevalence of physical inactivity.

Although the high percentage of physical inactivity (70.1%; CI 95%: 66.0%-74.0%) was similar to other studies of elderly Brazilians,[1,3,16] it was lower than studies of the elderly in the south and northeast of the country.[2,17]

The higher prevalence of physical inactivity among elderly men contradicted the findings of studies by Alves et al.[1] and Queiroz et al.,[2] which found no difference in the prevalence of physical inactivity between the genders. This result can be attributed to the presence of a culturally constructed model of masculinity, in which men are considered to be strong and tough,

thus hampering the adoption of healthy habits such as preventive behavior.[18] A study by Brito & Camargo[19] also reflects on the issue of different beliefs regarding how men and women care for their health. According to this study, the social representation of the health and disease process for men is connected with its curative aspect, while for women the same process is more linked with its preventive aspect. This finding also helps explain the higher prevalence of physical inactivity among elderly men in this sample.

The higher prevalence of physical inactivity among older elderly people can be explained by the presence of barriers such as physical limitations, fear of falls, the presence of pain, lack of energy, lack of confidence and a fear of failing to perform the exercise due to never having previously attempted it.[8,20]

In this study, the educational history of the group analyzed was marked by a low educational level, with the majority (79.2%) reporting a maximum level of schooling of having concluded the early grades of elementary school, or never having studied, a similar result to previous findings related to Brazilian elderly persons.[21] Studies have shown that lower levels of education are associated with less physical activity.[22,23] This scenario may contribute to worsening health conditions among individuals of lower socioeconomic status, which is evident in studies on inequalities in health.[24]

The association between functional incapacity and physical inactivity was positive and statistically significant, showing the importance of performing physical activities in order to maintain functional capacity. According to Virtuoso Júnior et al.,[25] 280 minutes/week of physical activity for women and 410 minutes/week of physical activity of men can predict an absence of functional incapacity. Regular physical activity is essential for maintaining strength, flexibility, muscular endurance, agility and balance, essential for maintaining the functional capacity of the elderly.[26]

In Latin America, one in four elderly people have difficulty in carrying out their daily activities.[27] In Brazil, 25% of elderly persons reported having limitations or difficulties when performing their habitual activities because of a health problem or incapacity.[28] Thus, sedentary lifestyles and an increase in CNCD often create a vicious circle: disease and disability reduce the level of physical activity which, in turn, predisposes the elderly to an increased risk of disease and disability.[29]

Among elderly smokers the prevalence of physical inactivity was 1.26 times greater than it was for non-smokers. Smoking is widely described as more prevalent in sedentary individuals while physical exercise is considered a protective factor against beginning smoking.[30] Smoking contributes doubly to the impairment of health, as in this study, inactivity positively associated with smoking, which has been identified as a risk factor for a number of diseases.–

Elderly holders of health plans declared that they participated more in physical activity than those who did not. Possessing a health plan is related to higher socioeconomic status, a greater concern for health, and having greater access to information and services that determined healthy lifestyles.[31] However, studies correlating affiliation to health plans and the performance of physical activity are scarce.

The present study has a number of limitations. Firstly, the fragility of the variable "physical activity" should be noted, as the criteria used to assess the practice of such activity was not objective. Other studies, however, have used research tools of a similar nature, through the questions: "Do you perform regular physical activity or sports?",[32] "Have you performed physical activity in the last two weeks to improve your health, physical condition or for aesthetic or pleasurable purposes?"[33] or, "How would you rate your physical activity for leisure purposes?".[34] Another limitation refers to aspects of the dependent variable in this study. Surveys that only measure the level of leisure-based physical activities tend to underestimate this factor, as they do not consider activities such as commuting to work and domestic and occupational activities, which are more frequent in poorer individuals with lower levels of education.[1] The cross-sectional design can also be characterized as a limitation, as

it makes identifying the causality between physical inactivity and the other study variables impossible.

CONCLUSION

The final model of the results of the present study indicated a higher prevalence of physical inactivity among elderly men aged over 80 years who were less educated, had low functional capacity, smoked and did not have health insurance. Given these results, systematic strategies should be developed to improve public policies for this age group, with a view to improving their living habits. The identification and consideration of associated factors is of considerable relevance in the context of Public Health. Special attention should be directed at men, older elderly individuals, the less educated, those with impaired functional capacity, smokers and people with poor access to health care.

REFERENCES

1. Alves JGB, Siqueira FV, Figueiroa JN, Facchini LA, De Silveira DS, Piccini RX, et al. Prevalência de adultos e idosos insuficientemente ativos moradores em áreas de unidades básicas de saúde com e sem Programa Saúde da Família em Pernambuco, Brasil. Cad Saúde Pública 2010;26(3):543-56.
2. Queiroz BM, Coqueiro RS, Leal Neto JS, Borgatto AF, Barbosa AR, Fernandes MH. Inatividade física em idosos não institucionalizados: estudo de base populacional. Ciênc Saúde Coletiva 2014;19(8):3489-96.
3. Freire RS, Lélis FLO, Fonseca Filho JA, Nepomuceno MO, Silveira MF. Prática regular de atividade física: estudo de base populacional no norte de Minas Gerais, Brasil. Rev Bras Med Esporte 2014;20(5):345-9.
4. World Health Organization. Global status report on noncommunicable diseases 2010. Geneva: WHO; 2011.
5. Brasil. Ministério da Saúde, Secretaria de Vigilância em Saúde, Departamento de Análise de Situação de Saúde. Plano de ações estratégicas para o enfrentamento das doenças crônicas não transmissíveis (DCNT) no Brasil 2011-2022. Brasília: Ministério da Saúde; 2011. (Série B. Textos Básicos de Saúde).
6. Maciel MG. Atividade física e funcionalidade do idoso. Motriz 2010;16(4):1024-32.
7. Giehl MWC, Schneider IJC, Corseuil HX, Benedetti TRB, D'Orsi E. Atividade física e percepção do ambiente em idosos: estudo populacional em Florianópolis. Rev Saúde Pública 2012;46(3):516-25.
8. Krug RR, Lopes MA, Mazo GZ, Marchesan M. A dor dificulta a prática de atividade física regular na percepção de idosas longevas. Rev Dor 2013;14(3):192-5.
9. World Health Organization. Physical status: the use and interpretation of anthropometry. Adults 60 years of age and older. Geneva: WHO; 1995. p. 375-411.
10. Cameron N. The measurement of human growth. London: Croom-Helm; 1984.
11. Katz S, Ford A, Moskowitz R, Jackson B, Jaffe M. Studies of illness in the aged. The index of ADL, a standardized measure of biological and psychosocial function. JAMA 1963;185(12):914-9.
12. Lawton M, Brody E. Assessment of older people: self maintaining and instrumental activies of daily living. Gerontologist 1969;9(3 Part 1):179-86.
13. Fiedler MM, Peres KG. Capacidade funcional e fatores associados em idosos do sul do Brasil: um estudo de base populacional. Cad Saúde Pública 2008;24(2):409-15.
14. Lipschitz D. Screening for nutricional status in the elderly. Prim Care 1994;21(1):55-67.
15. World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO Consulation on Obesity. WHO: Geneva; 1998. (Technical Report Series 894, Part 1).
16. Rocha SV, Almeida MMG, Araújo TM, Santos LB, Rodrigues WKM. Fatores associados à atividade física insuficiente no lazer entre idosos. Rev Bras Med Esporte 2013;19(3):191-5.
17. Benedetti TRB, Mazo GZ, Borges LJ. Condições de saúde e nível de atividade física em idosos participantes e não participantes e grupos de convivência de Florianópolis. Ciênc Saúde Coletiva 2012;17(8):2087-93.

18. Gomes R, Nascimento EF. A produção do conhecimento da saúde pública sobre a relação homem-saúde: uma revisão bibliográfica. Cad Saúde Pública 2006;22(5):901-11.

19. Brito AMM, Camargo BV. Representações sociais, crenças e comportamentos de saúde: um estudo comparativo entre homens e mulheres. Temas Psicol 2011;19(1):283-303.

20. Krug RR, Lopes MA, Mazo GZ. Barreiras e facilitadores para a prática da atividade física de longevas inativas fisicamente. Rev Bras Med Esporte 2015;21(1):57-64.

21. Instituto Brasileiro de Geografia e Estatística. Síntese de Indicadores Sociais: uma análise das condições de vida da população brasileira. Rio de Janeiro: IBGE; 2009. (Estudos e Pesquisas. Informação Demográfica e Socioeconômica, nº 26).

22. Martins TG, Assis MAA, Nahas MV, Gauche H, Moura EC. Inatividade física no lazer de adultos e fatores associados. Rev Saúde Pública 2009;43(5):814-24.

23. Costa EF. Prática de atividade física e sua relação com a escolaridade em adultos de Ermelino Matarazzo, Zona Leste de São Paulo, SP [dissertação]. São Paulo: Faculdade de Saúde Pública; 2009.

24. Barros MBA, César CLG, Carandina L, Torre GD. Desigualdades sociais na prevalência de doenças crônicas no Brasil, PNAD-2003. Ciênc Saúde Coletiva 2006;11(4):911-26.

25. Virtuoso Júnior JS, Tribess S, De Paulo TRS, Martins CA, Romo-Perez V. Atividade física como indicador preditivo para a incapacidade funcional em pessoas idosas. Rev Latinoam. Enferm 2012;20(2):259-65.

26. Carmo NM, Mendes EL, Brito CJ. Influência da atividade física nas atividades da vida diária de idosas. Rev Bras Ciênc Envelhec Hum 2008;5(2):16-23.

27. Organização Pan-americana da Saúde. Anais da 26ª Conferência Sanitária Pan-americana; 26 - 27 de setembro de 2002. Washington: Organização Panamericana de Saúde, Organização Mundial de Saúde; 2002.

28. Nunes D, Nakatani A, Silveira E, Bachion M, Souza M. Capacidade funcional, condições socioeconômicas e de saúde de idosos atendidos por equipes de Saúde da Família de Goiânia (GO, Brasil). Ciênc Saúde Coletiva 2010;15(6):2887-98.

29. Coelho C, Burini R. Atividade física para prevenção e tratamento das doenças crônicas não transmissíveis e da incapacidade funcional. Rev Nutr 2009;22(6):937-46.

30. Patterson F, Lerman C, Kaufmann VG, Neuner GA, Audrian-McGovern J. Cigarette smoking practices among american college students: review and future directions. J Am Coll Health 2004;52(5):203-10.

31. Cassou ACN, Fermino RC, Santos MS, Rodrigues-Añez CR. Barreiras para a atividade física em idosos: uma análise por grupos focais. Rev Educ Fís 2008;19(3):353-60.

32. Gomes VB, Siqueira KS, Sichieri R. Atividade física em uma amostra probabilística da população do município do Rio de Janeiro. Cad Saúde Pública 2001;17(4):969-76.

33. Alves R, Mota J, Costa M, Alves J. Aptidão física relacionada à saúde de idosos: influência da hidroginástica. Rev Bras Med Esporte 2004;10(1):31-7.

34. Siqueira FV, Facchini LA, Piccini RX, Tomasi E, Thumé E, Silveira DS, et al. Atividade física em adultos e idosos residentes em áreas de abrangência de unidades básicas de saúde de município das regiões Sul e Nordeste do Brasil. Cad Saúde Pública 2008;24(1):39-54.

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Anthropometric, functional and foot trajectory determinants of stride length in self-reliant community-dwelling elderly persons in Talca, Chile

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Abstract

Objective: To analyze anthropometric, muscle performance and foot trajectory determinants of stride length (SL) during walking at a comfortable pace among self-reliant community-dwelling elderly persons in Talca, Chile. *Method:* A total of 63 self-reliant elderly persons participated in this observational and cross-sectional study. They were characterized by the anthropometric measures of mass, height and body mass index. Dorsiflexor muscle strength performance (DF-MS) and rate of force development were quantified. Finally, the elderly persons were asked to walk comfortably around a 40 meter elliptical circuit, using determined SL and maximum foot clearance (MaxFC) and minimum foot clearance (MFC) trajectory parameters. The SL determinants were evaluated by calculating the coefficient of determination (r^2) considering a level of significance of $p \leq 0.05$. *Results:* The anthropometric variables demonstrated significant correlations ($r>0.41$) with the explanation of SL remaining incipient ($r^2<0.20$). Muscle performance, meanwhile, was significantly correlated ($r>0.52$), with DF-MS standing out ($r^2=0.342$). MaxFC represented a significant explanation for the data ($r^2=0.396$), while the low correlation of MFC was not significant ($r=0.24$, $r^2=0.058$). *Conclusion:* MaxFC and DF-MS are determinants of SL in self-reliant elderly Chileans. It is proposed that gait parameters could be normalized in accordance with trajectory and muscular performance.

Key words: Elderly; Walking; Anthropometry; Muscle Strength; Biomechanical Phenomena.

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INTRODUCTION

The demographic changes experienced by Latin American countries has led to a systematic increase in the number of people aged 60 years or more.[1] Aging is an extremely complex process of progressive, natural and irreversible changes,[2] which lead to impairments in functional capabilities and emotional, cognitive and physical performance, all of which affect the performance of basic, instrumental and advanced activities of daily living.

The ability to walk independently has been defined as a motor skills milestone in the human life cycle. This ability is acquired in the first year of life and matures during childhood to become a fundamental element of adult functioning.[3] Notwithstanding the foregoing, the aging process involves multi-factorial risks that, together with the expression of morbidities, lead to alterations in spatio-temporal gait parameters, affecting balance and stability.[4] Therefore, the specific and timely measurement of these risks has become more and more important in professional and disciplinary practice.

Gait assessments tend to be generic in nature, mostly based on the measurement of parameters that depend on time and space. Researchers have analyzed indicators related to the distance covered during the six-minute walk test,[5] physiological effort[6] and speed in both comfortable and maximum demand conditions.[7]

Besides speed, the most robust biomechanical gait indicator is stride length (SL), due to the relevance of what its complete cycle represents in spatial terms,[8] as well as the fact that it measures mechanical and physiological efficiency.[9] In this sense, it is conditioned by pre-established anthropometric characteristics[10] and specific functions.[4,11] It remains unknown which of these determinant variables has the most significant impact on the spatial expression of the gait cycle. This data could be useful for functional diagnoses, specific interventions and disciplinary strategies aimed at community-dwelling, elderly individuals.

Therefore, the aim of the present study was to assess anthropometric, muscle performance and foot trajectory determinants of stride length (SL) during walking at a comfortable pace among self-reliant community-dwelling elderly persons in Talca, Chile.

METHODS

Participants

This observational and cross-sectional investigation contained a non-probabilistic, convenience sample of 63 elderly individuals (age 70 ± 5 years) who were members of a number of social clubs in the community of Talca, Chile. After formal contact was made, measurements of the main variables were taken in offices of the Universidad Católica del Maule (Maule Catholic University) (UCM) in January and February of 2014 (morning appointments). All of the participants signed a free and informed consent form that was approved by the Scientific Ethics Committee of the UCM (project 2012-2014, follow-up report no. 2/2014). The inclusion criteria were controlled by the application of the Examination of Preventive Medicine for the Elderly (EMPAM),[12] while self-reliance was confirmed using the Functional Assessment for the Elderly-Chile, part A (EFAM-Chile). Normal cognition was assessed using the abbreviated mini-mental test (≥13 points)[12] and the absence of depression was confirmed by the Yesavage scale (<5 points).[12] The following subjects were excluded from this research: individuals with chronic wasting diseases; individuals who were at risk of falls, based on positive results in the timed up and go and leg balance tests;[12] individuals with severe sequelae from neurological diseases or cardiovascular decompensation; and individuals with moderate pain in the lower limbs (Visual Analog Scale >3 cm).

Measurements

Anthropometry

A basic anthropometric characterization involves measuring the body mass and height *(DETECTO stadimeter, model 2392)* of barefoot participants, who maintain the lower edge of the orbit on the same plane as the external auditory canal (*Frankfurt plane).*[13] Nutritional status was established using the body mass index (BMI) and the corresponding specific categorization for elderly Chilean individuals: emaciated (BMI<23 Kg/m^2); normal (BMI between 23.1 Kg/m^2 and 27.9 Kg/m^2); overweight (BMI between 28 Kg/m^2 and 31.9 Kg/m^2) and obese (BMI>32 Kg/m^2).[12]

Dorsiflexor muscle strength (DF-MS)

Measurements of the muscle strength of the dominant dorsiflexor (DF-MS) were taken with the participant in the supine decubitus position, with the ankle joint in a free position. A strap was tightened according to the tolerance of the individual and the relevant segment of the dominant leg (unilateral) was measured to avoid compensation during the performance. The participant was informed about the specificities of the test in advance. They were then asked to perform a sub-maximal contraction, to ensure they had understood the procedure. Subsequently, their maximum strength was measured using the *"*make test*"*,[14] which translates strength through a dynamometer (Lafayette Manual Muscle Test System, model 01165) and provides results in kilograms-strength. The time required to obtain this value was also monitored, and labelled the rate of force development (RDF-DF; Kg/s). Three consistent measurements were taken (<10% variability), with one minute rest periods between each. The maximum performance value was used in the analysis.

Kinematic analysis

The participants were asked to walk at a comfortable pace for three minutes on an elliptical 40-meter circuit. A Sony Handycam camera (model HDR-XR550) was strategically placed in a "recording" zone, at a distance of four meters. This camera provided a video of each stride (total of five) executed by the participant. When the test had been completed, the recordings were saved on a portable computer *(Toshiba,* model NB505-SP0115LL) for the subsequent transformation into analysis frames (30 images per second) using capture software (free video to jpg converter version 5.0.22, 2013, available at: http://free-video-to-jpg-converter.softonic.com). Simple kinematic analysis was conducted using a free access program.[15]

In the context of two-dimensional analysis of foot trajectory, clearance is understood to be the height in millimeters (mm) between the anterior inferior segment of the foot and the x-axis of the coordinates.[15] Thus, maximum foot clearance (MaxFC) is assessed in the initial swing phase of gait and represents the furthest value from the ground during this stage.[11,15,16] Minimum foot clearance (MFC) is the minimum height (in mm) between the anterior inferior segment of the foot and the x-axis of the coordinates, which generally occurs during the advanced swing phase.[11,15-17]

Stride length (SL) is understood to be the distance in millimeters that a subject requires to complete a full gait cycle, which is based on the anterior inferior apex of the marker at the beginning and end of a stride.[8,15]

Statistical analysis

The distribution type of the analysis variables was established using the Shapiro-Wilk test. Descriptive statistics were completed using the mean ±1 standard deviation. Pearson's *r* test was used to determine the correlation between SL and the

anthropometric determinants (muscle strength and foot trajectory). The variability in SL was determined by the coefficient of determination (r^2), with the level of statistical significance set at $p \leq 0.05$.

Both the descriptive and inferential statistics were analyzed using SPSS version 18.0. Graphical statistics were completed using *GraphPad Prism* version 5.0.

RESULTS

Table 1 contains the general characteristics of the participants, with a marked predominance of females (74.6%). The majority of the participants were aged between 65-75 years. The specific nutritional status of the participants was at the lower limit of the overweight category.

Table 1. Demographic, anthropometric and functional characteristics of the elderly participants. Talca, Maule Region, Chile, 2014

Gender	n	Age (years)	Mass (Kg)	Height (m)	BMI (Kg/m^2)	EFAM-A (Score)
Total	63	69.56(±5.41)	73.54(±12.12)	1.55(±0.08)	30.50(±4.32)	50.43(±2.97)
Female	47	69.17(±4.94)	71.44(±11.35)	1.52(±0.05)	30.85(±4.43)	50.14(±3.08)
Male	16	70.88(±6.79)	80.72(±12.23)	1.66(±0.06)	29.30(±3.48)	51.41(±2.37)

The values are expressed as the mean ± standard deviation for each variable; n=number of participants per group; BMI= body mass index; EFAM-A= functional assessment of the elderly – part A.

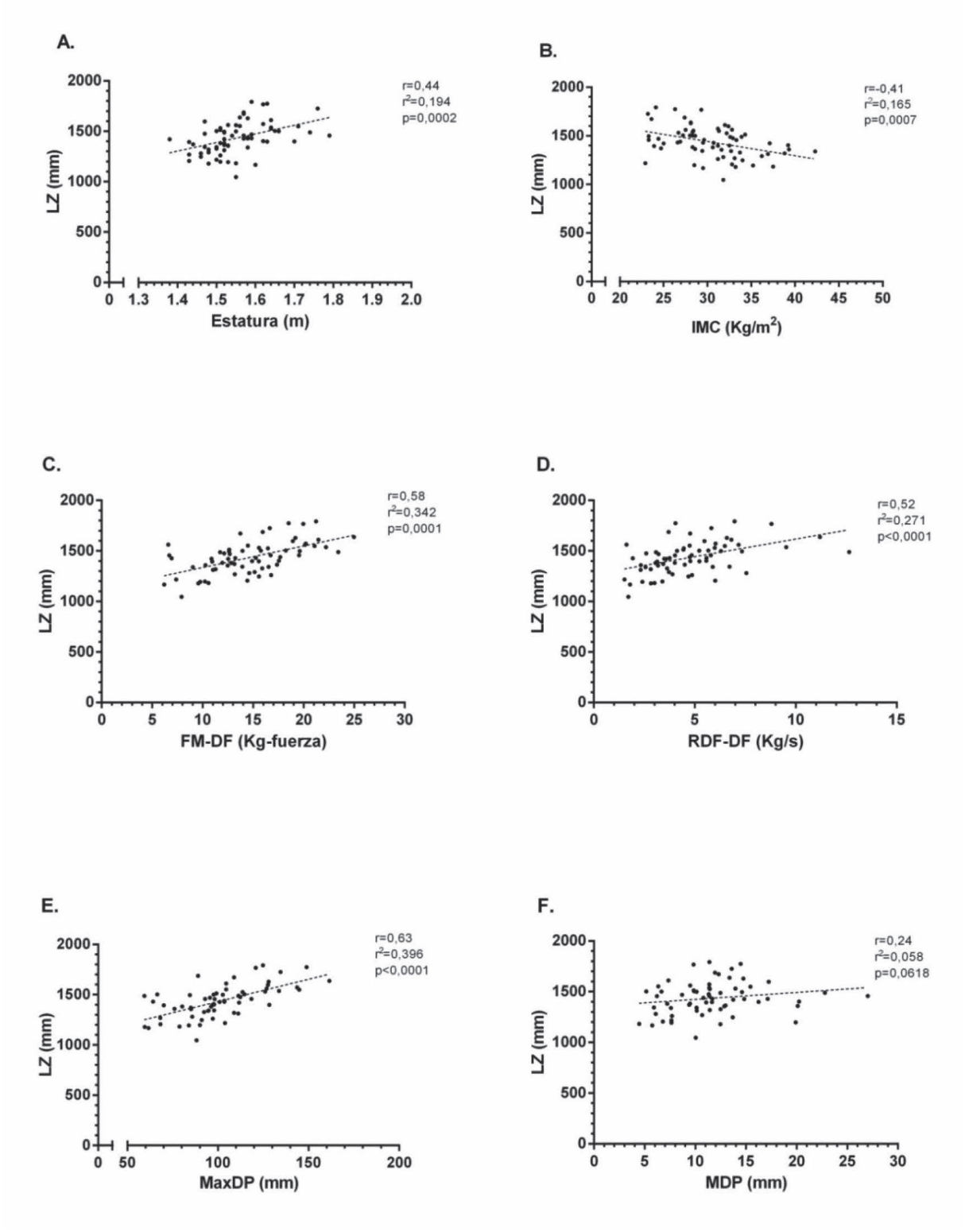
Table 2 displays the muscle performance of the ankle and the kinematics of the foot. The DF-MS was approximately 15 Kg in the general sample and was slightly higher among the male participants ($p<0.001$). The rate of force development for the dorsiflexors (RDF-DF) was approximately 5 Kg/s, with a 2kg/s higher rate among the male participants ($p=0.004$). With respect to the kinematics of comfortable walking, the MaxFC value in the early swing stage was approximately 101 mm for the total of all subjects, although it was significantly higher among the men ($p<0.001$). However, during the advanced swing stage, the MFC was similar for both genders, with values of approximately 12 mm ($p=0.357$). Stride length was approximately 1500 mm and was longer among the men ($p<0.001$).

Table 2. Muscle strength and kinematic values for the elderly participants. Talca, Maule Region, Chile, 2014

Gender	n	DF-MS (Kg-F)	RDF-DF (Kg/s)	MaxFC (mm)	MFC (mm)	SL (mm)
Total	63	14.8(±4.1)	4.7(±2.1)	100.9(±22.8)	11.6(±4.4)	1434,8(±158,9)
Female	47	13.5(±3.5)	4.3(±1.7)	93.6(±18.8)	11.3(±4.5)	1386,1(±134,9)
Male	16	19.0(±3.1)	6.3(±2.5)	122.1(±20.6)	12.4(±3.8)	1587,1(±131,5)
p-value		<0,001	0.004	<0.001	0.357	<0.001

The values are expressed as the mean ± standard deviation for each variable; n= number of participants per group; DF-MS= dorsiflexor muscle strength; RDF-DF= rate of force development for dorsiflexors; MaxFC=maximum foot clearance; MFC=minimum foot clearance; SL=stride length; the comparison according to gender was conducted using the students t-test for independent samples.

Figure 1 contains a graphic representation of the correlations between each of the SL determinants. The anthropometric variables exhibited significant correlations (Figures 1A and 1B). However, the explanation for the variability of SL was incipient. Muscle performance exhibited significant correlations (Figures 1C and 1D), particularly with the coefficient of determination for DF-MS. The foot trajectory indicators were unequal: they were very high, significant and explained approximately 40% of the data for MaxFC (Figure 1E). Conversely, MFC exhibited a non-significant, low correlation (Figure 1F).



A. height; **B.** BMI=body mass index; **C.** DF-MS= dorsiflexor muscle strength; **D.** RDF-DF=rate of force development for dorsiflexors; **E.** MaxFC=maximum foot clearance; **F.** MFC=minimum foot clearance; r= correlation index; r^2= coefficient of determination; *p*= value of statistical significance.

Figure 1. Correlations for the determinants of stride length in self-reliant elderly individuals. Talca, Maule Region, Chile, 2014.

DISCUSSION

SL is considered an important kinematic parameter of gait, due to the fact that is a general translator of all events that occur during its complete cycle, including the support and swing phases.[9] The elderly population is vulnerable to tripping/stumbling problems,[18] which can lead to falls and morbidities that negatively affect their functionality. Therefore, the opportune measurement of this variable is essential, as is the determination of the nature of indicators that can condition this variable, in order to propose safe and effective interventions for this section of the population. The most significant finding of the present study was the fact that the variables that most commonly explained the variability of SL were MaxFC and DF-MS, which are chronologically-ordered conditioners of performance in the swing phase.[9,16]

An analysis of SL in literature provided results consistent with those of the present study. Karst et al.[17] recorded spatial gait data for 16 elderly women using several different methodologies, with SL values of 1330±140 mm for natural cadence. These values are similar to those found in the present study (Table 2). A study of elderly men[19] reported SL results of 1530±120 mm on a hard surface, which are also similar to the results of this experiment (Table 2). The normative values for the spatial and temporal qualities of gait in the elderly have also been previously documented: Hollman et al.[8] recorded a SL of 1370±120 mm for men and 1180±150 mm for women.

While it is clear that controlled laboratory conditions are preferable for the performance of gait and the validity of the data produced, they can have a negative effect on the expression of comfortable and spontaneous gait when tracks that are shorter than five meters are used. This distance is not long enough to determine the expression of gait in natural conditions.[20] It has also been reported that the minimum time required by elderly individuals to achieve a steady pace is three minutes.[6] Therefore, extrapolation to situations of functional expression should consider neuromuscular, mechanical and physiological (adaptation) factors.

There is evidence that anthropometric indicators such as mass, height and BMI affect SL.[10] It has been recommended that the values obtained using these parameters should be corrected in order to ensure pertinent comparisons for both kinematic indicators and muscle performance.[9]

Although the values obtained for height and the BMI in the present study produced moderate and significant correlations (Figures 1A and 1B), they also exhibited a low explanation value for SL (coefficient of determination: $r^2<0.20$). This low statistical weight could be fundamentally explained by morphological factors, given that all of the subjects assessed were classified as being of normal weight or overweight (Table 1). Ko et al.[10] (2010) presented the results of a study in Baltimore, demonstrating that kinematic gait patterns in the elderly were significantly affected by obesity. These factors need to be studied among elderly individuals with a greater morphological variability.

To date, the specific association between morphological variables and SL is unknown. The present study is therefore a pioneer study in terms of the exploration of this behavior among a group of self-reliant elderly Chilean individuals.

The findings reported herein for the performance of the dorsiflexor muscles of the ankle (Table 2) are similar to those reported in previous studies.[21] The impact that this behavior would have on SL produced a significant and direct correlation, as well as a considerable explanation for the DF-MS (Figure 1C) and RDF-DF (Figure 1D) data. Thus, it is suggested that muscle integrity predominantly conditions the balance and stability of gait.[22,23] Consequently, it would have a considerable impact on SL, despite the fact that this relationship is non-linear,[24] which indicates a relative dependence on the magnitude of gait speed.[25,26] Cress & Meyer[27] assessed the muscle strength of knee extensors and maximum oxygen consumption among community-dwelling,

elderly individuals, reporting linear functionality thresholds. Thus, future studies should analyze these critical change points in order to establish how the magnitude of the result of this variable dynamically determines the SL as an indicator of gait functionality.

The dorsiflexor muscles of the ankle are mainly active during the late swing phase of gait, avoiding contact between the anterior section of the foot and the ground.[11] The results of the present study highlight the importance of this variable during the execution of comfortable walking by elderly individuals. It has been reported that both the aging process[18,21] and the expression of peripheral fatigue, caused by morbidities such as chronic obstructive pulmonary disease,[28] would negatively affect performance, leading to a less effective gait and the consequent occurrence of trips/stumbles, which may eventually cause falls.

The foot trajectory results reported herein expressed an unequal impact on the magnitude of SL. The MaxFC had a high and significant correlation with SL, explaining approximately 40% of the results (Figure 1E). These findings demonstrate the importance of this phase of gait performance to self-reliant elderly individuals: this was the main determinant found in the present study. The reason for this phenomenon could be linked to the accumulation of mechanical and elastic potential energy[9] in the beginning of the swing phase on behalf of the ankle plantar flexors, which would provide enough momentum for the subsequent foot trajectory. This phenomenon should be analyzed in more detail, considering two guidelines: a) the combined measurement of the muscle performance of the ankle plantar flexors[26,29] and; b) the inclusion of elderly individuals with different levels of functionality, in order to determine if this significance is maintained during different strategies of comfortable gait, including those that exhibit a significant decrease during the swing phase.

The MFC exhibited a low and non-significant correlation, as well as the most incipient explanation of data, for all of the determinants selected, with values of less than 6% (Figure 1F). This could be explained by the low relative importance of this phase among elderly individuals who do not suffer from any functional complications (the inclusion criteria of the present study specified that the participants must not have a history of falls or trips), in order to ensure that the kinetic and kinematic analysis would not be affected.[29-31] Conversely, in terms of the measurement methodology, this variable was the most complex, due to the speed of the image capture technique (three times that of the mass center),[16] which led to a high rate of dispersion in relation to the magnitude of the result (Table 2). Therefore, future studies should seek to optimize the image capture technique in order to ensure greater precision in the analysis, while also assessing this parameter by considering the different functional, demographic and anthropometric characteristics of the elderly population.

Considering the normalization of reference data for a functional diagnosis, the present study provides evidence of the specification of gait analysis among the elderly. Upon confirmation of the significant explanation of the variability of SL based on muscle performance indicators (Figures 1C and 1D) and MaxFC (Figure 1E), together with the importance of assessing the duality between movement and the environment,[32] specifically in relation to the irregular pavements found in urban contexts,[33] these results could be useful in the early recognition of eventual complications associated with the risks of trips/stumbles and falls in elderly individuals who do not exhibit a risk according to the conventional instruments established in public health policies.[12] Furthermore, knowledge of muscle performance and critical trajectory scores could guide therapeutic decisions, considering specific minimum and maximum overload values for each individual and their interaction with the environment (time and space), through the incorporation of ecological training as a preventive intervention.[34]

It has been reported in literature that the initial heel support phase is responsible for the risk of "stumbles" among the elderly population.[35]

Conversely, Russel et al.[36] demonstrated that the physiological cost is higher among obese women with osteoarthritis who had to reduce their SL by 15% while walking. These results should lead to the performance of new studies that consider complementary assessments of antagonist muscle groups, such as the ankle plantar flexors, while also analyzing fatigue tolerance as a dimension of muscle performance. We also recommend the incorporation of spatial and temporal kinematic analysis in order to determine angular positions and trajectory values over time, which may be critical during gait. The following factors should also be considered when assessing gait performance: the cost of transport; perceptions of fatigue and pain; the environment (homogenous and irregular surfaces).

The main limitation of the present study was the homogeneity of the sample: since the participants all belonged to a focal group, it was highly selected, which had a negative effect on the external validity of the investigation. A significant section of the correlations were found between a general gait indicator (SL) and the kinematic manifestation of a muscle group in the dominant segment, thereby impeding the complete extrapolation of the results obtained. We suggest that future studies should incorporate these determinants as complementary variables in population studies that consider a larger number of subjects from different focal groups (different geographic locations and socio-economic levels).

CONCLUSION

The results of the present study established that the determinants of stride length among self-reliant, community-dwelling, elderly individuals in Talca-Chile were maximum foot clearance and dorsiflexor muscle strength. These findings support the proposal of supplementing the conventional use of anthropometric variables with the normalization of kinematic gait data, including strength and trajectory parameters.

REFERENCES

1. Chackiel J. La dinámica demográfica de América Latina [Internet]. Santiago de Chile: Comisión Económica para América Latina y el Caribe; 2004 [acesso em 20 ene. 2014]. (Serie población y desarrollo ; nº 52). Disponível em: http://www.eclac.cl/cgibin/getProd.asp?xml=/publicaciones/xml/0/14860/P14860.xml&xsl=/celade/tpl/p9f.xsl&base=/celade/tpl/top-bottom.xsl
2. Weinert BT, Timiras PS. Invited review: theories of aging. J Appl Physiol 2003;95(4):1706-16.
3. González PM, Solorza EM. Evolución de la locomoción bípeda humana: el nivel socioeconómico como factor ambiental. Antropo 2014;31:15-24.
4. Salzman B. Gait and balance disorders in older adults. Am Fam Physician 2010;82(1):61-8.
5. Troosters T, Gosselink R, Decramer M. Six-minute walking distance in healthy elderly subjects. Eur Respir J 1999;14(2):270-4.
6. Malatesta D, Simar D, Dauvilliers Y, Candau R, Borrani F, Prefaut C, et al. Energy cost of walking and gait instability in healthy 65- and 80-yr-olds. J Appl Physiol 2003;95(6):2248-56.
7. Bohannon RW. Comfortable and maximum walking speed of adults aged 20-79 years: reference values and determinants. Age Ageing 1997;26(1):15-9.
8. Hollman J, McDade E, Petersen R. Normative spatiotemporal gait parameters in older adults. Gait Posture 2011;34(1):111-8.
9. Saibene F, Minetti AE. Biomechanical and physiological aspects of legged locomotion in humans. Eur J Appl Physiol 2003;88(4-5):297-316.
10. Ko S, Stenholm S, Ferrucci L. Characteristic gait patterns in older adults with obesity-results from the Baltimore Longitudinal Study of Aging. J Biomech 2010;43(6):1104-10.

11. Dadashi F, Mariani B, Rochat S, Büla CJ, Santos-Eggimann B, Aminian K. Gait and foot clearance parameters obtained using shoe-worn inertial sensors in a large-population sample of older adults. Sensors 2013;14(1):443-57.

12. Chile. Ministerio de Salud, Programa de Salud del Adulto Mayor. División de Prevención y Control de Enfermedades, Subsecretaría de Salud Pública. Manual de Aplicación del Examen de Medicina Preventiva del Adulto Mayor (EMPAM) [Internet]. [sem local]: Ministério de Salud De Chile; 2014 [acesso em 23 ene. 2014]. Disponível em: http://www.saludohiggins.cl/attachments/314_Instructivo%20del%20Control%20de%20Salud%200107.pdf

13. Sánchez-García S, García-Peña C, Duque-López MX, Juárez-Cedillo T, Cortés-Núñez AR, Reyes-Beaman S. Anthropometric measures and nutritional status in a healthy elderly population. BMC Public Health 2007 7:2.

14. Stratford PW, Balsor BE. A comparison of make and break tests using a hand-held dynamometer and the Kin-Com. J Orthop Sports Phys Ther 1994;19(1):28-32.

15. Medina P. Confiabilidad de una metodología aplicable para la medición de cinemática simple del pie en adultos mayores autovalentes de la comunidad. Biosalud 2014;13(1): 9-20.

16. Winter DA. Foot trajectory in human gait: a precise and multifactorial motor control task. Phys Ther 1992;72(1):45-53.

17. Karst GM, Hageman PA, Jones TF, Bunner SH. Reliability of foot trajectory measures within and between testing sessions. J Gerontol Ser A Biol Sci Med Sci 1999;54(7):343-7.

18. Begg R, Best R, Dell'Oro L, Taylor S Minimum foot clearance during walking: strategies for the minimisation of trip-related falls. Gait Posture 2007;25(2):191-8.

19. Merryweather A, Yoo B, Bloswick D. Gait characteristics associated with trip-induced falls on level and sloped irregular surfaces. Minerals 2011;1(1):109-21.

20. Najafi B, Helbostad JL, Moe-Nilssen R, Zijlstra W, Aminian K. Does walking strategy in older people change as a function of walking distance? Gait Posture 2009;29(2):261-6.

21. Melzer I, Benjuya N, Kaplanski J, Alexander N. Association between ankle muscle strength and limit of stability in older adults. Age Ageing 2009;38(1):119-23.

22. Wolfson L, Judge J, Whipple R, King M. Strength is a major factor in balance, gait, and the occurrence of falls. J Gerontol Ser A Biol Sci Med Sci 1995;50(n. Spec): 64-7.

23. Moxley Scarborough D, Krebs DE, Harris BA. Quadriceps muscle strength and dynamic stability in elderly persons. Gait Posture 1999;10(1):10-20.

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

25. Espy DD, Yang F, Bhatt T, Pai YC. Independent influence of gait speed and step length on stability and fall risk. Gait Posture 2010;32(3):378-82.

26. Misu S, Doi T, Asai T, Sawa R, Tsutsumimoto K, Nakakubo S, et al. Association between toe flexor strength and spatiotemporal gait parameters in community-dwelling older people. J Neuroengineering Rehabil 2014;11(1):1-8.

27. Cress ME, Meyer M. Maximal voluntary and functional performance levels needed for independence in adults aged 65 to 97 years. Phys Ther 2003;83(1):37-48.

28. Gagnon P, Maltais F, Bouyer L, Ribeiro F, Coats V, Brouillard C, et al. Distal leg muscle function in patients with COPD. COPD 2013;10(2):235-42.

29. Judge JO, Davis RB 3rd, Ounpuu S. Step length reductions in advanced age: the role of ankle and hip kinetics. J Gerontol Ser A Biol Sci Med Sci 1996;51(6):303-12.

30. Anderson DE, Madigan ML. Healthy older adults have insufficient hip range of motion and plantar flexor strength to walk like healthy young adults. J Biomech 2014;47(5):1104-9.

31. Chiba H, Ebihara S, Tomita N, Sasaki H, Butler J. Differential gait kinematics between fallers and non-fallers in community-dwelling elderly people. Geriatr Gerontol Int 2005;5(2):127-34.

32. Nathan R, Getz WM, Revilla E, Holyoak M, Kadmon R, Saltz D, et al. A movement ecology paradigm for unifying organismal movement research. Proc Natl Acad Sci USA 2008;105(49):19052-9.

33. Toker Z. Walking beyond the Socioeconomic Status in an objectively and perceptually walkable pedestrian environment. Urban Stud Res [Internet] 2015 [acesso em 23 ene. 2014];2015:1-15. Disponível em: http://www.hindawi.com/journals/usr/2015/919874/cta/

34. Magistro D, Liubicich ME, Candela F, Ciairano S. Effect of ecological walking training in sedentary elderly people: act on aging study. Gerontologist 2014;54(4):611-23.

35. Mills PM, Barrett RS. Swing phase mechanics of healthy young and elderly men. Hum Mov Sci 2001;20(4-5):427-46.

36. Russell EM, Braun B, Hamill J. Does stride length influence metabolic cost and biomechanical risk factors for knee osteoarthritis in obese women? Clin Biomech (Bristol, Avon) 2010;25(5):438-43.

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Population aging in Brazil: current and future social challenges and consequences

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Abstract

Objective: To analyze the current and future challenges related to the planning of public policies and population aging. *Method:* A case study was conducted using quantitative and qualitative data from secondary data information systems and interviews with actors of social policy and the country's health. *Results:* In 2010, there were 39 elderly persons for every 100 young people, while in 2040 there will be an estimated 153 elderly persons for every 100 young people. For those interviewed, Brazil is not prepared for the needs generated by such population aging, due to challenges such as the adequacy of the social security and health system. The growing number of elderly persons and increasing morbidity and mortality profiles worsen the heterogeneous epidemiological situation with disease, disability and sequelae that require the health system to be a continuous and multidisciplinary organization. The present study identified a reduction of beds and hospitalizations, which may reflect the improvement of primary care and quality of life, with a complexification of hospitalizations. *Conclusion:* With population aging and a lack of necessary support, society must be aware of the price that it must pay and the state must be prepared to provide specific policies to ensure comprehensive care, recognizing the characteristics of aging and preserving quality of life.

Key words: Demographic Transition; Demographic Aging; Public Policies.

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INTRODUCTION

From 1970 onwards, the demographic profile of Brazil transformed from a mostly rural and traditional society with large families and a high infant mortality rate to a mostly urban society with fewer children and a new structure in Brazilian families.[1] From a predominantly young population in the not so distant past, today an increasingly significant number of people aged 60 or older can be observed.[2]

Demographic transition begins with a fall in mortality rates which is soon followed by falling birth rates, resulting in significant changes in the age structure of the population.[3]

These changes have occurred rapidly, requiring a quick and appropriate response that cannot take place without the intervention of the State through the establishment and implementation of fundamental public policies.[4]

Projections indicate that by 2050 "the Brazilian population will be 253 million, the fifth largest population in the world, smaller only than India, China, USA and Indonesia". This will be only 40 years after 2005, when the country's total fertility rate reached 2.1 children per woman (the level that represents sustainable zero population growth) and the true period of zero growth of the Brazilian population.[5]

Population aging increases health problems which in turn put pressure on healthcare and social security systems. Getting older does not necessarily mean becoming sick. Unless there are associated illnesses, aging is associated with a good level of health. Moreover, advances in the fields of health and technology allow people with access to adequate public or private services to have a better quality of life at this stage of life. In addition, it is essential to invest in preventive actions throughout the course of life due to their potential to "solve the challenges of today and, increasingly, those of tomorrow".[6]

It is for this reason that countries are increasingly seeking to understand the process of population aging and searching for alternatives to "keep their elderly citizens socially and economically integrated and independent".[6] This is because the growing presence of elderly people in society imposes the challenge of including population aging in public policies and implementing actions of prevention and care to target their needs, thereby supporting a network with the capacity to offer services and actions of social protection.[7]

The proposal of the present study was to analyze the current and future challenges related to the planning of public policies and population aging, in a context of demographic transition and transformation of the demographic profile in the decades to come.

METHOD

A case study on population aging and its relation with the planning and formulation of public policies was carried out.

To characterize the scenario, secondary data from the main information systems in Brazil was utilized. To analyze the planning of public policies in the context of these transformations, eight people occupying relevant positions in social politics, health management and the legislative authorities were interviewed (a former national Health Minister, former secretaries of the Ministry of Health, and former state and municipal secretaries of health) in addition to intellectuals and planners from the area of health.

This study is an excerpt from a doctoral thesis on Public Health, which, as selection criteria to select participants, chose participants who had built their reputations in defense of the right to health, and who had been included in the political context and the organization of the country's health system since its inception.

In addition to the population data, three demographic indicators relating to the period 1920-2040 were analyzed. Data on population, life expectancy at birth, the dependency ratio and the aging index were calculated based on the estimates and censuses conducted by the Instituto Brasileiro de Geografia e Estatística - IBGE (Brazilian Institute of Geography and Statistics).

For the dependency ratio and aging index, calculations proposed by the Rede Interagencial de Informações para a Saúde (Interagency Network of Information for Health)[8] were used, considering the ratio between the number of people age 60 or above for every 100 people under 15 years of age and the ratio between the age segment of the population defined as economically dependent (people under 15 years of age and those aged 60 or more) and the potentially productive age segment (between 15 and 59 years of age), respectively.

According to the Interagency Network,[8] it is common for the calculation of these indexes to consider elderly people as those aged 65 and over and the potentially productive to be between 15 and 64 years of age. However, to maintain consistency with the other indicators and to comply with the National Policy for the Elderly (Law no. 8842, of January 4, 1994), the parameters of 60 and over for the elderly population and 15 to 59 years of age for the potentially productive population were utilized.

The information regarding the number of active elderly beneficiaries and the value of benefits, over the period 2002 to 2012, were extracted from the Ministério da Previdência Social (Ministry of Social Security) (MPS). Active benefits were analyzed, meaning those considered by the MPS to actually generate monthly payments to the beneficiary. To analyze the variation of the amounts paid, a calculation of public spending was carried out considering the devaluation of the currency, using the Índice Nacional de Preços ao Consumidor Amplo (National Index of Consumer Prices) (IPCA) from 2012, as a basis for calculation.

For the analysis of morbidity and mortality, standardized rates were calculated per 100,000 elderly people in each year studied. The five main chapters were chosen from the 10ª Revisão da Classificação Internacional de Doenças (10th Revision of the International Classification of Diseases) (CID-10), among the causes of hospitalization and death of the elderly. The technique of direct standardization by age was applied (60 to 69, 70 to 79 and 80 years and over), considering the resident population in the country in 2010 as standard.

The number of hospitalizations was obtained from the total of Autorização de Internação Hospitalar (Hospitalization Authorizations) (AIH) paid and registered in the Sistema de Informações Hospitalares (Hospital Information System) (SIH) of the Sistema Único de Saúde (National Health System) (SUS). The information is only related to hospitalizations in the SUS network and therefore, does not include hospitalizations that occurred in the supplementary system. Average values were calculated by means of the ratio between the amount paid by AIH and the number of hospitalizations, and were updated according to the IPCA (National Index of Consumer Prices) of the year, 2013.

The number of hospital beds available through the SUS (National Health System) only was obtained from the monthly records of the Ministry of Health, and an annual average was calculated from this data. For the years 1998 – 2003, data recorded in the SUS archived records (Cadastro Hospitalar-CH) (Hospital Registry) was used, provided by the IT Department of SUS (Datasus). For the other years of the series, data was acquired from the Cadastro Nacional de Estabelecimentos de Saúde (National Registry of Health Facilities) (CNES).

To verify the seasonal tendency of the variables, linear trend analysis was used. Simple linear regression models were estimated, defined as $Y= \alpha + \beta$ year, α being the mean coefficient in the analyzed period and β the mean increment (increase or decrease) in the period. The coefficient of determination R2 indicated the explanation capacity of the model. All decisions were made considering a statistical significance level of 5.0%.

To conduct, carry out and analyze the interviews that took place between June and July of 2015, the seven stages of research proposed by Kvale were applied.[9] The content of the interviews was defined based on the conceptual framework of universalization, social control, financing of needs and the decentralization of the SUS (National Health System).

The analysis of each question in the interviews was carried out using the meaning condensation technique, where formulations were constructed based on the responses of each of the respondents, the units of natural meanings are determined based on the content expressed by each subject, the core issues are determined in relation to the natural units and an essential description of the themes identified in the interview is performed, as defined by Kvale.[9]

The research complied with ethical standards and the databases are public domain, requiring publication of the source of data. In addition, the doctoral thesis project that resulted in this article was submitted to and obtained approval from the Research Ethics Committee of the Aggeu Magalhães Research Center of the Oswaldo Cruz Foundation in Recife, Pernambuco (Registration no: CAAE: 21258713.0.0000.5190).

RESULTS AND DISCUSSION

The elderly population is rising dramatically in Brazil, based on the concept of the World Health Organization which considers a person to be elderly at 60 years of age or older if residing in a developing country. In 1920, life expectancy was only 35.2 years and the elderly accounted for just 4.0% of the total population of the country. With this profile, for every 100 children (0 to 14 years of age), Brazil had approximately 11 elderly people (table 1).

In 2010 (table 1), with the doubling of life expectancy (almost 74 years of age), 10.8% of the population was 60 years of age or above, gradually increasing the relative proportion of elderly people in the age composition of the country. Associated with this, there is an increase in the aging index and a reduction in the dependency ratio.

Population estimates by the IBGE (Brazilian Institute of Geography and Statistics) indicate that the participation of elderly people will reach approximately 23.8% of the population in the fifth decade of the 21st century. With the number of elderly people increasing in relation to the young, it is estimated that there will be an inversion of the relation between young and old, with 153 elderly people for every 100 people under 15 years of age (table 1).

Table 1. Estimate of the Brazilian population and demographic characteristics between the years 1920 and 2040. Recife-PE, 2015.

Age group	1920	1950	1980	2010	2040
0 to 4 years	4.593.163	8.370.880	16.423.700	13.796.159	11.267.417
5 to 9 years	4.575.530	7.015.527	14.773.741	14.969.375	11.813.256
10 to 14 years	3.909.630	6.308.567	14.263.322	17.166.761	12.360.437
15 to 19 years	4.217.917	5.502.315	13.575.971	16.990.870	13.019.512
20 to 24 years	2.139.364	4.991.139	11.513.220	17.245.190	13.717.223
25 to 29 years	2.487.431	4.132.271	9.442.217	17.104.413	14.514.616
30 to 39 years	3.560.225	6.286.052	14.039.109	29.633.093	31.914.624
40 to 49 years	2.401.200	4.365.359	10.377.274	24.842.718	32.893.266
50 to 59 years	1.451.319	2.650.314	7.250.094	18.416.621	32.447.959
60 to 69 years	800.866	1.451.468	4.474.511	11.349.929	25.811.887
70 years or more	433.310	753.873	2.741.506	9.240.670	28.393.007
Life expectancy at birth	35.2	52.3	64.7	73.9	79.9
Dependency rate	89.0	85.6	79.6	55.2	64.7
Aging index	10.6	10.2	15.9	39.3	152.9

Source: IBGE (2015).

The transition in birth and mortality rates, from high to low, made major changes in population structure part of the demographic transition debate.[2] These changes have occurred quickly, "requiring rapid and adequate adaptations that will not take place without State intervention through fundamental public policies".[4]

The country is aging at an alarming pace. Changes in population structure are clear and irreversible. Since the 1940s, the highest rates of population growth have been observed among the elderly.[10] This growth of the elderly population generates a series of changes in society, related to the economic sector, the labor market, the health systems and services and family relations.[11,12]

Contrary to what has occurred in many developed countries, in Brazil, as seen in this text, the aging process has been extremely rapid. In the interviews carried out, it was affirmed that the country is not prepared to meet the needs generated by this aging of the population. According to one of the interviewees, only in recent years has the country directed its efforts to long-term policies, while being faced with emergency demands at the same time.

> *"In fact, Brazil started to have a vision and a concern for the long term...to plan ahead, following the installation of the Lula government, which on the other hand found itself dealing with a contingency that resulted in an emergency strategy to promote social inclusion [...]". (Interviewee 7)*

According to the World Health Organization,[13] the aging of the population is one of the greatest triumphs of humanity and yet also one of the major challenges to be faced by society. In the 21st century, aging will increase social and economic demands across the world. However, despite being greatly ignored, the elderly should be considered essential to the structure of societies.

In its report on aging in the 21st century, the United Nations Population Fund[14] stressed that although many countries have made substantial progress in adapting their policies and laws, it is necessary to direct more efforts to ensure that older people can reach their potential.

There was consensus among the interviewees that an aging population requires the urgent introduction of policies appropriate to their needs. The growth of the elderly population and increased life expectancy at birth, already discussed, represent major challenges for the country. Some interviewees pointed out, for example, the challenge to be faced by the social security system to adapt to the new demographic reality of Brazil.

> *"[...] probably we will be called upon to promote major reforms in the structure of the Brazilian state, especially in the area of social security, in relation to health. For the system to better adapt to the process of aging of the population". (Interviewee 7)*

> *"[...] surely changes will be demanded from society in terms of retirement schemes. Brazil has already implemented some changes and these are objects of great political debates, but surely, you can't maintain the same social security system created for a society in which life expectancy was 55 years, for a society with a life expectancy of 75 years of age [...]". (Interviewee 2)*

The number of elderly grew 40.3% between 2002 and 2012. In the same period, the number of active benefits, with the exception of pensions granted by the Ministry of Welfare, expanded by 55.3%. In current values, the significant increase ($p<0.05$) represented an expansion of nearly 146.0% in public spending in the period (table 2).

Table 2. Evolution of population, number and updated values of active benefits of Brazilian elderly between 2002 and 2012. Recife-PE, 2015.

Year	Elderly People		
	Population	Active benefits	Updated values (R$)*
2002	14,887,348	10,112,887	5.52
2003	15,050,492	10,526,480	6.27
2004	15,212,532	11,184,357	6.68
2005	15,581,260	11,652,478	7.29
2006	15,769,169	12,165,960	8.18
2007	18,204,829	12,674,963	8.74
2008	18,761,039	13,288,644	9.31
2009	19,428,086	13,890,631	10.25
2010	20,590,599	14,495,960	11.73
2011	20,742,226	15,045,858	12.33
2012	20,889,849	15,707,685	13.57

*Value updated in billions.

Source: IBGE (2015), Ministry of Social Security (2015).

This scenario of rapid aging has generated considerable pressure on the pension system, which had been organized to meet a demand represented by the increase in official employment and the brevity of the retirement period. The changes that have taken place in the demographic structure, have increased the pressure on social protection systems, mainly due to the fall in the number of the contributing population in relation to the increasing number of those who retire.[7]

According to Costa et al.[15] it is "essential to restructure the pension system in order to ensure its sustainability", due to the increase of the beneficiary population and the aging and reduction of the workforce.

In 2010, as previously mentioned, there were 20.5 million elderly people in the country, approximately 39 for every 100 young people. It is estimated that in 2040, this number will have doubled, representing 23.8% of the population and a ratio of almost 153 elderly people for every 100 young people. This new demographic reality, with a constantly growing number of elderly people, also requires that the health system has the capacity to respond to current and future demands.

> *"[...] A population that lives longer and with low quality of life tends to put pressure on the health system by demanding more expensive, more specialized services, and we are not preparing for this". (Interviewee 1)*

> *"[...] now is the time for the health system to structure itself for this growing demand of the elderly population. [...] because you are presented with a growth in the number of degenerative diseases that require coordinated actions by different professionals. So the preparation of the health system as a whole to meet this growing demand is a major challenge". (Interviewee 3)*

In addition, elderly people can acquire disease, disabilities and sequelae that require integrated actions in the health system. As previously analyzed, the results related to morbidity and mortality rates show part of the complex epidemiological profile experienced by Brazilian society (table 3).

Table 3. Morbidity and mortality rates* of elderly Brazilians according to chapters of the CID-10 between 1998 and 2013. Recife-PE, 2015.

Chapter CID-10	Morbidity**						Mortality					
	1998	2001	2004	2007	2010	2013	1998	2001	2004	2007	2010	2013
Cardiovascular diseases	4,704.5	4,429.7	4,437.6	3,580.5	3,165.4	2,995.9	1,574.3	1,374.7	1,471.1	1,302.9	1,230.9	1,231.6
Cancer (tumors)	767.7	754.4	1,111.0	1,124.6	1,010.8	1,195.4	555.0	545.3	601.9	577.3	573.4	608.3
Respiratory disease	3,639.1	2,908.8	2,919.8	2,198.4	1,949.6	1,876.2	544.1	466.5	540.6	450.8	462.2	517.9
Nutritional and metabolic endocrine dis.	773.8	805.2	743.9	637.9	648.5	574.9	225.0	238.5	265.4	257.6	266.5	271.7
External causes	632.1	653.7	728.4	693.1	732.7	852.7	107.7	100.6	113.1	104.3	114.7	123.6

* Standardized rates per 100,000 elderly; ** calculated based on admissions made by SÚS (National Health System).CID-10= 10th Revision of the International Classification of Diseases

Source: Sistema de Informações sobre Mortalidade (Information on Mortality System) / Ministry of Health (2015).

Although they are still the cause of a significant number of hospital morbidities among the elderly in Brazil, a reduction in hospitalizations due to cardiovascular illnesses, respiratory and nutritional and metabolic endocrine diseases can be observed. This decrease may reflect the expansion and improved quality of primary care services in the country. On the other hand, a significant and growing number of hospitalizations due to cancer and external causes was identified, demonstrating the heterogeneous epidemiological scenario of Brazil.

The variation in mortality rates also showed a significant trend ($p<0.05$), however, only deaths from cardiovascular and respiratory diseases presented a decrease during the study period, with an increase in deaths from cancer, external causes and endocrine and nutritional diseases. This profile represents a major challenge, especially with rapid population aging, as according to Omram,[16] in the third stage of the epidemiological transition, the main causes of death are non-communicable chronic diseases such as heart and cerebrovascular diseases and cancers that tend to cause death close to the age believed to be the end of the biological life limit.

According to Schimdt et al.,[17] non-communicable chronic diseases are currently the main priority for the health sector in Brazil. The country has introduced significant policies related to preventative actions, but due to the behavior and history of most risk factors, the challenge remains to carry out timely actions and introduce policies to deal with this problem.

Dealing with this complex profile of necessities requires a continuous and multidisciplinary organization of care from the health system, updating the work process, ensuring that health services and actions are carried out that promote the health and well-being of this elderly population on a permanent basis. This is mainly because of the association between the aging population and the increased demand for specialist and high cost care.

Among the elderly, although there are those who are healthy, many others have chronic illnesses and/or disabilities, resulting in an increase in the demand for health care, which due to their needs, is more expensive and specialized. The elderly population requires specific care, often specialized and directed towards the peculiarities that arise from the aging process, without segregating them from the society.[18-20]

One of the types of assistance, hospital care, should therefore be organized to meet the needs generated by this aging population. The analysis of bed usage and hospital admissions presented a significant variation ($p<0.05$), verifying the tendency of increasing demand for surgical care and a reduction in demand for internal medicine over the years. (table 4).

The total number of beds and hospital admissions underwent a reduction in the period analyzed. While the total number of beds decreased 34.1% between 1998 and 2013, there was also a decrease of 5.9% in hospital admissions, during a period when there was a population growth of 24.3% (39 million) and 54.3% of the elderly population. The exception was the growth in ICU beds (86.1%) and admissions for surgical care.

In relation to internal medicine, a reduction of 4.6% was registered in the number of admissions and a decrease of 28.2% in the number of beds, although the elderly population increased during this the period. In relation to the number of surgical admissions, there was an increase of 44.1% throughout the period, accompanying the growth of the population, although there was a reduction of 18.6% in the number of beds.

Table 4. Registered beds and hospitalizations between 1998 and 2013 in SUS*. Recife-PE, 2015.

Variable	1998	2001	2004	2007	2010	2013
Total beds	490.4	486.5	362	349.2	336.5	323.0
ICU beds	10.1	11.1	13.5	11.8	15.8	18.8
Total admissions	12,248.60	12,227.20	11,953.90	11,739.30	11,724.80	11,520.80
Internal medicine beds	147.3	146.8	103.3	108.2	105.6	105.8
Internal medicine admissions	4,216.50	4,123.10	3,878.10	3,806.90	4,097.10	4,021.6
Surgical care beds	93.1	95.3	77.1	75.8	76.5	75.8
Surgical care admissions	2,398.70	2,644.00	3,021.80	3,214.30	3,330.30	3,455.5

*Beds and admissions per thousand.

Source: Hospital Information System/Ministry of Health (2015); National Register of Health Facilities/Ministry of Health (2015).

Despite the population growth, especially in the elderly population, the study found a reduction of beds and admissions. This data points to a possible explanation: the reduction of admissions may be related to the improvement in the quality of life of the elderly and consequently, the reduction in the need for hospitalization of this population. One complicating factor, however, is the increase in the average cost of hospitalization (table 5).

In a study of the health tendencies of the Brazilian elderly population using data from the Pesquisa Nacional por Amostra de Domicílios (National Survey by Sample of Households), Lima-Costa et al.[21] identified improvements in some aspects of the health of the elderly, such as the reduction of hospitalizations. For the authors, the results corroborate the expansion of primary care in the country.

In 2013, hospital care for the elderly accounted for 31.6% of public spending on admissions (table 5). Despite the relative increase in the cost of hospital care, it is a small growth, considering the rapid increase in the population, which as seen in this text, can present chronic disease, disability and sequelae that require continuous, specialized and qualified attention and care.

Between 1998 and 2013 there were almost 38 million hospital admissions of elderly people in the SUS, approximately 152 hospitalizations for every group of 1,000 elderly. Despite the absolute growth, a reduction was seen in the number of hospitalizations per thousand elderly persons in this period.

Table 5. Characteristics of hospital admissions of elderly Brazilians in SUS between 1998 and 2013. Recife-PE. 2015.

Variables	1998	2001	2004	2007	2010	2013
Admissions	2,139,007	2,240,418	2,324,573	2,385,368	2,518,002	2,664,080
Total value (R$)*	845.15	1,216.57	1,672.59	2,019.72	3,062.43	3,971.82
Admissions /1,000 elderly	168.37	152.18	152.81	131.03	122.29	120.67
Average updated value (R$)	1,027.77	1,139.92	1,143.71	1,180.54	1,447.80	1,490.88
Proportion of values paid **	22.2	23.9	25.4	26.5	28.6	31.6

*Total value (R$) in millions; **proportion of values paid: considered as the proportional relation between the total value paid related to elderly admissions and the total value paid for all SUS admissions.

Source: Hospital Information System/Ministry of Health (2015).

In the assessed period, all the hospitalizations represented a cost of more than R$33 billion to the public health system in the country. In addition, the average cost of admissions increased significantly, demonstrating the expansion of spending and suggesting greater complexity of care. When compared with the first year studied, the average cost of admissions, corrected according to inflation, increased by more than 45.0%.

This greater complexity reinforces the need for greater investment in the health system, as according to interviewee 1, "the manner that the country will deal with this population, from a public health point of view, will depend a lot on additional 'heavy' expenditure in the system".

This scenario demonstrates the need to carry out actions to promote health and the prevention of illness, in order to prevent or delay chronic diseases and disabilities. One interviewee also pointed out the fragility of actions promoting health in the SUS, by recalling the concept of healthy cities and how they could promote the quality of life of the population.

> *"We don't have, for example, public health campaigns, or else they are insufficient to strongly encourage the population to adopt healthy life styles, to adhere to healthy public health policies, policies that promote health [...] The promotion of health some years ago, seven or eight years ago, was more effective in the context of the health policies of the country than today". (Interviewee 1)*

From the point of view of health policy, it is essential that the health system carries out actions covering all levels of care, considering both the prevention and treatment of chronic diseases that can affect the elderly. Thus, it is necessary that the health model goes beyond biological characteristics and through social determination, considers care in a broader perspective, including all the factors involved in the profile of the health of the elderly.

Preventive actions are effective at any level, even if carried out in the later stages of life. Therefore, "a model of health care for the elderly that intends to be effective and efficient must strengthen all levels of prevention".[11]

However, according to Küchemann,[10] coverage is still insufficient in relation to services and accommodation for long-term care. There are few spaces that offer full-time care, such as homes or recreation centers and these are restricted to higher socioeconomic sectors, able to afford such services.

This means that to meet the demand generated by this aging population, it is necessary to establish mechanisms to strengthen the model of health care for the elderly, including investing in the workforce and the training of professionals so they will have the skills necessary for the prevention, care and comprehensive health care of the elderly.

> *"The care of these elderly people depends on human care, health depends on health professionals, education depends on [professionals], and so on, rehabilitation depends on equipment, but also on people. So, we need a policy of appropriate personnel, we need to have adequate performance from these professionals, who are not bureaucrats, not aggressive, but who invest in the autonomy of the elderly [...]". (Interviewee 7)*

> *"For this we have to prioritize the study of Geriatrics, Gerontology in higher education institutions and it is not prioritized. So there is a lot to do, before reality comes and overwhelms us and we are forced to chase after better conditions". (Interviewee 4)*

Queiroz et al.[22] recognized that there is a lack of specialized human resources to adequately meet the needs of this population, showing the importance of essential training projects aimed at professionals working in services and care for the elderly.

This deficiency justifies the need for investment in quantitative and qualitative training of professionals able to attend this population. The training of health professionals should consider an overall interdisciplinary approach in an integrated manner with the other practices of the social care network.[23]

The issue demands urgent attention. According to Wong & Carvalho,[24] "investments in human resources training for geriatric and gerontological services take considerable time to show results".

Rather than being treated as a problem, the increase of human longevity should be a cause

for celebration.[25] The data demonstrates that Brazil's demographic transition represents both an achievement and a responsibility for public administration and society. It is essential to make investments that strengthen autonomy and promote healthy lives for elderly people, as well as ensuring adequate care for their needs. In order to do this, it is vital to direct the planning of policies and services. After all, from today onwards, the elderly population will increase until the year 2050.[26]

The question, therefore, is not related to the interpretation of from what age the health system should intensify its intervention, but what kind of life the health system should protect and wants to protect.[27] After all, we should celebrate aging and "the increase in life expectancy is a triumph of development".[28]

Studies that utilize secondary data as their source may have limitations due to issues related to data processing. The richness of the discussions was only possible because the data was related to the perception of important social players, who experience the struggle for social justice in their day-to-day lives.

It is important that further studies are carried out to analyze the evolution of socioeconomic conditions and health care, the current demographic transition and the new epidemiological profile and the demands it presents for the country.

CONCLUSION

The challenge of aging must be urgently confronted. The country already has a significant percentage of elderly people, which will increase in the coming years, demanding specialized public services that will reflect the current planning and priorities of public social policies. It is essential, therefore, that these policies have integrated interventions that ensure the necessary care for chronic diseases, but which strengthen the promotion of healthy aging.

The country must, in addition to reorganizing levels of care to meet these necessities, also innovate and use as a base experiences from other countries that have experienced the aging process.

With an aging population and a lower ratio between the active and dependent population, without family networks capable of supporting the elderly and lacking support structures for this population, society must be aware of the price it will have to pay and the increasing cost of care of the elderly population. Moreover, the State should be prepared for the provision of specific policies for the financing of support structures as well as for monitoring its own activities. This will ensure comprehensive care, recognizing the characteristics and specificities of the elderly and consecrating their quality of life. This is the challenge for society and government in the coming decades.

REFERENCES

1. Leone ET, Maia AG, Baltar PE. Mudanças na composição das famílias e impactos sobre a redução da pobreza no Brasil. Econ Soc 2010;19(1):59-77.
2. Vasconcelos AMN, Gomes MMF. Transição demográfica: a experiência brasileira. Epidemiol Serv Saúde 2012;21(4):539-48.
3. Alves JED. A transição demográfica e a janela de oportunidade. São Paulo: Instituto Fernand Braudel de Economia Mundial; 2008.
4. Brito F. A Transição demográfica e as políticas públicas no Brasil: crescimento demográfico, transição da estrutura etária e migrações internacionais [Internet]. Brasília, DF: SAE; 2007 [acesso em 16 abr 2013]. Disponível em: www.sae.gov.br/site/wp-content/uploads/07demografia1.pdf
5. Brito F. Transição demográfica e desigualdades sociais no Brasil. Rev Bras Estud Popul 2008; 25(1):5-26.
6. Kalache A. O mundo envelhece: é imperativo criar um pacto de solidariedade social. Ciênc Saúde Coletiva 2008;13(4):1107-11.

7. Batista AS, Jaccoud LB, Aquino L,El-Moor PD. Envelhecimento e dependência: desafios para a organização da proteção social. Brasília, DF: MPS, SPPS; 2008.

8. Rede Interagencial de Informação para a Saúde. Indicadores e dados básicos para a Saúde no Brasil (IDB) [Internet]. Brasília, DF: Ministério da Saúde; 2014 [acesso em 20 jun. 2014]. Disponível em: http://tabnet.datasus.gov.br/cgi/idb2012/matriz.htm

9. Kvales S. An introdution to qualitative research interview. Thousand Oaks: SAGE Publications; 1996.

10. Küchemann BA. Envelhecimento populacional, cuidado e cidadania: velhos dilemas e novos desafios. Soc Estado 2012; 27(1):165-80.

11. Veras R. Envelhecimento populacional contemporâneo: demandas, desafios e inovações. Rev Saúde Pública 2009;43(3):548-54.

12. Veras RP, Caldas CP. Promovendo a saúde e a cidadania do idoso: o movimento das universidades da terceira idade. Ciênc Saúde Coletiva 2004;9(2):423-32.

13. Organização Mundial da Saúde. Envelhecimento ativo: uma política de saúde. Brasília, DF: OPAS; 2005.

14. Fundo de população das nações unidas. Resumo Executivo. Envelhecimento no Século XXI: celebração e Desafio. New York; 2012.

15. Costa CKF, Mesquita RA, Porto SS Junior, Massuda EM. Envelhecimento populacional e a necessidade de reforma da saúde pública e da previdência social brasileiras. Econ Rev 2011;19:121-31.

16. Omram AR. The epidemiologic transition: a theory of the epidemiology of population change. Milbank Q 2005; 83(4):731-57.

17. Schimdt MI, Duncan BB, Azeedo e Silva G, Menezes AM, Monteiro CA, Barreto SM, et al. Doenças crônicas não transmissíveis no Brasil: carga e desafios atuais. Lancet 2011;377:61-74.

18. Bergmark A, Parker MG, Thorslund M. Priorities in care and services for elderly people: a path without guidelines? J Med Ethics 2000;26:312-8.

19. Mendes MRSSB, Gusmão JL, Mancussi e Faro AC, Leite RCBO. A situação social do idoso no Brasil: uma breve consideração. Acta Paul Enferm 2005;18:422-6.

20. Ribeiro CDM, Schramm FR. A necessária frugalidade dos idosos. Cad Saúde Pública 2004;20(5):1141-59.

21. Lima- Costa MF, Matos DL, Camargos VP, Macinko J. Tendências em dez anos das condições de saúde de idosos brasileiros: evidências da Pesquisa Nacional por Amostra de Domicílios (1998, 2003, 2008). Ciênc Saúde Coletiva 2011;16:3689-96.

22. Queiroz ZPV, Ruiz CR, Ferreira VM. Reflexões sobre o envelhecimento humano e o futuro: questões de ética, comunicação e educação. Rev Kairós 2009;12:21-37.

23. Motta LB, Aguiar AC. Novas competências profissionais em saúde e o envelhecimento populacional brasileiro: integralidade, interdisciplinaridade e intersetorialidade. Ciênc Saúde Coletiva 2007;12:363-72.

24. Wong LLR, Carvalho JA. O rápido processo de envelhecimento populacional do Brasil: sérios desafios para as políticas públicas. Rev Bras Estud Popul 2006;23:5-26.

25. Lloyd- Sherlock PL, MCKee M, Ebrahim S, Gorman M, Greengross S, PRINCE M, et al. Population ageing and health. Lancet 2012;379:1295-6.

26. Minayo MCS. O envelhecimento da população brasileira e os desafios para o setor saúde. Cad Saúde Pública 2012;28:208-9.

27. Diniz D, Medeiros M. Envelhecimento e alocação de recursos em saúde. Cad Saúde Pública 2004;20:1154-5.

28. Help Page International. Índice Global del Envejecimiento: Resumen [Internet]. Madrid; 2013 [acesso em 18 set. 2014]. Disponível em: http://www.helpage.es/noticias/helpage-international-presenta-el-primer-ndice-global-del-envejecimiento/

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Evaluation of balance and fear of falling in elderly individuals before and after senile cataract surgery

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Abstract

Introduction: During aging there is a close relationship between visual deficits, imbalance and falls, and eye surgery can be an efficient treatment option for elderly persons. *Objective:* Evaluate the influence of visual conditions on patients suffering from senile cataract with increasing imbalance. *Method:* A descriptive and analytical study using a quantitative longitudinal cohort technique was conducted. The study included 30 individuals who were evaluated before and 30 and 60 days after surgery. The Mini Mental State Examination (MMSE), Berg Balance Scale (BBS), Short Physical Performance Battery (SPPB), International Falls Efficacy Scale adapted for Brazil (FES-I) and a medical history questionnaire were used to collect data. Statistical analysis involved the Chi-squared, Student's t and Mann-Whitney tests. Values of $p<0.05$ were considered significant. *Results:* The SPPB found that of 15 elderly women, 13 (87%) achieved moderate performance of the lower limbs while the performance of two (13%) remained poor, after 60 postoperative days. The FES-I revealed that three (20%) elderly persons were mildly worried about falls 60 days post-surgery. Of the 15 elderly male subjects evaluated by BBS, before and at 30 and 60 days after surgery, one (7%), managed to maintain some balance but needed assistance; while 14 (93%) maintained good balance. The SPPB found that the performance of five elderly persons (33%) was moderate and that of nine (67%) was good. *Conclusion:* Senile cataract surgery had positive preventative effects on lower limb performance, balance and fear of falling among the elderly studied, preventing the falls and fractures that are common during aging.

Key words: Postural Balance; Accidental Falls; Elderly; Senile Cataract.

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INTRODUCTION

Aging is a universal biological process in most living creatures, especially human beings. It is not limited to the simple passage of time but is a dynamic, progressive and irreversible process, characterized by different biological, psychic and social manifestations that occur during the lives of individuals.[1-3]

In this context, longevity is often accompanied by losses that occur throughout life. One of the first systems to be impacted by physiological aging is the sensory system, notably vision. Elderly people with visual impairment tend to suffer from postural control deficit, functional impairment and increased risk of falls.[4]

The operation of the visual system has the function of providing the central nervous system (CNS) with data about the position and movement of parts of the body relative to objects in the surrounding physical environment, including people or objects in motion. With aging, the visual system undergoes a series of changes, such as a reduction in acuity and the field of vision, diminished contrast sensitivity, a reduction in dark adaptation, and alterations in the absorption of light and depth perception.[5]

The visual system may be compromised in a cumulative and progressive manner by means of metabolic and environmental damage, characterizing the intimate relationship between vision and senescence. Associated with the physiological changes to vision that occur during aging, chronic eye diseases corroborate the decline in the visual ability of the elderly.[6] Visual impairment is usually defined by the visual acuity value, which is part of the functional vision of the indivídual.[7] This is the ideal value that characterizes loss of vision and is used as a criterion to define visual impairment by the World Health Organization (WHO).[8]

Among the causes of loss of visual acuity loss is the cataract, the most significant etiological factor for blindness and visual impairment in the world, accounting for approximately 50% of cases in developed and developing countries and leading to a decrease in visual acuity, contrast sensitivity and color perception.[9,10] Yet a cataract is a condition that can be treated easily and safely. Ultrasound modulation surgery, for example, has produced great benefits for ophthalmic practice and also for patients. In such surgery, cataract removal is performed with precise incisions in the crystalline lens, allowing the surgeon a high degree of confidence and reproducibility.[11]

Studies have identified a close relationship between visual impairment, imbalances, falls and hip fractures among the elderly.[12] This pathology – the cataract – leads to a reduced perception of surfaces, depth, distance, body positions and contrast, thus affecting mobility and the ability to maintain postural control of the elderly. The ability to maintain balance and postural control is important for the proper functional performance of the activities of daily living (ADLs) by an individual. Elderly people with balance disorders are more likely to suffer falls and their consequences.[13] It is estimated that the prevalence of complaints of imbalance in the population over 65 years of age is as high as 85%, and the condition is associated with several etiologies, such as: degeneration of the vestibular system; decreased visual acuity, the ability to perform visual accommodation and persecution movements; proprioceptive changes; musculoskeletal deficit; cerebellar atrophy; a decrease in mechanisms of attention and reaction. These conditions contribute to balance disorders in the elderly and therefore increase the chance of falls.[14]

In this context, fractures from falls account for approximately 70% of accidental deaths in people over 75 years.[15] The precise identification of the cause of an imbalance must involve a clinical evaluation aimed at the patient's complaint and related diseases, as well as a comprehensive evaluation of the systems involved in balance and their possible limitations.[16]

Therefore, given that a cataract may alter balance and lead to falls, and that eye surgery can be an effective alternative for the elderly, significantly improving their physical and functional parameters, the present study aimed to evaluate the balance and fear of falls in elderly persons of both genders who suffered from senile cataract, both before and after eye surgery was performed, through different assessment tests and tools.

METHOD

A descriptive and analytical study using a quantitative longitudinal cohort approach was carried out between January and July 2014. The study was approved by the Ethics Research Committee of the Universidade Católica de Brasília (the Catholic University of Brasília) (CEP/UCB), CAAE: 108221513.9.0000.0029, in accordance with Resolution nº 466/2012 of the National Health Council. The volunteers received detailed information about the aim and procedures of the study and took part only after signing a Free and Informed Consent Form (FICF).

The field of research of the study was the Instituto de Catarata de Brasília (the Brasilia Cataract Institute) (ICB), located at SEP/S - EQ 715/915 Sul, Conjunto A, Bloco C, Asa Sul, Brasília, in the Distrito Federal (Federal District) of Brazil.

Sample selection was performed by cross-sectional, observational and individualized inquiry, taking into account the availability of the individuals to participate in the study. It was estimated that with 15 patients of each gender, the study would have a power of 80% to detect clinically important differences between genders (60 days compared to baseline) using Berg Balance Scale (BBS) scores, assuming a mean difference in score between the groups of 2.3 points with a combined standard deviation of 2.1 points (obtained from published data),[1] for a significance level of 5%. Thus, the sample consisted of 30 elderly patients with pure and mixed bilateral senile cataract, diagnosed clinically by an ophthalmologist from the ICB, who had not undergone surgical treatment. The statistical calculation to set the sample size was based on previous studies.[13] A pilot study was conducted with four elderly men and six elderly women in order to calibrate the protocol and adjust the instruments.

The inclusion criteria used were that individuals should be aged over 60 years, of either gender, with senile cataract and physical conditions that allowed the proposed assessments to be performed. Older people who did not achieve a score of 27 points on the Mini Mental State Examination were excluded (MMSE);[17] as well as those whose mobility was dependent on aids; those with a low level of education; vestibular disorders; recent reports of fractures; the presence of painful symptoms or edema of the lower limbs (LL); orthopedic and/or rheumatic diseases in the lower limbs and patients who were taking medications that interfered with their balance, such as antihypertensive, antiarrhythmic, diuretics and vasodilator medication and drugs against hyperthyroidism.

The present study involved a risk of falling or imbalance during the tests. To avoid such an event, a researcher remained next to the elderly persons during the time of the tests, providing safety in clinical exams. To avoid the fatigue of the elderly persons, a rest period of five minutes was established between each test, and individuals continued to the next examination only when fully recovered.

In relation to the evaluation procedures, the appointments of the volunteers were scheduled only after they had undergone a medical consultation. They were instructed to return to the study location to be re-evaluated on two occasions. At the first appointment an assessment was carried out between one and seven days before eye surgery was performed, with the MMSE applied to assess cognitive function in order to ascertain whether the individual would be able to participate in the study. After this first step, the elderly persons were evaluated by the BBS,[18] to evaluate the functional

balance of individuals with static and dynamic balance deficit. The BBS is often used to determine risk factors for loss of independence and falls in the elderly. This scale assesses balance across 14 items common to daily life, each of which has five alternative responses ranging from 0-4 points, giving a maximum score of 56 points. The lower the score achieved by the individual, the greater his or her risk of falling.[18]

On a third occasion, LLs performance was evaluated using the Short Physical Performance Battery (SPPB) instrument,[19] assessing the balance, gait and strength of the lower limbs using three feet positions: (1) in parallel, (2) with the hallux resting against the medial edge of the heel and (3) with the hallux resting against the back edge of the heel. One point was attributed if the first or second test was performed in 10 seconds or less (≤) (10") and zero points were awarded if the first or second test took longer than 10 seconds (>) (10"). In the third test, the points awarded varied from 0 for <3", 1 for between 3" and 9.99" and 2 if ≥10".[19] For gait evaluation, a stopwatch was used to record the time that a person took to move along a corridor of three meters (round trip), repeating the route twice. The scores of the instrument ranged from: 0, when unable; 1 if took > 6.52"; 2 if the time required was between 4.66" and 6.52"; 3 if the time was between 3.62" and 4,65" and 4 if the time was <3.62". The muscle strength of the LLs was also evaluated using the time that the elderly persons took to get up from a chair (45 cm in height with armrest) with the upper limbs (UL) crossed over their chests, repeating the test five consecutive times. The scores varied according to the time taken: 0 when incapable of performing the action; 1, if >16.7"; 2 between 13.7" and 16.69"; 3 for a time between 11.2" and 13.69" and 4 if <11.19".

The total SPPB score allows values between 0 and 12 points and represents the performance of the LLs of the elderly through the following grading: 0 to 3 where incapable or perform very poorly; 4 to 6 points for poor performance; 7-9 points for moderate performance and 10 to 12 points if performed well.[20]

Finally, the elderly were assessed by the Falls Efficacy Scale – International adapted for Brazil (FES-I-Brazil).[21] The choice of this scale as a tool to measure the fear of falling in community-dwelling elderly persons was based on its measuring properties, internal consistency (a-Cronbach=0.96) and test-retest reliability (ICC=0.96). The FES-I-Brazil includes questions regarding concern over the possibility of falling and involves 16 activities, with respective scores of one to four. The total score can range from 16 (not at all concerned) to 64 (very concerned), with up to 16 points representing an absence of concern; up to 32 mild concern; up to 48 moderate concern and up to 64 extreme concern.[21]

The tests were performed on Mondays, Thursdays and Fridays in the morning, over a period of seven months. The time of evaluation was chosen based on the availability of the patient and the researcher. However, it was observed that in the morning the patients felt positive about factors that influence vision such as light, sleep and nutritional factors.

The two subsequent meetings were scheduled in the postoperative period, 30 and 60 days after bilateral surgery (the patient underwent the surgery in one eye and following an average of 7 to 15 days the other eye was operated on), and lasted approximately 30 minutes.

The baseline characteristics, or those before senile cataract surgery, of the two groups (men and women) were compared using the Chi-squared test or Fisher's exact test, in the event that the expected frequencies were less than five, for the qualitative variables. The Student-t test was used for the quantitative variables with Gaussian distribution and the Mann-Whitney test for those without Gaussian distribution. The Chi-squared test or Fisher's exact test were used to assess the association between the occurrence of fear of falling and physical activity.

Longitudinal disorders were tested independently for each group (elderly men and women), using a mixed effect linear regression model with random intercept, with an adjustment for baseline values and age, for each of the outcome variables (BBS, SPPB and FES-I-Brazil). It should be considered that the linear regression model is not a common linear model, but one of mixed effects where the intra-individual changes (over time) and the changes among individuals (for each gender) are evaluated. As age is a confounding variable, influencing the effects, it must be controlled in the statistical model even if it later interferes in the results. The change in each dependent variable outcome was defined as: values at 30 days less the baseline values and the values at 60 days less the baseline values.

The independent variables in the model were considered to be the effect of time (30 to 60 days), age and as a covariate the value of the outcome at baseline. The main focus of the analysis was to check, for each outcome, if the mean values at 30 and 60 days differed significantly from the mean values at baseline. When the overall *p*-value of the linear effect over time was less than 0.05, comparisons at 30 and 60 days compared to baseline were tested. Analyses were performed with the use of the Statistical Analysis System version 9.3. The results were also expressed in absolute/relative values for the categorical variables.

RESULTS

The study sample consisted of 30 elderly persons, 15 women (50%) and 15 men (50%). Table 1 shows the characteristics of the sample before senile cataract surgery.

Table 1. Baseline characteristics of study participants. Brasília, Federal District, 2014.

	Groups		
Variable	Elderly women (n=15)	Elderly men (n=15)	*p*-value
Educational level*			0,0176
Primary School	3 (20.0)	0 (0.0)	
High School	9 (60.0)	5 (33.3)	
Higher education	3 (20.0)	10 (66.7)	
Has suffered falls?*			0.4642
No	6 (40.0)	8 (53.3)	
Yes	9 (60.0)	7 (46.7)	
Fear of falls?*			0.2557
No	8 (53.3)	11 (73.3)	
Yes	7 (46.7)	4 (26.7)	
Overweight/obesity*			0.4561
No	7 (46.7)	5 (33.3)	
Yes	8 (53.3)	10 (66.7)	
Age**	65.6 (±6.6)	71.1 (±6.2)	0.0092
BBS**	54.7 (±1.49)	52.3 (±7.8)	0.3969
SPPB**	6.8 (±1.5)	8.6 (±1.8)	0.0110
FES-I-Brazil**	26.5 (±9.3)	21.3 (±4.9)	0.0354

*Values expressed in n (%); **mean and standard-deviation; BBS= Berg Balance Scale; SPPB= *Short Physical Performance Battery*; FES-I-Brazil= Falls Efficacy Scale International adapted to Brazil.

Table 2 shows that no elderly persons displayed improvement in balance before and after the surgical procedure according to the BBS test. All retained a score of between points 41 and 56, representing independent individuals with proper functional balance, or in other words, ideal for ADLs. From the SPPB, it was observed that of the 15 elder persons before surgery, seven had poor (47%) and eight had good LL performance (53%). After 30 days of surgery, it was observed that 12 elderly persons (80%) had a score of between 7 and 9 points, or in other words moderate performance, and three (20%) had a score of between 4 and 6 points, indicating poor LL performance. At 60 days after surgery it was observed that of the 15 elderly persons, 13 (87%) achieved moderate performance and two (13%) poor performance. Assessing the FES-I-Brazil test, it was observed that before senile cataract surgery four elderly women (27%) had a score of between 32 and 48 points, indicating a mild concern about falling and 11 (73%) had a score of 16 and 32 points, indicating they were not at all concerned about falls. After 30 days of surgery, it was observed that these values were maintained, in other words of the 15 elderly persons, four (27%) had mild concern about falling and 11 (73%) had no concern. At 60 days after surgery, it was observed that three (20%) elderly persons continued to have a mild concern over the falls and 12 (80%) had no concern.

When observing the difference between genders (Table 2), of the 15 elderly subjects evaluated by the BBS before surgery and at 30 and 60 days after surgery, one elderly person maintained a score of between 21 and 40 (7%), or in other words this patient maintained some balance, but required assistance, and 14 (93%) had scores of 41-56, which characterizes individuals with good balance or who are independent for the performance of ADLs. Assessing the SPPB test results, it was observed that before surgery, one elderly person (7%) had a score of between 4 and 6, or poor LL performance; ten elderly subjects (67%) had a score of between 7 and 9, indicating moderate performance and four elderly persons (26%) had a score of 10 to 12, which indicates good LL performance. After 30 days of surgery, it was observed that the LL performance of one elderly (7%) remained poor, nine elderly (60%) persons had moderate performance and five (33%) had good performance. After 60 days of surgery, it was observed that five elderly persons (33%) had moderate performance and nine (67%) had good SPPB results. Regarding the FES-I-Brazil test, there was no variation in the results before and at 30 and 60 days after surgery. Of the 15 elderly persons, one (7%) had mild concern about falling and 14 (93%) had no concern.

Table 2. Analysis of effect of eye surgery on the parameters of static and dynamic balance, performance of lower limbs and fear of falls by groups of elderly persons after 30 and 60 days. Brasília, Federal District, 2014.

Variable	Time (days)			*p*-value#		
	Basal*	Change at 30 days*	Change at 60 days*	Linear effect	30 x Basal	60 x Basal
Group of Elderly Women (n=15)						
BBS	54.73(±0.38)	0.87(±0.16)	1.07(±0.16)	0.1746	-	-
SPPB	6.80(±0.39)	0.53(±0.22)	1.20(±0.22)	0.0160	0.0304	< 0.0001
FES-I-Brazil	26.53(±2.40)	-1.20(±0.94)	-3.53(±0.94)	0.0798	-	-
Group of Elderly Men (n=15)						
BBS	52.27(±2.01)	0.33(±0.38)	1.33(±0.38)	0.0326	0.3979	0.0036
SPPB	8.60(±0.46)	0.27(±0.19)	0.53(±0.19)	0.0933	-	-
FES-I-Brazil	21.27(±1.26)	-0.07(±0.79)	-0.53(±0.79)	0.6646	-	-

*Values expressed in means and standard-deviation; #*p*-values calculated using linear regression model of mixed effects with random intercept; BBS= Berg Balance Scale; SPPB= *Short Physical Performance Battery;* FES-I-Brazil= Falls Efficacy Scale International adapted to Brazil.

The results show that the linear trend over time of the BBS results of the group of elderly women did not significantly differ from zero (p=0.1746), indicating that the average values of BBS at 30 and 60 days did not differ from the mean BBS value at baseline (figure 1). In contrast, this linear trend differed significantly from zero (p=0.0326) among elderly men. It was also verified that the mean value of BBS at 30 days did not differ significantly from baseline (p = 0.3979), while at 60 days there was an increase of 1.33 points in the BBS, significantly higher than baseline (p=0.0036).

In terms of SPPB, it was observed that in the group of elderly men the linear trend over time did not significantly differ from zero (p=0.0933), indicating that the mean SPPB values at 30 and 60 days did not significantly differ from the mean basal SPBB value (figure 2). However, among elderly women this linear trend differed significantly from zero (p=0.0160). The mean value of SPPB at 30 days showed a significant increase of 0.53 points (p=0.0304) from the baseline, while at 60 days there was an increase of 1.20 points in the SPPB value, which was significantly higher than the first evaluation (p<0,0001).

With respect to the FES-I-Brazil, it can be seen that in both groups the linear trend over time did not differ significantly from zero (p=0.0798, p= 0.6646, respectively), indicating that the mean FES-I-Brazil values at 30 and 60 days did not differ from the initial FES-I-Brazil mean (baseline) (figure 3).

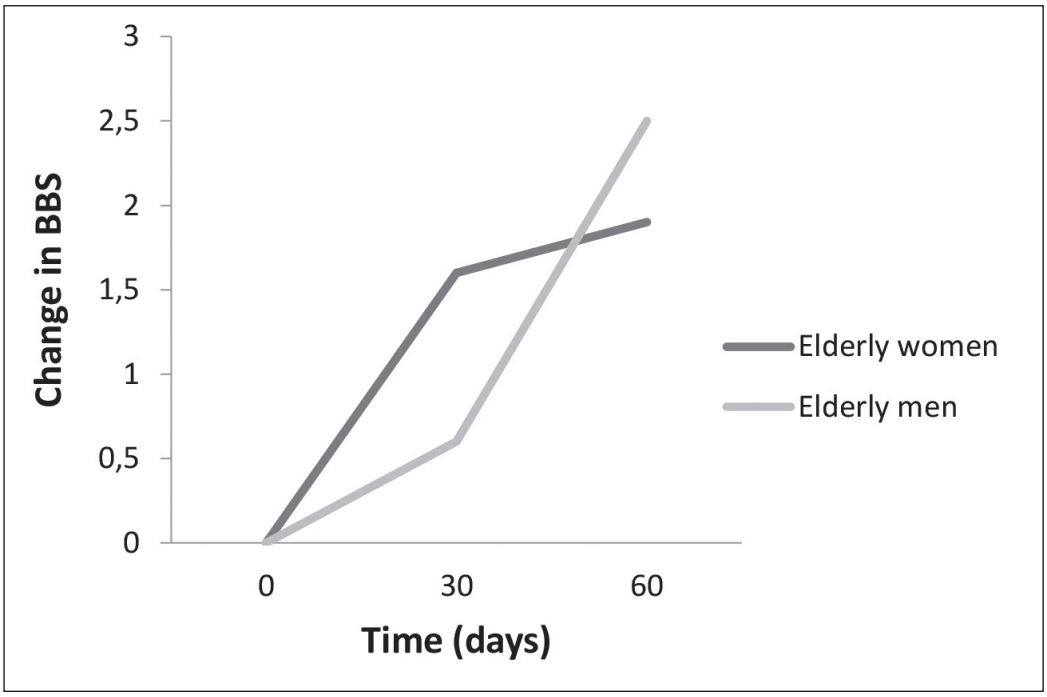

Figure 1. Analysis of effect before and after eye surgery on the parameters of static and dynamic balance (Berg Balance Scale - BBS) by elderly group. Brasília, District Federal, 2014.

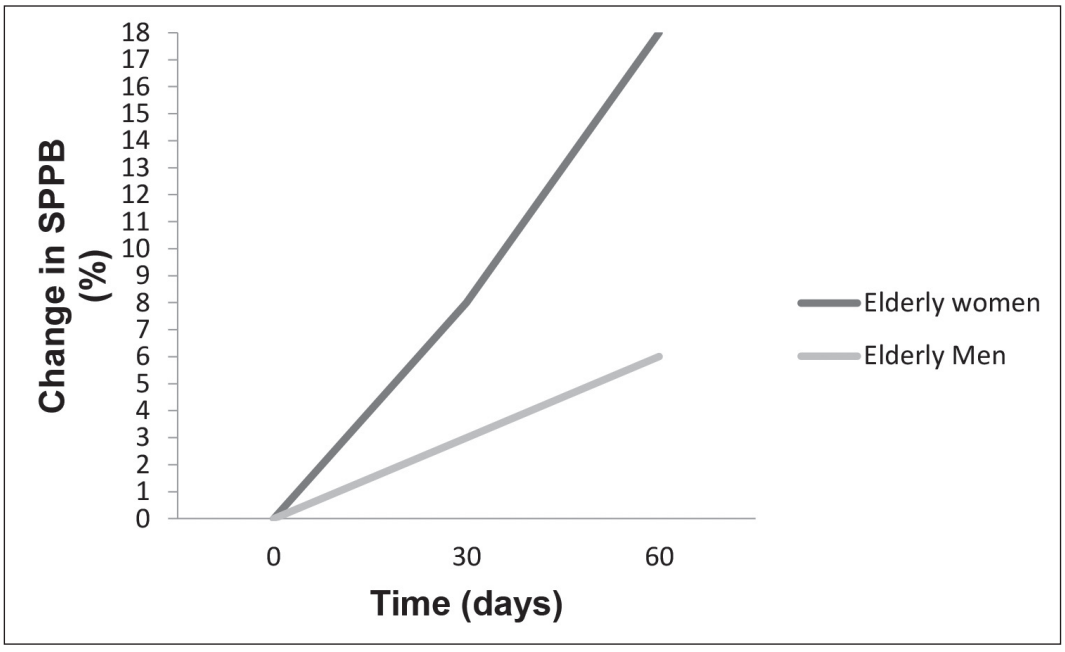

Figure 2. Analysis of effect before and after eye surgery on lower limb performance parameters (Short Physical Performance Battery test - SPPB) by elderly group. Brasília, Federal District, 2014.

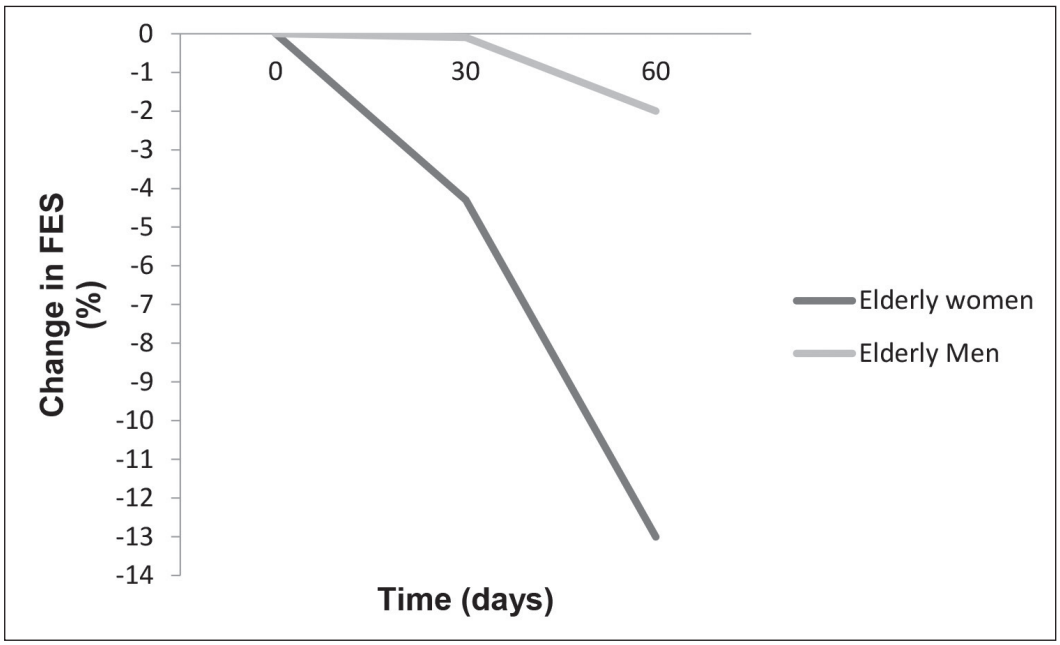

Figure 3. Analysis of effect before and after eye surgery on the parameters of fear of falls (Falls Efficacy Scale International adapted to Brazil - FES-I-Brazil) by elderly group. Brasília, Federal District, 2014.

Figures 1, 2 and 3 show the mean values for the elderly women and elderly men versus the variables throughout the follow-up period.

DISCUSSION

According to the results of this study, BBS values did not differ significantly over time for elderly women, in other words, cataract surgery did not improve – or worsen – their static and dynamic balance. Among all the elderly women the BBS test proved that over a short period of time (60 days after surgery) cataract surgery did not contribute to postural stability; results which are not concordant with other studies.[22,23]

However, the BBS values of the elderly men increased 1.33 points after 60 days, which was significantly higher than baseline (p=0.0036). This result was expected as the elderly men were older than the older women and by the fact that the elderly men seek medical services later that older women.[24] The older the individual the greater difficult in balancing he or she will have and therefore, as the elderly men were older they would be expected to have lower results related to static and dynamic balance; these results are consistent with other studies.[22,23]

Elderly patients with visual impairment due to cataracts develop other compensatory mechanisms to perform their ADL. However, three tasks proposed by the BBS test – reach forward, stand with one foot in front of the other and stand on one foot – have been found to be more suitable for detecting functional changes in balance, as they are more difficult for elderly persons to perform.[18]

Therefore, the result of the present study showed that there was a correlation between decreased visual acuity (the ability to see within a normality of 90% of healthy vision) and the performance of the elderly individual in the BBS test. Studies have found a similar association between visual impairment and functional balance disorders in the elderly, including through the application of other tests, such as the Performance Oriented Mobility Assessment and the Tinetti Balance test.[25,26]

In terms of the SPPB results, the linear trend over time did not differ significantly for the elderly men, with the mean SPBB values at 30 and 60 days not differing from the mean SPPB value at baseline. In other words, for the group of elderly men, the SPPB test revealed there were no statistically significant benefits from cataract surgery in relation to balance and LL strength. In the group of elderly women, however, this linear trend was significant, as it was found that the mean SPPB value after 30 days showed a significant increase compared to baseline, while the value at 60 days was significantly greater than baseline (p<0.0001). This fact proves that cataract surgery improved balance in older women 30 and 60 days after surgery.

It was also observed that the elderly women maintained routines of physical activity more often than elderly men, demonstrating the probable improvement of lower limb strength identified by the SPPB. In other words, of the 15 elderly women, nine practiced physical activities between three and seven days a week; of the 15 elderly men, nine practiced physical activities between two and five days a week; in other words, less frequently than the elderly women. Studies indicate that regular physical activity can improve balance in the elderly, as noted in the SPPB test.[27] Physical activity reduces the risk of falls as it improves cognitive activities and promotes a strengthening of the locomotor system.[22]

Fear of falling is associated with physical decline – including visual and functional declines affecting the ability to perform ADLs and alterations in the balance and gait of the elderly. Tinetti et al.[28] suggested that the effectiveness of balance control in relation to falls through specific tests assesses performance more fully than subjective and dichotomous questions about fear of falling. This study[28] is based on a composite sample of older adults, showing independence in their routines, 35% of whom practiced some kind of physical activity.

The results of the FES-I-Brazil test did not differ significantly in statistical terms over time, meaning that the mean values of the FES-I-Brazil test at 30 and 60 days remained linear with respect to baseline. These results show that in this study cataract surgery did not significantly improve fear of falls among individuals.

Some authors have reported that even elderly individuals who had not fallen may have fear of falling.[29] Some studies show that the prevalence of fear of falling in the elderly, regardless of gender, ranges from 20% to 85%. In this sense, fear may be a protective factor as elderly persons take more care not to expose themselves to risk, yet it may also be a risk when it causes limitations and insecurity.[30] In this study, it was also noted is that, among the 15 elderly women, nine had experienced more than one fall and of those, five were afraid of falling again. Among the 15 elderly men, seven had fallen at least once and of those three were afraid of relapses. Arfken et al.[31] demonstrated the relationship between fear of falling and the number of falls suffered by an individual, which supports the results obtained in this study.

It was also found that there was no statistically significant relationship between elderly individuals who had suffered falls and were afraid of falling with schooling and overweight/obesity. However, Cordeiro[32] demonstrated the relationship between balance disorders in patients with diabetes *mellitus* type II, all of whom were overweight/obese. Studies have shown that there is a relationship between the education of elderly persons and falls, or in other words, the higher the level of education, the lower the risk of falling, as more educated older people tend to seek information on, for example, how to achieve a good quality of life in old age.[33,34]

In summary, this study was notable due to its easy reproducibility and low cost, although it was limited by its focus on the elderly population who retained mobility without the use of walking aids. It is also likely that the low statistical significance

observed for some results was due to the short assessment period proposed. Thus, the scientific community should be aware of the importance of new research related to this subject, involving longer study periods.

CONCLUSION

This study demonstrated that senile cataract surgery improved static and dynamic balance, assessed by the Berg Balance Scale, especially among elderly men; it significantly improved the performance of the lower limbs, measured by the Short Physical Performance Battery, notably among older women; but had no effect in relation to the fear of falling among all the participants in this study, probably due to the short intervals when reassessment took place (30 and 60 days).

The contributions of this study include the inference that early diagnosis of visual impairment significantly benefits the elderly and prevents future functional losses arising from this and other consequences, such as falls, as well as showing that senile cataract surgery can have positive effects on balance, especially among elderly men, functioning as an important tool for reducing falls, which are common in the physiological process of aging.

REFERENCES

1. Freitas EV, Py L, Cançado FAXC, Doll J, Gorzoni ML. Tratado de Geriatria e Gerontologia. 2ª ed. Rio de Janeiro: Guanabara Koogan; 2011
2. Motta AB. Envelhecimento e sentimento do corpo. In: Minayo MCS, Coimbra CEA Jr. Antropologia, saúde e envelhecimento. Rio de Janeiro: Fiocruz; 2002. p. 37-50.
3. Rebelatto JR, Morelli JGS. Fisioterapia Geriátrica: a prática da assistência ao idoso. 2ª ed. Barueri: Manole; 2007.
4. Menezes RL, Bachion MM. Condições visuais autorrelatadas e quedas em idosos institucionalizados. Rev Bras Oftalmol 2012;71(1):23-7.
5. Perracini MR, Fló CM. Funcionalidade e envelhecimento. Rio de Janeiro: Guanabara Koogan; 2011.
6. Luiz LC, Rebelatto JR, Coimbra AMV, Ricci NA. Associação entre déficit visual e aspectos clínico-funcionais em idosos da comunidade. Rev Bras Fisioter 2009;13(5):444-50.
7. Berger S, Porell F. The association between low vision and function. J Aging Health 2008;20(5):504-25.
8. Luiz L.C. et al. Associação entre déficit visual e aspectos clínico-funcionais em idosos da comunidade. Revista Brasileira de Fisioterapia. v. 13, n. 5, p. 444-50, 2009. Organização Mundial de Saúde. ISBN 13009789242560817. 2010. Disponível em: http://who.int/bookorders/anglais/detart1.jsp?sesslan=1&codlan =2&codcol=24&codcch=8283
9. Temporini ER, Kara JN, José NK, Holzchuh N. Popular beliefs regarding the treatment of senile cataract. Rev Saúde Pública 2012;36(3):343-9.
10. Tideiksaar R. As quedas na velhice: prevenção e cuidados. 2ª ed. São Paulo: Andrei; 2010.
11. Giménez GR. Buscando la excelencia en la cirugía de la catarata. Arch Soc Esp Oftalmol 2007;82(4):254.
12. Lord SR, Smith ST, Menant JC. Vision and falls in older people: risk factors and intervention strategies. Clin Geriatr Med 2010;26(4):569-81.
13. 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 Gerontol 2012;15(2):265-74.
14. Figueiredo KM, Lima KC, Guerra RO. Instrumentos de avaliação do equilíbrio corporal em idosos. Rev Bras Cineantropom Desempenho Hum 2007;9(4):408-13.
15. Fuller GF. Falls in the elderly. Am Fam Physician 2000;61(7):2159-68.
16. Simoceli L, Bittar RMS, Bottino MA, Bento RF. Perfil diagnóstico do idoso portador de desequilíbrio corporal: resultados preliminares. Rev Bras Otorrinolaringol 2010;69(6):772-7.
17. Nitrini R, Caramelli P, Bottino CMC, Damasceno BP, Brucki SMD, Anghinah R. Diagnóstico de doença de Alzheimer no Brasil: critérios diagnósticos e exames complementares. Arq Neuropsiquiatr 2005;63(3A):713-9.

18. Miyamoto ST, Lombardi I Júnior , Berg KO, Ramos LR, Natour J. Brazilian Version of Berg Balance Scale. Braz J Med Biol Res 2004;37(9):1411-21.

19. Nakano MM. Versão brasileira da Short Physical Performance Battery – SPPB: adaptação cultural e estudo da confiabilidade [dissertação]. Campinas: Universidade Estadual de Campinas; 2007.

20. Sposito G, Diogo MJD, Cintra FA, Neri AL, Guariento ME, De Sousa MLR. Relações entre o bem-estar subjetivo e a funcionalidade em idosos em seguimento ambulatorial. Rev Bras Fisioter 2010;14(1):81-9.

21. Camargos FF, Dias RC, Dias JF, Freire MT. Cross-cultural adaptation and evaluation of the psychometric properties of the Falls Efficacy Scale-International Among Elderly Brazilians (FES-I-BRAZIL). Rev Bras Fisioter 2010;14(3):237-43.

22. Barnett A, Smith B, Lord SR, Williams M, Baumand A. Community based group exercise improves balance and reduces falls in at-risk older people: a randomized controlled trial. Age Ageing 2011;32(4):407-14.

23. Overstall PW, Exton-Smith AN, Imms FJ, Johnson AL. Falls in the elderly related to postural imbalance. Br Med J 1977;1(6056):261-4.

24. Caldas CP, Veras RP, Motta LB, Lima KC, Kisse CBS, Trocado CVM, et al. Rastreamento do risco de perda funcional: uma estratégia fundamental para a organização da Rede de Atenção ao Idoso. Ciênc Saúde Coletiva 2013;18(12): 3495-506.

25. Huang M, Burguess R, Weber M, Greenwald N. Performance of balance impaired elders on three balance tests under two visual conditions. J Geriatr Phys Ther 2006;29(1):5-9.

26. Owsley C, McGwin G Jr. Association between visual attetion and mobility in older adults. J Am Geriatr Soc 2004;52(11):1901-6.

27. Rebelatto JR, Calvo JI, Orejuela JR, Portillo JC. Influência de um programa de atividade física de longa duração sobre a força muscular manual e a flexibilidade corporal de mulheres idosas. Rev Bras Fisioter 2006;10(1):127-32.

28. Tinetti ME, Richman D, Powell L. Falls efficacy as a measure of fear of falling. J Gerontol 1990;45(6):239-43.

29. Scheffer AC, Schuurmans MJ, Van de Rooij SE. Fear of falling: measurement strategy, prevalence, risk factors and consequences among older persons. Age Ageing 2008;37(1):19-24.

30. Zijlstra GA, Van Haastregt JC, Van Eijk JT, Van Rossum E, Stalenhoef PA, Kempen GI. Prevalence and correlates of fear of falling, and associated avoidance of activity in the general population of community-living older people. Age Ageing 2007;36(3):304-9.

31. Arfken C, Lach H, Birge S, Miller J. The prevalence and correlates of fear of falling in elderly persons living in the community. Am J Public Health 1994 84(4):565-70.

32. Cordeiro RC. Caracterização clínico-funcional do equilíbrio em idosos portadores de Diabetes Mellitus do tipo II [dissertação]. São Paulo: Universidade Federal de São Paulo; 2001.

33. Custódio EB, Malaquias JJ, Voos MC. Relação entre cognição (função executiva e percepção espacial) e equilíbrio de idosos de baixa escolaridade. Fisioter Pesqui 2010;17(1):46-51.

34. Pereira F, Fernandes A, Miguel T. Fatores, riscos e consequências de quedas em idosos institucionalizados. In: 6º Congresso Internacional de Saúde, Cultura e Sociedade [Internet]; 28-29 maio 2010; Chaves, Portugal. Chaves: Escola Superior de Enfermagem Dr. Timóteo Montalvão Machado; 2010 [acesso em 10 de fevereiro de 2014]. p. 1-12. Disponível em: https://bibliotecadigital.ipb.pt/handle/10198/4437.

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Analysis of potential drug interactions and adverse reactions to nonsteroidal anti-inflammatory drugs among the elderly

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Abstract

Objective: The aim of the present study was to analyze potential drug interactions and adverse reactions to NSAIDs in elderly users of a private drug distribution service. *Method:* A prospective, exploratory and descriptive study with a quantitative approach was performed. The elderly users of NSAIDs attended by the service were interviewed and their prescriptions analyzed between May and September, 2014. Analysis of drug interactions was performed through computerized databases. The post-sales analysis of adverse reactions was performed using the Adverse Drug Reaction Probability Scale. Statistical analysis was performed with the Chi-squared and Fisher's Exact tests. *Results:* The study evaluated 200 elderly persons, among whom women predominated (56.5%). The average age was 65 years ±10. The NSAIDs accounted for 38.7% of prescription drugs used, and included dipyrone (26.9%), nimesulide (22.8%) and ketoprofen (16.3%). A total of 8.5% of such drugs were considered inappropriate medications for the elderly. A total of 104 potential drug interactions were identified, of which 24% were considered highly clinically significant. The NSAIDs with the greatest risk of interactions were ketoprofen 46.2%, ketorolac 14.4%, nimesulide 12.5% and diclofenac 9.6%. In post-sales monitoring 30.5% of the elderly persons reported undesirable symptoms after the use of NSAIDs, with stomach discomfort the most prevalent (17%). *Conclusion:* The present study confirmed the importance of monitoring the use of NSAIDs among the elderly due to the increased risk of drug interactions and adverse reactions associated with age, concomitant diseases, multi- prescriptions and polypharmacy. The choice of appropriate drugs for the elderly, the reconciliation of all the medications taken by the patient, and effective pharmaceutical care are measures that can contribute to the rational and safe use of NSAIDs.

Key words: Elderly; Nonsteroidal Anti-inflammatory Drugs; Drug Interactions; Drug-Related Side Effects and Adverse Reactions.

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INTRODUCTION

The increase in drug consumption among the elderly population is due to the prevalence of chronic diseases, the physiology of aging, the influence of the pharmaceutical industry on prescriptions and the medicalization that is common in the training of health professionals.[1,2] Brazilian studies of this group of patients indicate a mean drug consumption of two to four drugs per elderly individual.[3-6]

The consequences of polypharmacy have a direct impact on clinical, diagnostic, therapeutic and pharma-economic environments. These factors can be reflected in the patient's quality of life and health-related expenditure. The pharmacokinetics/pharmacodynamics of drugs and the physiological conditions associated with the aging process (decreased production of gastric juice, slower gastric emptying, lower total water content, higher total adipose tissue content, fewer plasma proteins, decreased kidney irrigation, glomerular filtration and tubular secretion, reduced blood flow and enzyme activity in the liver, among others) may lead to a greater prevalence of adverse reactions to drugs and drug and food interactions.[6]

The risk of adverse reactions to drugs (ARDs) is 13% when an individual consumes two drugs, 58% for those who use five drugs and 82% among those who consume seven or more drugs.[7] Approximately 15% of hospital admissions caused by ARDs are the result of drug interactons.[8] The risk of drug interactions is higher among the elderly population due to the prevalence of polytherapy and the number of doctors that assess a single individual.[5]

Drug interactions, whether pharmacokinetic or pharmacodynamic, can lead to positive or negative effects, with an enhanced, decreased or null action. They can even cause toxic reactions. Analysis can predict possible drug interactions, although scientific proof depends on dose-dependent reactions and clinical signs that are compatible with the pharmacological action, as well as a laboratorial profile.[6,9]

The aim of the present study was to analyze potential drug interactions and adverse reactions to non-steroidal anti-inflammatories (NSAIs) among elderly users of a private drug distribution service.

METHODS

This was a prospective, exploratory and descriptive study with a quantitative approach. The sample contained individuals aged 60 years or more who had obtained a prescription for at least one NSAI between May and September of 2014.

The patients were interviewed in a private pharmacy in the city of São José do Rio Preto (São Paulo, Brazil) after they had signed a free and informed consent form. In order to ensure the confidentiality of the elderly individuals involved in this research, sequential numerical codes were used for each individual in all stages of the investigation.

A multi-professional health team containing Pharmacy course lecturers who were also students in the Masters and Doctorate programs of the Faculdade de Medicina de São José do Rio Preto (the São José do Rio Preto Medicine School) (FAMERP) collected sociodemographic, clinical and pharmacotherapeutic data using a standardized questionnaire. The interviews were conducted by Pharmacy students from the Centro Universitário de Rio Preto (University Center of Rio Preto) (Unirp), under the supervision of the lecturers who coordinated the project.

The following sociodemographic variables were analyzed: gender; age; marital status; education and place of origin. The clinical data involved the diagnostic assessment of diabetes *mellitus* and systemic arterial hypertension (SAH). These two illnesses were selected based on their high prevalence among the elderly population.[2,3,5]

The analysis of NSAI prescriptions included the following: the total number of drugs used by the patients during the week of the study; drug combinations containing NSAIs; and the use of NSAIs found on the list of drugs that

are inappropriate for elderly individuals.[3,10,11] Acetylsalicylic acid (ASA) was not considered an NSAI when it was prescribed at a daily dose of 100 mg and used as an antiplatelet. Despite their weak anti-inflammatory action (and stronger analgesic and antipyretic action), paracetamol and dipyrone are considered NSAIs due to the fact that they inhibit cyclooxygenase-1 (COX-1) and cyclooxygenase-2 (COX-2). These enzymes are involved in the synthesis of prostaglandins, and consequently were included in the analysis of the present study.[12]

The analysis of adverse reactions to drugs was performed through post-sales monitoring and telephone contact. Once the NSAI was no longer being used, the adverse drug reaction probability scale was applied to determine the causality of specific reactions. This test was selected as it is simple and practical and has been previously validated.[13,14]

The analysis of drug interactions was conducted in three computerized databases: the Drug Interaction Checker (Medscape);[15] Truven Health Analytics (Micromedex)[16] and the Drug Interaction Checker (Drugs Information Online).[17] The Vade Mecum database was used to analyze interactions related to dipyrone and nimesulide, neither of which are available in the abovementioned databases.[18] Drug interactions were classified according to their intensity: low or non-significant (may alter the patients clinical condition but there is no need to modify the therapeutic strategy); moderate or significant (worsen the clinical condition of the patient and the drug therapy should be analyzed and modified); and severe (potentially severe or fatal affects that may weaken the patient's clinical condition and immediate medical intervention is needed). In cases that involved different classifications of intensity in different databases, the highest level of intensity was adopted.

Descriptive statistical analysis was used to characterize the sociodemographic, clinical and pharmacotherapeutic profile of the participants in the present study. Continuous variables with a normal distribution were presented using mean and standard deviation values. The categorical variables were displayed using numbers and proportions (%), which were assessed using the Chi-squared test or Fisher's exact test. In the 2 x 2 contingency tables, expected values of less than five and small samples can affect the approximation of the distribution of the chi-squared test. In these cases, the Chi-squared test was not suitable and was replaced by Fisher's exact test. In all tests, the level of statistical significance was set at $p<0.05$. BioEstat software (version 5.0) was used for the analysis.

The present study received approval from the Research Ethics Committee of the Centro Universitário de Rio Preto under protocol number CAAE: 30768614.1.0000.5604 and was in accordance with Resolution 466/2012 of the National Health Council. The research was also approved by the management of the pharmacy where the data was collected.

RESULTS

The sample contained 200 elderly individuals, with 113 (56.5%) women and 87 (43.5%) men. The mean age of the participants was 65±10 years, with a minimum age of 60 years and a maximum age of 96 years. Most of the participants were married (n=162; 81%), followed by divorced (n=21; 10.5%). Concerning their education levels, 33.5% (n=67) of the participants had completed high school and 31.5% (n=63) had not, while 19 (9.5%) had completed a higher education course. Concerning their place of origin, 192 (96%) resided in the urban zone of the municipality of São José do Rio Preto (Sao Paulo). In terms of clinical condition, 47 (23.5%) were being treated for SAH and 19 (9.5%) had type 2 diabetes *mellitu*s. Table 1 displays this data.

The 200 prescriptions that were analyzed prescribed 760 drugs, of which 294 (38.7%) were NSAIs (Table 2).

Table 1. Sociodemographic and clinical characteristics of 200 elderly users of a commercial pharmacy. São José do Rio Preto-SP, 2014.

Variable	n	%
Gender		
Female	113	56.5
Male	87	43.5
Age (mean and standard deviation)	65±10 years	
Marital status		
Married	162	81.0
Divorced	21	10.5
Single	3	1.5
Widow	14	7.0
Education		
Higher level complete	19	9.5
Higher level incomplete	3	1.5
High school complete	67	33.5
High school incomplete	17	8.5
Primary school complete	31	15.5
Primary school incomplete	63	31.5
Origin		
Urban zone	192	96.0
Rural zone	8	4.0
Clinical condition		
Arterial hypertension	47	23.5
Diabetes *mellitus*	19	9.5

Table 2. Distribution of the 294 non-steroidal anti-inflammatories prescribed on the 200 prescriptions for elderly users of a pharmacy. São José do Rio Preto-SP, 2014.

Generic name	N	%
Dipyrone	79	26.9
Nimesulide	67	22.8
Ketoprofen	48	16.3
Paracetamol	36	12.2
Ketorolac	27	9.2
Diclofenac	17	5.8
Ibuprofen	9	3.1
Piroxicam	6	2.0
Meloxicam	3	1.0
Celecoxib	2	0.7
Total	294	100

The mean number of drugs per prescription was 3. Among the NSAIs, 69 drugs (23.5%) were prescribed under their generic name. In total, 126 (42.9%) were not on the list of drugs that are standardized in the municipality. Only 26 (13%) patients did not know why the NSAI had been prescribed. The most common reasons for the prescription of NSAIs were: rheumatic problems (21%); throat pain (12%); odontological treatment (12%) and backache (7.5%). Only one prescription prescribed an injectable NSAI containing a combination of dipyrone, adiphenine hydrochloride and promethazine hydrochloride. Three NSAIs belonged to the list of controlled substances,[19] composed of the following associations: (1) paracetamol and codeine; (2) tramadol and paracetamol; and (3) celecoxib in isolation. Seven NSAIs were prescribed in the form of a drug combination (usually dipyrone and paracetamol), with other main active ingredients.

Of the NSAIs prescribed, 8.5% (n=25) were on the list of drugs that are inappropriate for the elderly, including ketoprofen (n=14; 56%), piroxicam (n=6; 24%), meloxicam (n=3; 12%) and naproxen (n=2; 8%).

Of the 200 prescriptions analyzed, 65 (32.5%) contained two drugs and 81 (40.5%) contained three drugs, while other quantities were less common. Potential drug interactions were identified in 89 (44.5%) prescriptions, giving a total of 104 potential drug interactions, which were most common on prescriptions containing either three (n=36) or two (n=22) drugs. This data is displayed in Table 3.

Table 3. Number of drugs per prescription and the frequency of potential drug interactions in the analysis of 200 prescriptions for elderly individuals. São José do Rio Preto-SP, 2014.

Number of drugs per prescription	Prescriptions with interactions	Prescriptions without interactions	*p*	n	%
2	22	43	0.1714*	65	32.5
3	36	45	0.0901*	81	40.5
4	18	17	0.5650*	35	17.5
5	4	4	0.9555**	8	4.0
6	4	1	0.2626**	5	2.5
7	3	1	0.4799**	4	2.0
8	2	0	0.3922**	2	1.0
Total	89	111		200	100.0

*Chi-squared test; ** Fisher's exact test.

Potential drug interactions were described in 28 (59.6%) of the 47 patients with hypertension (p=0.1169; chi-squared) and in 56 of the 153 patients without hypertension. Nine (47.4%) patients with type 2 diabetes *mellitus* exhibited potential drug interactions (p=0.7752; chi-squared), whereas 69 of the 181 participants without diabetes exhibited potential drug interactions. No significant associations were found between these two illnesses and drug interactions.

Concerning the intensity of the 104 potential drug interactions, 24% (n=25) were classified as high or severe, with 40.4% (n=42) classified as moderate and 22.1% (n=23) classified as low. A further 13.5% (n=14) were not classified by the databases used herein. The NSAIs with the greatest risk of drug interactions were ketoprofen (n=48; 46.2%), ketorolac (n=15; 14.4%), nimesulide (n=13; 12.5%) and diclofenac (n=10; 9.6%). Table 4 displays the potential drug interactions with the greatest intensity levels.

Table 4. Most common potential drug interactions in the therapeutic plans of patients, as well as their clinical implications and the databases used. São José do Rio Preto-SP, 2014.

Drug interactions		Clinical implications	Database**	Patients	
Drug 1 (NSAI)	Drug 2			n	%
Ketoprofen	Ketorolac*	Risk of adverse gastrointestinal affects	1,2,3	6	24.0
Ketoprofen	Enoxaparin	Risk of bleeding	1,2,3	4	16.0
Ketoprofen	AAS	Risk of adverse gastrointestinal affects	1,2,3	3	12.0
Piroxicam	Ciprofloxacin	Risk of convulsions	2,3	2	8.0
Ketoprofen	Citalopram	Risk of bleeding	1,2,3	1	4.0
Ketoprofen	Clopidogrel	Risk of bleeding	1,2,3	1	4.0
Ketoprofen	Escitalopram	Risk of bleeding	1,2,3	1	4.0
Ketoprofen	Rivaroxaban	Risk of bleeding	1,2,3	1	4.0
Ketorolac	Gabapentin	Reduction in the anticonvulsant affect	1	1	4.0
Ketorolac	Cilostazol	Risk of gastrointestinal bleeding	1,3	1	4.0
Ketorolac	Enoxaparin	Risk of bleeding	1,2,3	1	4.0
Ketorolac	Escitalopram	Risk of bleeding	1,2,3	1	4.0
Diclofenac	Duloxetine	Risk of bleeding	1,2,3	1	4.0
Ibuprofen	Escitalopram	Risk of bleeding	1,2,3	1	4.0
Total				25	100.0

*Interaction between NSAIs; **(1) *Micromedex*, (2) *Medscape*, (3) *Drugs*.

During post-sales drug monitoring, 61 (30.5%) of the patients reported undesirable symptoms. The most common problems were stomach discomfort, which was reported by 34 (17%) individuals, and nausea, which was mentioned by 11 (5.5%) patients. The drugs that were most often linked to adverse reactions were nimesulide (n=21) and ketoprofen (n=20). None of the undesirable reactions achieved the classification of a defined adverse reaction, despite the fact that several of them were described on the label of the drug containers (Table 5).

Table 5. Probability of adverse reactions according to the algorithm of Naranjo et al.,[13] reported for 61 patients, with a causal relationship for the use of non-steroidal anti-inflammatories, and the description (or lack of) on the labels of drugs. São José do Rio Preto-SP, 2014.

Adverse reaction	NSAI	Description on the label	Causal relationship	Number of patients
Stomach discomfort	Nimesulide	Yes	Probable	15
Stomach discomfort	Ketoprofen	Yes	Possible	10
Stomach discomfort	Ketorolac	Yes	Probable	5
Stomach discomfort	Dipyrone	No	Possible	4
Nausea	Nimesulide	Yes	Probable	3
Nausea	Ketorolac	Yes	Probable	2
Nausea	Ketoprofen	Yes	Possible	4
Nausea	Ibuprofen	Yes	Possible	1
Purple stains on the skin	Ketoprofen	No	Probable	2
Hypotension	Ketorolac	No	Probable	1
Hypotension	Dipyrone	Yes	Probable	1
Swelling	Diclofenac	No	Probable	1
Swelling	Nimesulide	No	Probable	1
Drowsiness	Meloxicam	Yes	Probable	1
Drowsiness	Ketoprofen	Yes	Probable	3
Drowsiness	Nimesulide	Yes	Probable	2
Heartburn	Ketorolac	No	Probable	1
Heartburn	Ketoprofen	No	Probable	1
Constipation	Dipyrone	No	Probable	1
Burning eyes	Ketorolac	Yes	Probable	2
Total				61

Of the 61 patients who reported undesirable symptoms, 29 (47.5%) exhibited potential drug interactions. Of the 139 who had no symptoms, 48 (34.5%) exhibited potential drug interactions. No significant differences were found between the presence of interactions and the occurrence of undesirable symptoms (p=0.1135; chi-squared test).

DISCUSSION

The significant increase in the elderly population is reflected in the health services through the prevalence of chronic and degenerative diseases such as hypertension, diabetes *mellitus*, coronary diseases, depression and Alzheimer´s disease, among others. The elderly are continuous drug users, and consequently, they are exposed to certain risks.[1,3,11,20]

Drug consumption by females represented 56.5% of the sample studied. Women tend to consume more drugs due to biological reasons, as well as the fact that they are more concerned with health issues and they tend to use health services more frequently.[1,3,4,10,11,21]

Education is a relevant factor when analyzing healthcare. A low level of education can lead to difficulties when reading and interpreting the labels on drugs, with the consequent risks of incorrect use and worsening health.[5] In the present study, 33.5% of the participants had completed high school. This finding differs from earlier studies, such as a survey in Novo Horizonte (São Paulo), in which 68.6% of the elderly participants had not completed primary school and 22.1% were illiterate.[4] Another study conducted in São Paulo reported that 16.6% of the participants were illiterate, while 64.1% had completed between one and seven years of study and 19.3% had studied for eight or more years.[10] The mean quantity of drugs per prescription in the present study (4) corroborates the results in literature (between two and five drugs per prescription). [1,10]

Concerning the clinical condition of the participants, 23.5% were being treated for SAH and 9.5% had type 2 diabetes *mellitus*. A study in São Paulo reported that 44.7% of the elderly participants had zero or one chronic diseases, while the remainder (55.3%) had two or more.[10] The prevalence of chronic diseases among the elderly leads to the greater consumption of drugs and the consequent increase in the risk of drug interactions and adverse reactions.[7,9,11]

Of the 294 NSAIs prescribed, 69 drugs (23.5%) were prescribed under their generic name and 126 (42.9%) were not on the list of standardized drugs. On the drug prescriptions, the use of the generic name varied between 43% and 98.7%, while the prescription of standardized drugs ranged between 68.6% and 99.4%.[1] The World Health Organization (WHO) recommends the adoption of generic names on all prescriptions and a minimum prescription of 70% standardized drugs, considering the individuality of the patient.[22] The fact that the present study was conducted in a private pharmacy does not rule out the impossibility of access to drugs due to cost. Therefore, it is essential to respect the standardization of drugs when making prescriptions. These results suggest that the list of standardized drugs is not being analyzed at the time of prescription. Thus, the patient may not be taking the drug that they need, which represents a medication-related issue.[23]

Twenty-five (8.5%) of the NSAIs prescribed were on the list of inappropriate drugs for the elderly, including ketoprofen, piroxicam, meloxicam and naproxen. This result is higher than a study in São Paulo, which reported that 1.5% of the NSAIs prescribed were inappropriate for elderly individuals, including piroxicam, naproxen and cetorolaco.[10] Conversely, other Brazilian studies have found no inappropriate NSAIs on prescriptions for elderly individuals.[3,11,24]

NSAIs are most commonly used to treat different inflammatory conditions, as well as to pain and fever without inflammation.[25] The frequency of use of NSAIs, including non-selective inhibitors (ketoprofen, diclofenac, ibuprofen, paracetamol, meloxicam, piroxicam, among others) and selective COX-2 inhibitors (celecoxib and etoricoxib) has increased in recent years.[26] The main causes for this increase include the ease of access to drugs, some of which are freely available, and a larger elderly population with concomitant inflammatory diseases.[27]

Among the range of NSAIs used, the present study confirmed 38.7% of them on the prescriptions, with a predominance of dipyrone (26.9%), followed by nimesulide (22.8%) and ketoprofen (16.3%). Another Brazilian study also reported that dipyrone was the most commonly prescribed drug of this class among the elderly.[1] Conversely, other national and international studies have cited the following NSAIs as the most common on prescriptions: ibuprofen (58.6% and 19.2%);[21,25] diclofenac (50%);[28] naproxen (78.3%);[29] and ibuprofen, naproxen, ketoprofen and flurbiprofen (29.7%).[30]

NSAIs are responsible for between 20 to 25% of all ARDs.[28] NSAIs that are non-selective for cyclooxygenase inhibit the production of prostaglandins in the gastrointestinal mucosa, which can cause abdominal pain and discomfort, gastric ulcers, or even digestive bleeding. COX-2 selective inhibitors are safer in terms of gastric

problems, although the cardiovascular risk is higher, which has led to several of these drugs being removed from the global drug market. This explains the low rate of prescription for these drugs in the present study, in which celecoxib was only found on two prescriptions.[26,28,31,32]

Stomach discomfort was the most common undesirable reaction encountered by the participants, with nimesulide and ketoprofen the most common cause. Nimesulide is derived from sulfonanilide and has an analgesic and anti-inflammatory affect. It is used to combat inflammation of the osteoarticular and upper respiratory systems, headaches, myalgia and post-surgical pain.[28] During its use, gastrointestinal disorders such as nausea and vomiting may occur, which seem to be correlated with the dose and the period of use. Traditional NSAIs exhibit lower rates of gastrointestinal injuries, and as such, they are considered a safe and effective therapeutic option, with satisfactory oral absorption, a fast action, a favorable risk-benefit profile and low renal toxicity.[33] Ketoprofen is a derivative of propionic acid, similar to ibuprofen and naproxen, which are non-selective cyclooxygenase inhibitors with similar therapeutic effects (and side-effects) to other NSAIs.[30,34] In the present study, no statistically significant differences were found between the occurrence of undesirable symptoms and the risk of potential drug interactions.

In general, NSAIs can worsen kidney problems, particularly in elderly individuals who suffer from hypertension and diabetes, while also increasing the risk of drug interactions.[26,28,31,32] In the present study, 23.5% of the patients using NSAIs suffered from SAH, while 9.5% had diabetes. However, no statistically significant differences were found between the occurrence of these illnesses and the risk of drug interactions.

In the present study, a total of 124 potential drug interactions were identified among the 204 NSAIs prescribed. Of these interactions, 24% were classified as high intensity, indicating a greater clinical significance. The use of two drugs involved in an interaction concomitantly is not recommended as the risks generally outweigh the benefits.[30] The following interactions were classified as high intensity in the present study: NSAI + anticoagulant; NSAI + antiplatelet; NSAI + antidepressant selective serotonin reuptake inhibitors (SSRIs), which were associated with a risk of bleeding. In addition, a significant interaction was recorded between NSAIs and antimicrobials, with a risk of convulsions, and between NSAIs and anticonvulsant drugs, leading to a reduction in the anticonvulsant effect. The most common moderate drug interaction was between NSAIs + anti-hypertensives and diuretics, with a risk of reducing the desired effects. No statistically significant associations were found between the number of drugs prescribed and the risk of drug interactions.

A Portuguese study confirmed the occurrence of 123 moderate drug interactions and two minor interactions, of which 12.8% involved an interaction between NSAIs and diuretics, angiotensin receptors, calcium channel blockers or angiotensin converting enzyme inhibitors.[30] A systematic review of hypertensive patients and the use of NSAIs identified 21 types of interactions between NSAIs, antihypertensives and diuretics.[35] However, a Colombian study reported a low proportion of chronic use of NSAIs among patients with a high cardiovascular risk.[29]

The drug interactions confirmed were related to NSAIs and continuous use drugs, such as hematological agents, antidepressants, anticonvulsants, antihypertensives and diuretics. The interactions between NSAIs occurred due to drug duplicity on prescriptions, since some drugs were prescribed in association and in isolation. Examples include: the prescription of ketoprofen in isolation and in association with paracetamol; the prescription of ketoprofen in isolation and diclofenac associated with carisoprodol, paracetamol and caffeine. Potential drug interactions should be assessed by the pharmacist at the time of dispensation. This would lead to the risks to patients being communicated to the doctor who provided the prescription, thereby optimizing pharmacotherapy and ensuring the safety of patients.

The present study contains a number of limitations, due to the fact that it is a descriptive transversal study. In other words, this investigation did not confirm the occurrence of possible problems related to the drugs prescribed, such as adverse reactions and drug interactions, through prolonged systematic monitoring. Future studies should involve continuous monitoring of the study group to assess the incidence of clinical occurrences related to pharmacotherapy using continuous pharmaceutical care projects.

CONCLUSION

The data obtained in the present study enabled us to identify the prescription profile of non-steroidal anti-inflammatories in a sample of elderly individuals who used a private drug distribution service. The importance of monitoring the use of these drugs was confirmed, given the high potential for drug interactions and adverse reactions among elderly individuals who take them. These patients usually have concomitant chronic diseases, such as systemic arterial hypertension and diabetes *mellitus*, and are polymedicated, which involves consultations with more than one specialist. These factors favor the occurrence of drug interactions and adverse reactions to drugs. It is the responsibility of the pharmacist to identify these problems, as they have contact with the patients during the final cycle of medication (dispensation). The occurrence of these problems could be reduced by identification and preventive measures, thereby ensuring the safer (and more rational) use of these drugs.

REFERENCES

1. Maschio-Lima TA, Nakazone MA, Furini AAC. Avaliação preliminar de prescrições para idosos em serviço de cardiologia de um hospital de ensino. Rev Bras Cardiol 2014;27(5):333-41.
2. Santos MB, Ribeiro SA. Dados sociodemográficos e condições de saúde de idosas inscritas no PSF de Maceió, AL. Rev Bras Geriatr Gerontol 2011;14(4):613-23.
3. Ribas C, Oliveira KR. Perfil dos medicamentos prescritos para idosos em uma Unidade Básica de Saúde do município de Ijuí-RS. Rev Bras Geriatr Gerontol 2014;17(1):99-114.
4. Furini AAC, Maschio-Lima TA, Faitarone NC, Verona JP, Silva LAM, Santos SS, et al. Atenção farmacêutica nas interações medicamentosas e indicadores de prescrição em unidade básica de saúde. Arq Ciênc Saúde 2014;21(2):99-106.
5. Barbosa MT. Os idosos e a complexidade dos regimes terapêuticos. Rev Assoc Med Bras 2009;55(4):364-65.
6. Bueno CS, Oliveira KR, Berlezi EM, Eickhoff HM, Dallepiane LB, Girardon-Perlini, et al. Utilização de medicamentos e risco de interações medicamentosas em idosos atendidos pelo Programa de Atenção ao Idoso da Unijuí. Rev Ciênc Farm Básica Apl 2009;30(3):331-8.
7. Secoli SR. Polifarmácia: interações e reações adversas no uso de medicamentos por idosos. Rev Bras Enferm 2010;63(1):136-40.
8. Varallo FR, Costa MA, Mastroianni PC. Potenciais interações medicamentosas responsáveis por internações hospitalares. Rev Ciênc Farm Básica Apl 2013;34(1):79-85.
9. Passos MMB, Santos RC, Bergamini VG, Souza DC. Interações medicamentosas em pacientes internados na clínica médica de um hospital de ensino e fatores associados. Rev Bras Farm 2012;93(4):450-6.
10. Cassoni TCJ, Corona LP, Romano-Lieber NS, Secoli SR, Duarte YAO, Lebrão ML. Uso de medicamentos potencialmente inapropriados por idosos do Município de São Paulo, Brasil: Estudo SABE. Cad Saúde Pública 2014;30(8):1708-20.
11. Cuentro VS, Andrade MA, Gerlack LF, Bós AJG, Silva MVS, Oliveira AF. Prescrições medicamentosas de pacientes atendidos no ambulatório de geriatria de um hospital universitário: estudo transversal descritivo. Ciênc Saúde Coletiva 2014;19(8):3355-64.
12. Brasil. Ministério da Saúde. Formulário Terapêutico Nacional [Internet]. 2. ed. Brasília, DF: Ministério da Saúde; 2010 [acesso em 15 abr. 2016]. Disponível em: http://bvsms.saude.gov.br/bvs/publicacoes/formulario_terapeutico_nacional_2010.pdf

13. Naranjo CA, Busto U, Sellers EM, Sandor P, Ruiz I, Roberts EA, et al. A method for estimating the probability of adverse drug reactions. Clin Pharmacol Ther 1981;30(2):239-45.

14. Visacri MB, Souza CM, Sato CMS, Granja S, Marialva M, Mazzola PG, et al. Adverse Drug Reactions and quality deviations monitored by spontaneous reports. Saudi Pharm J 2014;22(4)283-390.

15. Medscape [Internet]. New York: MD LLC; 1994- . Multi-drug Interaction Checker; 2014 [acesso em nov. 2014]. Disponível em: http://reference.medscape.com/drug-interactionchecker.

16. Micromedex. [place unknown]: Truven Health Analytics; 2014 [acesso em 23 nov. 2014]. Disponível em: http://aplicacao.periodicos.saude.gov.br.

17. Drugs.com. [Internet]. [place unknown]; 2000- . Drug Interactions Checker Drug Information Online; 2014 [acesso em 14 nov. 2014]. Disponível em: http://www.drugs.com/drug_interactions.php

18. P.R. Vade-Mécum [Internet]. Perdizes: GR Publicações; 2014- [acesso em 23 nov. 2014]. Disponível em: http://br.prvademecum.com/

19. Brasil. Portaria nº 344, de 12 de maio de 1998. Aprova o Regulamento Técnico sobre Substâncias e Medicamentos Sujeitos a Controle Especial. Diário Oficial da União, Brasília, 19 mai. 1998, Seção 1.

20. Menezes TN, Sousa NDS, Moreira AS, Pedraza DF. Diabetes mellitus referido e fatores associados em idosos residentes em Campina Grande, Paraíba. Rev Bras Geriatr Gerontol 2014;17(4):829-39.

21. Bandeira VAC, Pai CTD, Oliveira KR. Uso de anti-inflamatórios não esteroides por idosos atendidos em uma Unidade de Estratégia de Saúde da Família do município de Ijuí (RS). Rev Bras Ciênc Envelhec Hum 2013;10(2):181-92.

22. World Health Organization, Action Programme on Essential Drugs. How to investigate drug use in health: selected drug use indicators. Geneva: WHO; 1993. (EDM Research Series, nº 007. WHO/DAP/93.1).

23. Comité de Consenso. Segundo consenso de Granada sobre problemas relacionados con medicamentos. Ars Pharm 2002;43(3-4):179-87.

24. Stroher A, Zubioli A. Prevalência de medicamentos potencialmente inapropriados para idosos entre os padronizados no Hospital Universitário Regional de Maringá de acordo com os critérios de Beers-Fick. Infarma 2014;26(1):4-10.

25. Osorio A, Otero RW, Gómez ZM. Utilización de AINES y uso de IBP profilácticos en pacientes de medicina interna. Rev Col Gastroenterol 2014;29(2):125-30.

26. Batlouni M. Anti-inflamatórios não esteroides: efeitos cardiovasculares, cérebro-vasculares e renais. Arq Bras Cardiol 2010;94(4):556-63.

27. Melgaço SSC, Saraiva MIR, Lima TTC, Silva GB Júnior, Daher EF. Nefrotoxicidade dos anti-inflamatórios não esteroidais. Medicina (Ribeirão Preto) 2010;43(4):382-90.

28. Schallemberger JB, Pletsch MU. Riscos do uso indiscriminado de anti-inflamatórios não esteroidais [Internet]. In: Salão do Conhecimento. 23º Seminário de Iniciação Científica; 2014; Ijuí. Ijuí: UNIJUÍ; 2014 [citado em 23 nov. 2014]. Disponível em: https://www.revistas.unijui.edu.br/index.php/salaoconhecimento/article/view/3490/2890.

29. Machado-Alba JE, Alzate-Carvajal V, Echeverri-Cataño L. Estudio farmacoepidemiológico de uso de anti-inflamatorios no esteroideos en pacientes de alto riesgo cardiovascular. Rev Peru Med Exp Salud Publica 2013;30(4):626-9.

30. Castel-Branco MM, Santos AT, Carvalho RM, Caramona MM, Santiago LM, Fernandez-Llimos F, et al. As bases farmacológicas dos cuidados farmacêuticos: o caso dos AINEs. Acta Farm Port 2013;2(2):20-7.

31. Areia M, Pereira AD, Banhudoc A, Coutinho G. Non-steroidal anti-inflammatory drugs and gastroprotection gap among Family Physicians: results from a survey. GE J Port Gastrenterol 2013;20(6):243-9.

32. Couto G. Baixa taxa de gastroproteção em doentes de risco sob terapêutica com anti-inflamatórios não esteroides. GE J Port Gastrenterol 2013;20(6):237-9.

33. Oliveira KR, Pereira DC, Coleta CF. Dispensação de anti-inflamatórios, analgésicos e antipiréticos na farmácia-escola da Unijuí. Rev Contexto Saúde 2012;12(23):67-74.

34. Muri EMF, Spotito MMM, Metsavaht L. Nonsteroidal anti-inflammatory drugs and their local pharmacology. Acta Fisiátrica 2009;16(4):186-90.

35. Villa J, Cano A, Franco D, Monsalve M, Hincapié J, Amariles P. Relevancia clínica de las interacciones medicamentosas entre antiinflamatorios no esteroideos y antihipertensivos. Aten Prim 2014;46(9):464-74.

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Prevalence of functional incapacity by gender in elderly people in Brazil: a systematic review with meta-analysis

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Abstract

Considering that functional capacity is an important indicator of health in aging, the present study aimed to describe the prevalence of disability by gender among elderly people in Brazil through a systematic review and meta-analysis of articles about this subject. Articles published up to June 2013 were included, and a search was performed of the MEDLINE, SciELO, LILACS, Scopus, Web of Science and Science Direct electronic databases. The inclusion of articles in the systematic review was guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) and by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A descriptive analysis of the selected articles was performed and expressed in a forest-plot type graph. Of 3,656 articles initially identified in all the databases, 2,585 duplicates were excluded and 23 articles were deemed eligible for review. Prevalence rates ranged from 12.3% to 94.1% for men and from 14.9% to 84.6% for women. The methods used to assess functional capacity in elderly people in Brazil also differed between the articles. This variation complicates the comparison of results between the articles, demonstrating the need for standardized methods of measuring functional capacity.

Key words: Aging; Health of the Elderly; Gender; Functional Disability.

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INTRODUCTION

Maintaining functional capacity is considered to be the main parameter for the assessment of health and quality of life during the aging process.[1] From this perspective, the promotion of healthy aging can involve the adoption and consolidation of active lifestyles that include frequent physical activity, the diversification of one's daily routine, and active participation in groups as possible ways of exercising functional capacity.[2] As a result, measures to promote health and the prevention of disease, along with the appropriate management of existing comorbidities, are aimed at maintaining this capacity and preventing disabilities.

According to the World Health Organization (WHO),[3] functional incapacity can be understood as the process of losing the ability to perform the daily tasks necessary for an independent and autonomous life. From a practical standpoint, this ability can be measured by the performance of daily activities, which are didactically divided into *basic activities of daily living* (BADL) such as bathing, eating, using the toilet and walking through the rooms of the house, and instrumental activities of daily living (IADL), such as shopping, performing housework and preparing meals. It has been shown that there is a dose-response type association between age and the prevalence of functional incapacity, and that aging is different for men and women.[5,6] However, most such studies involve representative samples of municipal districts or states, and not nationwide research.

Considering the importance of functional capacity as a health indicator for the elderly and the scattered information on the topic in Brazilian research, the present study aimed to describe the prevalence of functional incapacity by gender among elderly Brazilian individuals through a systematic review and meta-analysis of articles on the topic.

METHOD

In this systematic review and meta-analysis, we sought to answer the following question: Are there differences by gender in the prevalence of functional incapacity among elderly Brazilians?

A search for articles published up to June 2013 was performed in the MEDLINE, SciELO, LILACS, Scopus, Web of Science and Science Direct electronic databases.

The descriptors used in the review process were selected after consulting the Bireme DeCS Health Sciences Descriptors. The search was conducted in English using concepts grouped into three blocks. The first included terms related to functional capacity ("functional assessment", "functionality", "daily activities") the second with terms related to aging ("old" and "old age") and the third with terms related to Brazil ("Brazil"). To combine these descriptors, we used the logical operator "OR" within each block and the logical operator "AND" to combine the blocks. The same search strategy was used in all the databases surveyed.

We chose not to employ any restrictions related to the size of the data, language, type of study or sample or publication period. Although the studies did not cover the same time periods, we did not exclude articles based on publication period to ensure that all the studies of potential relevance to the review were included.

The inclusion criteria were: a population sample consisting only of elderly persons (aged 60 years or over); assessment of functional capacity to calculate the prevalence of incapacity by gender, and data collection carried out in Brazil. Articles were excluded if they were limited to specific health conditions among the elderly (obesity, hypertension, diabetes, dementia and other diseases). In addition, the authors chose to exclude theses, dissertations

and monographs, as systematic research on this topic for these works would not be viable.

Articles were firstly selected by title and abstract and then through a full reading. Each article was reviewed and selected by two reviewers. Where there was disagreement, a third person was consulted. Duplicate articles, with identical results published in different magazines, were checked to allow the exclusion of one of the studies. In the case of the duplication of articles from more than one database, the version with the widest scope was maintained.

In addition to prevalence of functional incapacity, the articles selected were mapped in relation to type of study, location, sample size, age of participants, type of statistical analysis and the method of evaluation and classification of functional capacity.

In the case of items with incomplete information, three attempts were made to contact the corresponding author via e-mail, between the months of August and September 2013, in order to seek additional information. A standard e-mail was sent to the authors, requesting the following information: *n* total of statistical analysis, percentage of men in the sample and prevalence of functional incapacity by gender.

The instruments used to assess the methodological quality of the observational articles to be included in the systematic review were Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). STROBE contains 22 items that deal with recommendations on what should be contained in a precise and complete description in an observational study.[7] PRISMA is a list of specific checks for systematic review studies. It contains 27 topics and is designed to increase the quality of systematic reviews and meta-analyzes of randomized controlled trials and nonrandomized studies.[8]

Analysis of the selected articles was carried out descriptively and in two stages. The first included: year; authorship; location; type of study; target population; study design and statistical analysis of data. The second stage comprised an analysis of the prevalence of functional incapacity by gender data with the Mantel-Haenszel test and presentation via a forest-plot graph using the *BioEstat* 3.0 program.

RESULTS

Figure 1 shows the flowchart of the article selection process. Of the 3,656 articles initially identified from all the databases, 2,585 duplicates were excluded and 114 articles were eligible for a full reading. It was not possible to identify the prevalence of functional incapacity in percentage form in 42 of the articles, and 28 articles did not separately assess functionality by gender. Although 44 articles were reviewed and approved according to the PRISMA and STROBE criteria, 21 articles were excluded due to a lack of response from the authors for complementary information. After this stage, 23 items were considered eligible for the systematic review.

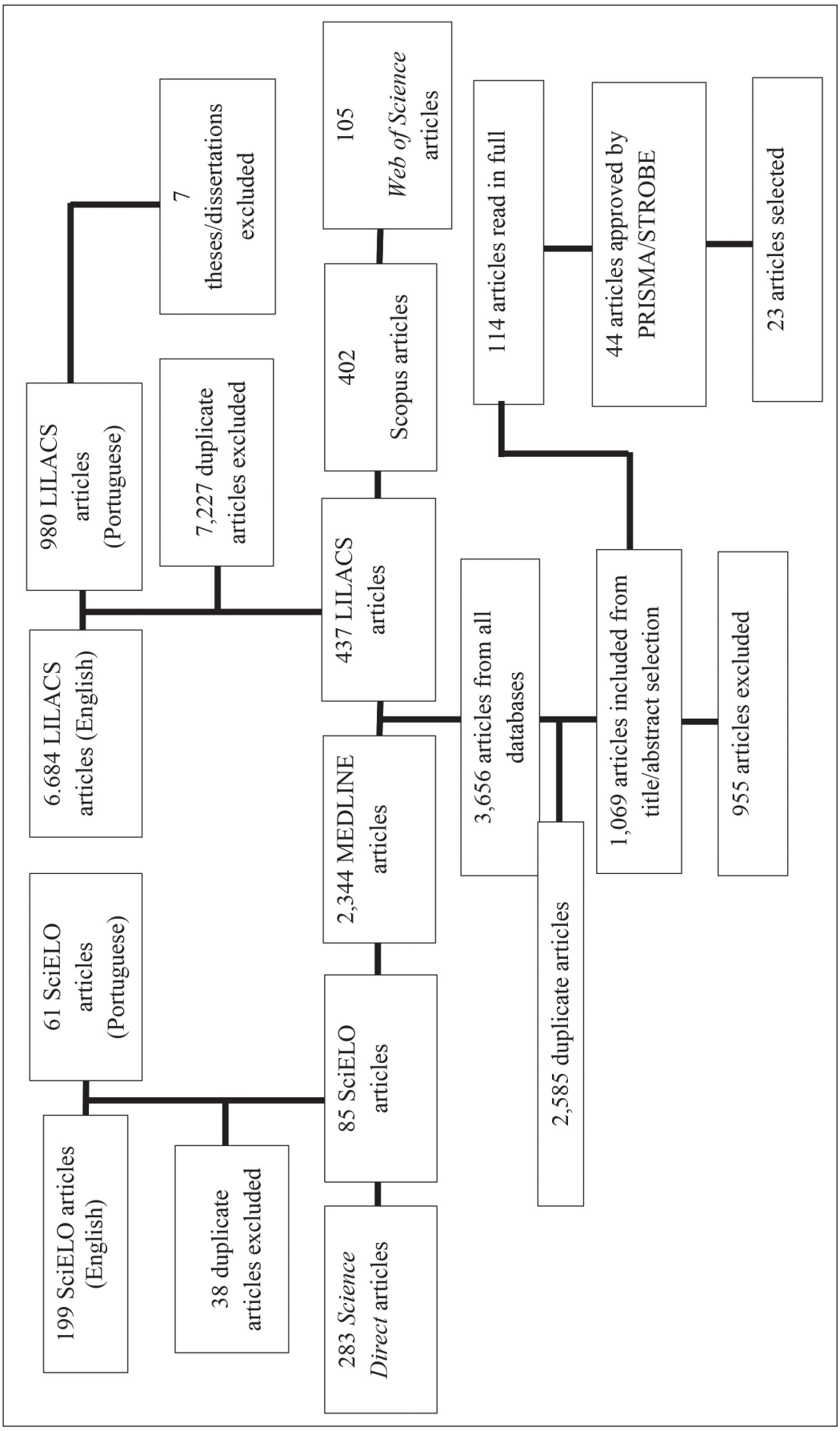

Figure 1. Flowchart of selection of scientific articles from databases. Belo Horizonte, Minas Gerais, 2014.

All articles present in the review defined a minimum age for inclusion in the study. A total of 19 (82.0%) studies included individuals aged 60 years of age or older; two (8.7%) included persons aged 65 or more, and the same number included individuals aged 80 or older.

In terms of study location, nine[9-17] (39.0%) studies were exclusively conducted in urban areas, one[18] (4.3%) was carried out in a rural region, two[19,20] (8.7%) were performed in both and seven[21-27] (30.0%) did not specify whether the study was conducted in an urban or rural area. The four (17.4%)[28-31] remaining studies involved elderly persons in long term care facilities (LTCFs), users of health plans, those admitted to gerontology-geriatric nursing care and elderly persons treated in public rehabilitation services, respectively.

Only eight (35.0%) studies[12,15,18,19,21,27-29] explicitly described one or more exclusion criteria for participation in the studies. These included: be aged under 60 or not registered in the LTCFs studied (4.3%); be a private health care plan user or reside outside the coverage area (4.3%); could not respond to the questionnaire (13.0%); was not found at home for data collection (8.7%); was bedridden (4.3%); presented cognitive and/or mobility impairment (4.3%).

The characteristics of the articles are shown in Table 1. In relation to the databases, 13 (56.5%) articles[9,10,13,17-21,23,24,28-30] were published in LILACS, eight (34.7%) in PUBMED[11,12,14,16,25-27,30] and only two (8.7%) articles[15,22] were selected from the SciELO base. No articles were selected from the Scopus, *Web of Science* and *Science Direct* databases.

Table 1. Characteristics of articles included in the review. Belo Horizonte, Minas Gerais, 2014.

Authors	Location	Database	Type of study	Data collection	Measure of functional incapacity	Age range	Sample	Men (%)	Losses (%)	Type of statistical analysis
Aires et al. 2010[19]	Three regions (RS)	LILACS	Cross-sectional	Secondary data	BOMFAQ	≥80 years	Probabilistic	36.1	27.5	Multiple logistic regression
Araújo et al. 2007[28]	Taubaté (SP)	LILACS	Cross-sectional	LTCF	Katz Scale	≥60 years	Census	25.6	Not described	Descriptive analysis
Cardoso & Costa, 2010[29]	Porto Alegre (RS)	LILACS	Cross-sectional	Domiciliary	Need for assistance with activities of daily living	≥60 years	Probabilistic	44.5	Not described	Chi-squared test
Cardoso et al. 2012[21]	São Leopoldo (RS)	LILACS	Cross-sectional	Domiciliary	Barthel Index	≥60 years	Census	28.2	3.7	Poisson Regression
d'Orsi et al. 2011[22]	São Paulo (SP)	SciELO	Longitudinal	Domiciliary	BOMFAQ	≥60 years	Probabilistic	38.0	38.7	Poisson Regression
Fiedler & Peres, 2008[9]	Joaçaba (SC)	LILACS	Cross-sectional	Domiciliary	*Functional fitness test*	≥60 years	Probabilistic	34.8	7.3	Multiple logistic regression
Freitas et al. 2012[10]	Lafaiete Coutinho (BA)	LILACS	Cross-sectional	Domiciliary	Katz Scale and LBI	≥60 years	Census	45.3	Not described	Multiple logistic regression
Giacomin et al. 2008[11]	RMBH (MG)	PUBMED	Cross-sectional	Domiciliary	Difficulty in performing at least one IADL	≥60 years	Probabilistic	41.1	3.1	Multiple logistic regression
Lebrão & Laurenti 2005[12]	São Paulo (SP)	PUBMED	Longitudinal	Domiciliary	*Pfeffer functional activities questionnaire*	≥60 years	Probabilistic	41.4	Not described	Descriptive analysis
Lima-Costa et al. 2003[23]	PNAD 1998	LILACS	Cross-sectional	Domiciliary	Difficulty in feeding oneself, bathing or going to the bathroom	≥60 years	Probabilistic	44.47	1.1	Descriptive analysis
Maciel & Guerra 2007[13]	Santa Cruz (RN)	LILACS	Cross-sectional	Domiciliary	Katz Scale and LBI	≥60 years	Probabilistic	36.5	11.0	Logistic Regression

Continues on next page

Continuation of Table 1

Medeiros et al. 2012[14]	Florianópolis (SC)	PUBMED	Cross-sectional	Domiciliary	Katz Scale and LBI	≥60 years	Probabilistic	36.1	10.8	Poisson Regression
Nogueira et al. 2010[24]	São Geraldo (MG)	LILACS	Cross-sectional	Domiciliary	Andreotti and Okuma scale of self-assessed performance of IADL	≥80 years	Non-Probabilistic	47.0	Not described	Multiple logistic regression
Nunes et al. 2009[25]	Ubá (MG)	SciELO	Cross-sectional	Domiciliary	Andreotti and Okuma scale of self-assessed performance of IADL	≥60 years	Probabilistic	41.5	0	Multiple logistic regression
Nunes et al. 2010[15]	Goiânia (GO)	PUBMED	Cross-sectional	Domiciliary	BADL and IADL	≥60 years	Probabilistic	40.3	4.6	Chi-squared test and Fisher`s Exact Test
Ramos et al. 1998[16]	São Paulo (SP)	PUBMED	Longitudinal	Domiciliary	BOMFAQ	≥60 years	Probabilistic	35.0	Not described	Chi-squared test
Rigo et al. 2010[18]	Nova Roma do Sul (RS)	LILACS	Cross-sectional	Domiciliary	OARS IADL Scale	≥60 years	Census	44.1	12.8	Descriptive analysis
Rosa et al. 2003[17]	São Paulo (SP)	LILACS	Cross-sectional	Domiciliary	OARS IADL Scale	≥60 years	Probabilistic	35.5	29.2	Multiple logistic regression
Rossi et al. 2013[30]	São Paulo (SP)	PUBMED	Cross-sectional	Rehabilitation Center	BOMFAQ	≥60 years	Non-Probabilistic	36.1	7.1	Chi-squared test
Santos et al. 2007[26]	GUATAMBU (SC)	LILACS	Cross-sectional	Domiciliary	Barthel Index	≥60 years	Census	29.0	5.1	Poisson Regression
Santos et al. 2008[20]	São Paulo (SP)	PUBMED	Longitudinal	Domiciliary	Difficulty in performing IADLs	≥60 years	Probabilistic	47.5	30.9	Logistic Regression
Santos & Griep, 2013[27]	Belém (PA)	PUBMED	Cross-sectional	Laboratory	MPPT	≥60 years	Non-Probabilistic	52.6	1.5	Logistic Regression
Siqueira et al. 2004[31]	São Paulo (SP)	LILACS	Clinical	Hospital	BOMFAQ and OARS IADL Scale	≥60 years	Non-Probabilistic	43.8	Not described	Chi-squared test

BADL= basic activities of daily living; IADL= instrumental activities of daily living; BOMFAQ= Brazilian OARS Multidimensional Function Assessment Questionnaire; LTCF= Long-term Care Facility for the Elderly; MPPT= Modified Physical Performance Test; OARS= Older American Resources and Services; LBI= Lawton–Brody Index.

Most of the research was carried out between the years 2009 and 2013, and 11 (47.8%)[11,12,16,17,20,22,24,25,28,30,31] studies were conducted in the southeast of Brazil. Of the total of 23 studies, only four (17.3%)[12,16,22,26] were of the longitudinal type carried out in the homes of elderly people and provided prevalence data for a given year (table 1).

Functional incapacity was measured indirectly, or in other words, based on information provided by individuals. In all the studies included in this review the BADL and IADL measurement scales were the most commonly used instruments. Five (21.7%) studies[16,19,22,30,31] used the Brazilian Multidimensional Function Assessment Questionnaire (BOMFAQ), three (13.0%) studies[10,13,14] used the Katz scale combined with the Lawton-Brody Index (LBI) and three (13.0%) studies[17,18,31] used the ABVD scale from Older American Resources and Services (OARS). Although most studies used previously validated questionnaires that provided scores, four (17.3%)[11,21,23,26] inquired about the functional capacity of older people through open questions regarding the presence of difficulty in performing one or more BADL or IADL (table 1).

With respect to the sampling process, there was significant gender variation in the composition of the samples, with only one study[27] mainly comprising men. Five studies (21.7%) used census data[10,18,20,28,29] and 14 (60.8%)[9,11-17,19,20-23,25] used a probabilistic sampling process based on selecting the number of participants through a draw and/or the number of households sampled. Seven (30.4%) studies[10,12,16,21,24,28,31] did not describe the loss percentage of the sample (Table 1).

In terms of data analysis, comparisons between prevalence and frequency data were mixed, with logistic regression the most used statistical test (ten studies).[9-11,13,15,17,19,24,26,27] Only four (17.3%) studies[14,20,22,29] used Poisson Regression for the analysis of prevalence data (table 1).

Data relating to the prevalence of functional incapacity in each study and prevalence stratified by gender is shown in Table 2. There was considerable variability in the overall prevalence results, which ranged from 13.2% to 85.0%. Prevalence rates by gender ranged from 12.3% to 94.1% for men and from 14.9% to 84.6% for women.

The sample sizes of the studies also varied, with the smallest consisting of 39 elderly persons and the largest of 28,943 elderly individuals (Table 2).

Table 2. Prevalence of functional incapacity among elderly Brazilians (total and by gender). Belo Horizonte, Minas Gerais, 2014.

Authors	Total (N)	Prevalence of functional incapacity		
		Total (%)	Men (%)	Women (%)
Aires et al. 2010[19]	214	45.8	54.1	45.9
Araújo et al. 2007[28]	187	62.6	94.1	68.5
Cardoso et al. 2010[29]	254	13.8	12.4	14.9
Cardoso et al. 2012[21]	1,078	26.1	19.3	28.7
d'Orsi et al. 2011[22]	1,667	41.7	17.2	17.8
Fiedler & Peres, 2008[9]	345	37.1	25.8	43.1
Freitas et al. 2012[10]	316	57.7	63.7	50.4
Giacomin et al. 2008[11]	1,786	16.0	12.3	18.6
Lebrão & Laurenti, 2005[12]	2,143	19.3	14.8	22.5
Lima-Costa et al. 2003[23]	28,943	15.4	13.3	17.1
Maciel & Guerra, 2007[13]	310	13.2	68.4	44.8
Medeiros et al. 2012[14]	1,656	30.0	23.1	33.4
Nogueira et al. 2010[24]	129	28.7	57.4	71.3
Nunes et al. 2009[25]	397	20.2	16.2	30.0
Nunes et al. 2010[15]	388	34.8	27.0	40.5
Ramos et al. 1998[16]	1,167	66.4	54.8	72.6
Rigo et al. 2010[18]	39	64.7	46.5	78.9
Rosa et al. 2003[17]	1,362	24.4	70.3	54.2
Rossi et al. 2013[30]	130	26.9	69.5	30.5
Santos et al. 2007[26]	371	30.5	24.3	37.1
Santos et al. 2008[20]	1,479	30.1	13.4	27.1
Santos & Griep, 2013[27]	259	45.6	28.0	52.7
Siqueira et al. 2004[31]	94	85.0	85.7	84.6

Taking into account the samples of all the studies, 44,714 elderly persons were interviewed. The result of the Chi-squared and Mantel-Haenszel tests are shown in Figure 2. There was a significant statistical difference between men and women in relation to the prevalence of functional incapacity. The proportion of functional incapacity among women was 1.51 times greater than among men (p<0.001), with a confidence interval of between 1.43 and 1.59. This effect was not significant in only five studies (21.7%)[16,24,26-28], where the horizontal line of the Forest-plot graph crossed the vertical line.

Authors	OR	CI 95% OR	
Aires et al. 2010	2.54	1.27	5.10
Araújo et al. 2007	0.40	0.19	0.85
Cardoso et al. 2012	1.64	1.18	2.27
Cardoso et al. 2010	1.24	0.60	2.56
d'Orsi et al. 2011	0.94	0.52	1.70
Fiedler et al. 2008	2.17	1.34	3.54
Freitas et al. 2012	1.74	1.10	2.76
Giacomin et al. 2008	1.64	1.25	2.15
Lebrão et al. 2005	1.67	1.33	2.10
Lima-Costa et al. 2003	1.34	1.26	1.44
Maciel et al. 2007	1.43	0.90	2.28
Medeiros et al. 2012	1.67	1.33	2.10
Nogueira et al. 2010	6.44	1.78	23.27
Nunes et al. 2010	1.59	1.05	2.41
Nunes et al. 2009	2.20	1.33	3.65
Ramos et al. 1998	2.19	1.70	2.81
Rigo et al. 2010	4.29	0.96	19.18
Rosa et al. 2003	2.08	1.48	2.90
Rossi et al. 2013	2.41	1.09	5.33
Santos et al. 2013	2.87	1.60	5.13
Santos et al. 2008	2.40	1.83	3.14
Santos et al. 2007	1.84	1.16	2.10
Aires et al. 2010	0.96	0.31	3.04
Overall	**1.51**	**1.43**	**1.60**

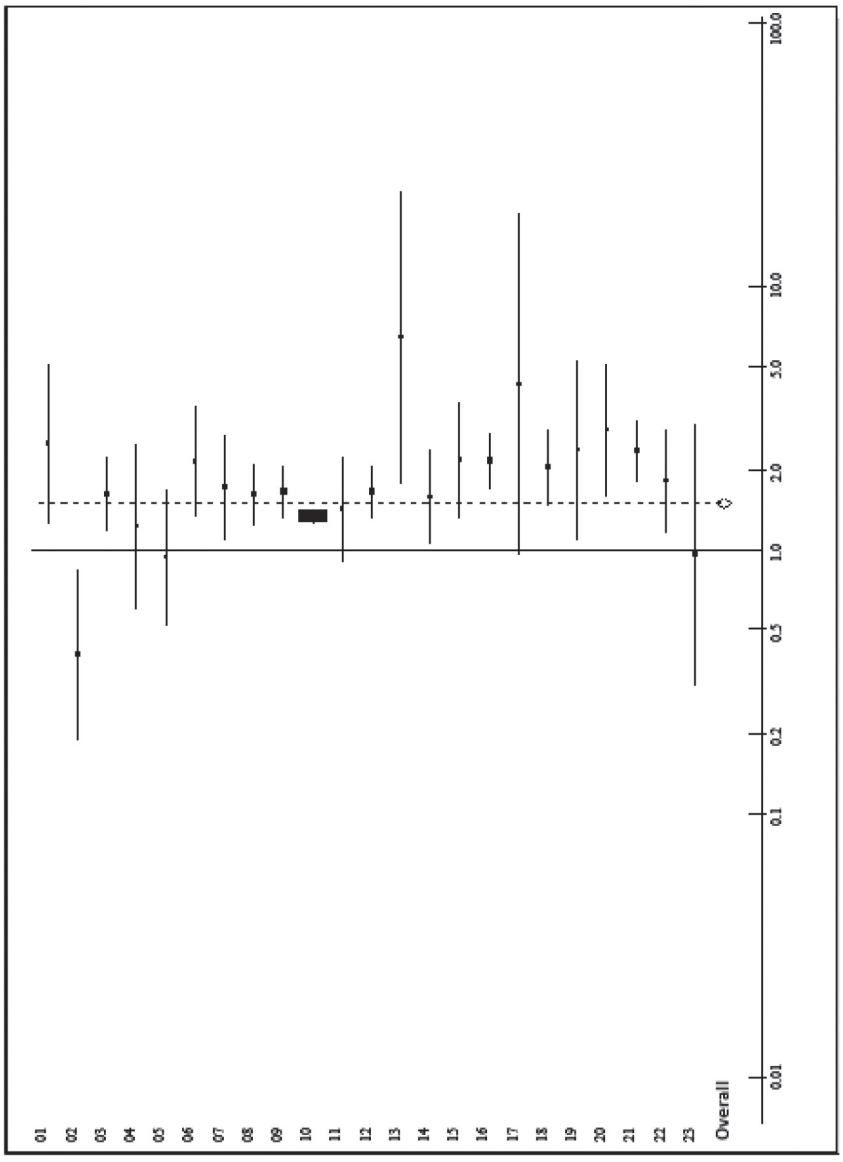

Figure 2. *Forest-plot* of prevalence of functional incapacity of elderly Brazilian individuals by gender. Belo Horizonte, Minas Gerais, 2014.

DISCUSSION

The vast majority of studies included in this systematic review were conducted in the south and southeast of Brazil. A possible explanation for this finding would be the significant regional differences in the rate of aging, which has an effect on the scientific production of each area. A study based on 2010 census data found that population aging in Brazil is increasing rapidly, with an increase of 268.0% in the aging rate between 1970 and 2010. In terms of regional variation, in 2010 the highest rates were found in the south (54.9%) and southeast (54.5%) and the lowest rate was found in the north (21.8%).[32]

The samples of the selected studies were mainly composed of women, corroborating official Brazilian data. The aforementioned census results found that the gender ratio, which had been 99.8 men for every 100 women in 1960, was 96 men for every 100 women in 2010.[33]

This study confirmed the high prevalence of functional incapacity among elderly Brazilians and the wide variability between genders. The average prevalence was 42.8% (±21.0) among women and 39.6% (±26.2) among men. These results are similar to other Brazilian studies.[34,35]

In eight of the studies selected for review,[11,12,15,19,21,22,24,31] the prevalence of functional incapacity among women was higher than 50.0%. Differences in the prevalence of functional incapacity between genders were also identified in other articles.[23,36]

Few studies have been published in Brazil that attempt to assess possible explanations for gender differences in functional incapacity, or the more accentuated loss of functional capacity among women.[14]

Some hypotheses to explain this gender difference include the fact that women tend to report greater functional difficulties than men;[2] there are higher initial levels of incapacity among older women;[36] and greater longevity among women, which combined with limitations, may lead to dependency on care.[2] An additional hypothesis for explaining these differences is based on higher levels of widowhood among women in comparison to men.[34,35] The resulting weakening of an individual's support network associated with greater life expectancy and a higher prevalence of chronic diseases increase the vulnerability of women to incapacitating conditions.

In the case of the present study, variations in prevalence can also be explained by the lack of standardization in the measures of functional capacity used and the differences in sample size between the studies.

Two of the selected studies[19,24] involved octogenarians. The variability of the cutoff points used to analyze the data made it impossible to establish a relationship between age and functional capacity by gender during meta-analysis. However, age has been considered an important risk factor for functional incapacity, and elderly persons aged over 75 years of age are less likely to recover.[36-38] The initial results of the Rede de Estudos sobre a Fragilidade em Idosos Brasileiros (Frailty among Elderly Brazilians Study Network) (FIBRA) found a statistically significant reduction in the performance of BADL and IADL over a six-month period in a sample of 167 elderly persons in Belo Horizonte in the state of Minas Gerais.[39]

Although important indicators have been established to define the functional incapacity of older elderly persons that hinders the performance of daily activities, Brazilian scientific production related to the functionality of this population is recent.[40]

The instruments used to assess functional incapacity among elderly Brazilians in literature and in this systematic review are mostly indirect and self-reported methods of evaluation, and refer to how the elderly individuals perform their daily activities, most specifically ADLs and IADLs. The advantage of using self-reported or subjective measures is that it provides information on the severity and type of limitations experienced in different situations and contexts.[41] Furthermore, these questionnaires are easy to access and apply and can be good indicators for assessing incapacity

and/or limitations in the physical functioning and mental health of the elderly caused by disease and other conditions associated with aging.[42] The disadvantages of using these instruments include the fact that information collected through self-reporting may be influenced by the physiological, cognitive and emotional changes that occur during aging. Furthermore, for elderly individuals living in the community, some of these instruments do not have the necessary discriminatory power for all ADLs and IADLs, as the majority of such individuals are considered functionally independent.

The scales adopted in the selected studies include the BOMFAQ,[43] the Katz scale[44] and the Lawton-Brody index.[45]

The BOMFAQ is used to evaluate the difficulty involved in performing 15 daily activities, of which eight are classified as BADLs and seven are considered IADLs. The reported presence of difficulty or dependence involved in each of these activities is recorded, regardless of the degree of such difficulty or dependence.[43]

The Katz scale evaluates independence in six ADLs on three levels, through which the elderly person is classified into one of eight possible categories.[44] In Brazil, the cross-cultural adaptation and validation of the Katz scale into Portuguese was performed by Lino et al.[46]

The Lawton-Brody scale, assessed for reliability by Santos & Virtuoso[47] and validated by Araújo et al.,[48] was also adopted in some of the studies, and evaluates independence in six BADLs, described by the authors as the physical activities of daily living, eight IADL for women and five for men, in three to five levels. There are two score possibilities, one of which considers the score for each activity and one that considers the total score.

The limitations of this systematic review are related to the variability in the research types and the contexts in which data collection was performed, as well as the small number of characteristics analyzed. This may explain, at least in part, the heterogeneity of the prevalence of functional incapacity observed in the articles selected.

Considering that Brazilian scientific literature is relatively recent in relation to the calculation of prevalence of incapacity among the elderly, it was decided not to adopt a strict delimitation in the search strategy. The main selection criteria for this review were age and the absence of specific health conditions among the elderly individuals, which did not allow a full comparison between the populations.

Moreover, although all the selected studies used questionnaires and scales to measure functional capacity, the cutoff point for failure differed among the studies. These variations demonstrate the need to use standardized methods in the cross-cultural adaptation process to objectively calculate the functionality of the elderly, and investigate risk and protective factors between the genders.

Despite its limitations, this review can serve as a basis for studying the influence of the clinical situation of elderly persons, and of possible associations between diseases and morbidities that can compromise the functional capacity of the elderly and therefore directly influence the prevalence of functional incapacity.

CONCLUSION

The main contribution of the present study lies in the fact that it is the first to use a systematic review and meta-analysis to investigate the prevalence of functional incapacity among the elderly by gender. It can be concluded that the prevalence of functional incapacity in elderly Brazilians is high, especially among women. The results of this systematic review also suggest that the differences between the genders need to be better investigated. The conditions necessary to enable the results of studies to be compared include the standardization of the instruments used for measuring functional disabilities, and the definition of variables and other comparable

measures for the realization of meta-regression and the testing of associations between disability and possible risk factors.

It is suggested that further studies should include, as well as a rigorous design, a sample of sufficient size to allow statistical comparison between men and women, and the application of standardized instruments for monitoring long-term results.

Despite the challenges observed, it is believed that the present study represents an initial effort to systematize information about functional capacity, a major health indicator for elderly persons. Further studies of this nature will allow the identification of specific groups for intervention and health promotion strategies, aimed primarily at maintaining and improving the functional capacity and autonomy of the elderly as long as possible.

REFERENCES

1. Ramos LR. Fatores determinantes do envelhecimento saudável em idosos residentes em centro urbano: Projeto Epidoso, São Paulo. Cad Saúde Pública 2003;19(3):793-8.
2. Barros APM, Machado VB. Revisão sistemática da produção científica sobre os benefícios adquiridos na promoção do envelhecimento saudável. Rev Eletr Gest Saúde [Internet] 2012 [acesso em 10 Nov 2014];3(2):692-703. Disponível em: http://gestaoesaude.unb.br/index.php/gestaoesaude/article/view/181/pdf.
3. World Health Organization. Disability prevention and rehabilitation [Internet]. Geneva: WHO; 1981 [acesso em 10 nov. 2014]. Disponível em: http://whqlibdoc.who.int/trs/WHO_TRS_668.pdf
4. Ribeiro PCC, Neri AL, Cupertino APFB, Yassuda MS. Variabilidade no envelhecimento ativo segundo gênero, idade e saúde. Psicol Estud 2009;14(3):501-9.
5. Paskulin LMG, Aires M, Goncalves AV, Kottwitz CCB, Morais EP, Brondani MA. Aging, diversity, and health: the brazilian and the canadian context. Acta Paul Enferm 2011;24(6):851-6.
6. Flores VB, Benvegnú LA. Perfil de utilização de medicamentos em idosos da zona urbana de Santa Rosa, Rio Grande do Sul, Brasil. Cad Saúde Pública 2008;24(6):1439-46.
7. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA Statement. PLoS Med [Internet] 2009 [acesso em 10 nov. 2014];6(7):1-7. Disponível em: http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1000097
8. Malta M, Cardoso LO, Bastos FI, Magnanini MMF, Silva CMFP. Iniciativa STROBE: subsídios para a comunicação de estudos observacionais. Rev Saúde Pública 2010;44(3):559-65.
9. Fiedler MM, Peres KG. Capacidade funcional e fatores associados em idosos do Sul do Brasil: um estudo de base populacional. Cad Saúde Pública 2008;24(2):409-15.
10. Freitas RS, Fernandes MH, Coqueiro RS, Reis WM Júnior, Rocha SV, Brito TA. Capacidade funcional e fatores associados em idosos: estudo populacional. Acta Paul Enferm 2012;25(6):933-9.
11. Giacomin KC, Peixoto SV, Uchoa E, Lima-Costa MF. Estudo de base populacional dos fatores associados à incapacidade funcional entre idosos na Região Metropolitana de Belo Horizonte, Minas Gerais, Brasil. Cad Saúde Pública 2008;24(6):1260-70.
12. Lebrão ML, Laurenti R. Saúde, bem-estar e envelhecimento: o estudo SABE no Município de São Paulo. Rev Bras Epidemiol 2005;8(2):127-41.
13. Maciel ACC, Guerra RO. Influência dos fatores biopsicossociais sobre a capacidade funcional de idosos residentes no nordeste do Brasil. Rev Bras Epidemiol 2007;10(2):178-89.
14. Medeiros FL, Xavier AJ, Schneider IJC, Ramos LR, Sigulem D, D'Orsi E. Inclusão digital e capacidade funcional de idosos residentes em Florianópolis, Santa Catarina, Brasil, (EpiFloripa 2009-2010). Rev Bras Epidemiol 2012;15(1):106-22.
15. Nunes MCR, Ribeiro RC L, Rosado LEFPL, Franceschini SC. Influência das características sociodemográficas e epidemiológicas na capacidade funcional de idosos residentes em Ubá, Minas Gerais. Braz J Phys Ther 2009;13(5):376-82.

16. Ramos LR, Toniolo JN, Cendoroglo MS, Garcia JT, Najas MS, Perracini M, et al. Two-year follow-up study of elderly: methodology and preliminary results. Rev Saúde Pública 1998;32(5):397-407.

17. Rosa TEC, Benício MHA, Latorre MRDO, Ramos LR. Fatores determinantes da capacidade funcional entre idosos. Rev Saúde Pública 2003;37(1):40-8.

18. Rigo II, Paskulin LMG, Morais EP. Capacidade funcional de idosos de uma comunidade rural do Rio Grande do Sul. Rev Gaúcha Enferm 2010;31(2):254-61.

19. Aires M, Paskulin LMG, Morais EP. Functional capacity of elder elderly: comparative study in three regions of Rio Grande do Sul. Rev Latinoam Enferm 2010;18(1):11-7.

20. Santos KA, Koszuoski R, Dias-da-Costa JS, Pattussi MP. Fatores associados com a incapacidade funcional em idosos do Município de Guatambu, Santa Catarina, Brasil. Cad Saúde Pública 2007;23(11):2781-8.

21. Cardoso MC, Marquesan FM, Lindôso ZCL, Schneider R, Gomes I, De Carli GA. Análise da capacidade funcional dos idosos de Porto Alegre e sua associação com autopercepção de saúde. Estud Interdiscip Envelhec 2012;17(1):111-24.

22. D' Orsi E, Xavier AJ, Ramos LR. Work, social support and leisure protect the elderly from functional loss: epidoso study. Rev Saúde Pública 2011;45(4):685-92.

23. Lima-Costa MF, Barreto SM, Giatti L. Condições de saúde, capacidade funcional, uso de serviços de saúde e gastos com medicamentos da população idosa brasileira: um estudo descritivo baseado na Pesquisa Nacional por Amostra de Domicílios. Cad Saúde Pública 2003;19(3):735-43.

24. Nogueira SL, Ribeiro RCL, Rosado LEFPL, Franceschini SCC, Ribeiro AQ, Pereira ET. Fatores determinantes da capacidade funcional em idosos longevos. Braz J Phys Ther 2010;14(4):322-9.

25. Nunes DP, Nakatani AYK, Silveira EA, Bachion MM, Souza MR. Capacidade funcional, condições socioeconômicas e de saúde de idosos atendidos por equipes de Saúde da Família de Goiânia, GO, Brasil. Ciênc Saúde Coletiva 2010;5(6):2887-98.

26. Santos JLF, Lebrão ML, Duarte YAO, Lima FD. Functional performance of the elderly in instrumental activities of daily living: an analysis in the municipality of São Paulo, Brazil. Cad Saúde Pública 2008;24(4):879-86.

27. Santos MIPO, Griep RH. Capacidade funcional de idosos atendidos em um programa do SUS em Belém (PA). Ciênc Saúde Coletiva 2013;18(3):753-61.

28. Araújo MLM, Fló CM, Muchale SM. Efeitos dos exercícios resistidos sobre o equilíbrio e a funcionalidade de idosos saudáveis: artigo de atualização. Fisioter Pesqui 2010;17(3):277-83.

29. Cardoso JH, Costa JSD. Características epidemiológicas, capacidade funcional e fatores associados em idosos de um plano de saúde. Ciênc Saúde Coletiva 2010;15(6):2871-8.

30. Rossi AL, Pereira VS, Driusso P, Rebelatto JR, Ricci NA. Profile of the elderly in physical therapy and its relation to functional disability. Braz J Phys Ther 2013;17(1):77-85.

31. Siqueira AB, Cordeiro RC, Perracini MR, Ramos LR. Impacto funcional da internação hospitalar de pacientes idosos. Rev Saúde Pública 2004;38(5):687-94.

32. Closs VE, Schwanke CHA. A evolução do índice de envelhecimento no Brasil, nas suas regiões e unidades federativas no período de 1970 a 2010. Rev Bras Geriatr Gerontol 2012;15(3):443-58.

33. Instituto Brasileiro de Geografia e Estatística. Atlas do censo demográfico 2010 [Internet]. Rio de Janeiro: IBGE; 2013 [acesso em 12 dez. 2014]. Disponível em: http://censo2010.ibge.gov.br/apps/atlas/

34. Alexandre TS, Corona LP, Nunes DP, Santos JL, Duarte YA, Lebrão ML. Gender differences in incidence and determinants of disability in activities of daily living among elderly individuals: SABE study. Arch Gerontol Geriatr 2012;55:431-7.

35. Drumond AFC, Guevara PE, Lebrão ML, Duarte YAO, Santos JL. Gender differences in life expectancy and disability-free life expectancy among older people in São Paulo, Brazil. J Womens Health 2011;21:64-70.

36. Parahyba MI, Veras R. Diferenciais sociodemográficos no declínio funcional em mobilidade física entre os idosos no Brasil. Ciênc Saúde Coletiva 2008;13(4):1257-64.

37. Parahyba MI, Simões CCS. A prevalência de incapacidade funcional em idosos no Brasil. Ciênc Saúde Coletiva 2006;11(4):967-74.

38. Organização Mundial da Saúde. Envelhecimento ativo: uma política de saúde [Internet]. Brasília, DF: Organização Pan- Americana de Saúde; 2005 [acesso em 12 dez 2014]. Disponível em: http://bvsms.saude.gov.br/bvs/publicacoes/envelhecimento_ativo.pdf

39. Figueiredo CS, Assis MG, Silva SL, Dias RC, Mancini MC. Functional and cognitive changes in community-dwelling elderly: Longitudinal study. Braz J Phys Ther 2013;17(3):297-306.

40. Lourenço TM, Lenardt MH, Kletemberg DF, Seima MD, Tallmann AEC, Neu DKM. Capacidade funcional no idoso longevo: uma revisão integrativa. Rev Gaúcha Enferm 2012;33(2):176-85.

41. Paixão CM Júnior, Reichenheim ME. Uma revisão sobre instrumentos de avaliação do estado funcional do idoso. Cad Saúde Pública 2005;21(1):7-19.

42. Ramos LR, Rosa TEC, Oliveira ZM, Medina MCG, Santos FR. Perfil do idoso em área metropolitana na região sudeste do Brasil: resultados de inquérito domiciliar. Rev Saúde Pública 1993;27(2):87-94.

43. Ramos LR. Family support for the elderly in São Paulo, Brazil. In: Kendig H, Hashimoto A, Coppard L, org. Family support for the elderly: the international experience. Oxford: Oxford University Press; 1992.

44. Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged. The index of ADL: a standardized measure of biological and psychosocial function. JAMA 1963;185:94-9.

45. Lawton MP, Brody E. Assessment of older people: self maintaining and instrumental activities of daily living. Gerontologist 1969;9(3):179-86.

46. Lino VRS, Pereira SEM, Camacho LAB, Ribeiro ST Filho, Buksman S. Adaptação transcultural da Escala de Independência em Atividades da Vida Diária, (Escala de Katz). Cad Saúde Pública 2008;24(1):103-12.

47. Santos RL, Virtuoso JS Júnior. Confiabilidade da versão brasileira da escala de atividades instrumentais da vida diária. Rev Bras Promoç Saúde 2008; 21(4):290-6.

48. Araújo F, Pais-Ribeiro J, Oliveira A, Pinto C, Martins T. Validação da escala de Lawton e Brody numa amostra de idosos não institucionalizados. In: Leal I, Pais-Ribeiro J, Silva I, Marques S. (Edts.). Actas do 7º Congresso Nacional de Psicologia da Saúde [Internet]. Lisboa: ISPA. 2008 [acesso em 10 nov. 2014];217-20. Disponível em: https://www.cdi.ensp.unl.pt/docbweb/multimedia/rpsp2007-2/05.pdf.

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