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ABEC

Contents

EDITORIAL

ORIGINAL ARTICLES

Contents

The Transition of the Care Model

Over the last 50 years Brazil has experienced two processes of transition which have had a direct impact on the lives of its citizens: a demographic transition, with the elderly population growing at the expense of children and young people, and an epidemiological transition, with a reduced burden of infectious disease and an increase in chronic diseases, which are largely responsible for mortality and morbidity.

Life expectancy in the 1960s was 48, while the birth rate was four children per woman. Today, life expectancy is 78 years and the birth rate is 1.6 children. This has caused the number of elderly people to rise from 4.5% to 13% of the overall population over this period.

The result is that people are living longer, with a significant segment of the older population suffering from chronic diseases that require long-term care and which can lead to disability and functional limitation, making individuals completely dependent on the care of others.

Our health and social care model, however, remains the same as in the industrial era, structured in terms of scale and productivity but lacking personalization and individualization. The focus is on the disease, not the person.

The structure of the current health model is aimed at the treatment of disease based on diagnosis via laboratory and imaging tests, therapeutic procedures and drug therapy. There is no space for prevention and the system responds to health care needs with increasing numbers of consultations, doctors, specialists, emergency units, ambulance call-outs, hospitals and ICUs.

As we can already see, continuing in this way is unsustainable. By 2030, the elderly population will consume 46% of the hospitalization costs of the SUS, the Brazilian Public Health Service.

There is a disconnect between the objectives of health professionals and patients who want to live and preserve their functionality as much as possible despite their diseases and symptoms. This difference in priorities makes successful disease management impossible, further burdening the system.

Where do we go from here? Towards person-centered, individualized care, planned according to the living conditions of each individual and not just the disease they are suffering from. This is comprehensive health care. Care that is coordinated and integrated, irrespective of where it is provided. Care where the individual actively participates in decisions about how he or she should be treated, rather than acting simply as a patient who receives prescriptions and guidance on how to tackle diseases.

People-centered care is responsive to the preferences, needs and values of the individual and ensures that these concepts guide all clinical decisions. It would represent a transition from a model where the health professional has the task of deciding the treatment of the patient, to a new model where he or she has the role of supporting the autonomy and individual choice of the person under his or her care.

We urgently need to begin the transition to a new model where listening prevails over the number of consultations and where the identification of health needs is as important as the diagnosis of diseases, providing clarity on the health situation of the individual rather than simply giving instructions. The focus of the health professional and the patient should not, at the end of the medical consultation, be simply the carrying out of exams and the prescription of medication, but the satisfaction and well-being of the person receiving care.

João Bastos Freire Neto
President of the Brazilian Geriatrics and Gerontology Society

The inclusion of elderly persons from the Instituto Henrique da Silva Semente (IHESS) in Indaiatuba, São Paulo, in the digital age: physio-gerontological contributions

Eliana Carvalho[1]
Rodrigo Caetano Arantes[2]
Angélica Sartori Rossi Cintra[3]

Resumo

Introduction: The evolution of information technologies has become part of our daily life and directly or indirectly affects the elderly population. The presence of these technologies, such as mobile phones, smartphones, computers, and tablets, at home where elderly persons live with their families demonstrates the necessity of including the elderly population in the technological universe. *Objective:* The aim of the present study was to describe the benefits obtained by the elderly from using such Information and Communication Technologies (ICTs), the effect of such use on their Activities of Daily Living (ADLs) and which physio-gerontological contributions resulted in the best use of the ICTs. *Method:* A convenience sample (n=30) was performed of individuals aged over 60 years who were students at the Instituto Henrique da Silva Semente (IHESS). Demographic and social data, the Geriatric Depression Scale (GDS) and the Mini Mental State Examination (MMSE) were considered. The data was collected between April and May 2014. *Results:* The average age was 67.9 years with a predominance of women (76.7%). Among the respondents 83.3% used a computer at home; 66.6% had some kind of difficulty in using computers; and 86.6% used ICTs in their daily lives. Despite the difficulties in using the devices resulting from the limitations imposed by age, it was observed that the equality of the age range encouraged interaction with friends and family, and as a result 100% of respondents displayed excellent interpersonal relationships with the class group. It was also observed that the elderly persons had a great desire to learn and interact through the use of technological devices, and that females were involved in recreational and educational activities, with wives encouraging their husbands to attend the computer class. However, there were exemplary risks of the misuse of these devices, such as poor posture when handling electronic devices or spending long spells in unsuitable positions, demonstrating the need for physical therapy and geriatric guidelines to ensure the well-being of the elderly. *Conclusion:* The inclusion of elderly persons in the IHESS or in any other educational activity should consider the familiar environment in which they live as well as providing professional support in physiotherapeutic and gerontologic areas in order to assure well-being and quality of life, especially at this stage of life, senescence.

Key words: Elderly; Aging; Digital Inclusion; Cognition; New Technologies.

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INTRODUCTION

The increased life expectancy of the world's population means that the elderly have become a central theme of discussions in various forms of media. Most of these discussions have focused on quality of life (QOL), with the aim of achieving a healthier aging process, with greater dependence for the elderly person. Additional years of life offer the elderly the opportunity to develop new activities, such as education or a new career, or the chance to develop in an area that they have neglected during life. Older people can also contribute to their families and communities in various manners. However, the extent of these opportunities and contributions strongly depends on one factor: health.[1]

With respect to the theme of digital inclusion, Chapter V"§ 1 of the Estatuto do Idoso (the Statute of the Elderly), Decree No. 6214, 2007[2] states that: "special courses for the elderly should include content on communication and computing techniques and other technological advances, for integration into modern life." In keeping with the provisions of the Statute and their increasing representation in an aging society, elderly persons aim to participate more effectively in activities related to the technological advances of the modern world. Considering the universe of elderly persons and their needs, it is clear that communication and social interaction are important processes for this group.[3] Despite their difficulties, elderly persons have shown a great desire to be connected and, therefore, have attended information technology classes in order to become computer users and have fun, as well as engaging with colleagues and family through the most common forms of digital socialization.

The elderly, in their eagerness to use computers in their homes, may face problems due to the long periods spent in a sitting position that these devices promote among their users. A typical example refers to one's posture while sitting at the computer and the exaggerated use of smartphones. Unsuitable postures when handling these devices can cause harm to users, especially the elderly, such as the acceleration of the loss of visual capacity, reduced fine motor skills due to the excessive use of a mouse, reduced cardiovascular circulation due to the time spent sitting, weakened abdominal muscles due to the curvature of the body during the operation of these devices, and pain in the cervical regions and/or lumbar. Roughly speaking, people should be aware of the type of work and/or leisure activity performed when using the computer, for example, with the aim of developing ways to adopt a correct and more ergonomic position to prevent disease.[4] In this context, the present study aimed to understand what contributions digital inclusion can offer the elderly, what is the effect on their ADLs and what are the negative aspects, mainly postural, which may occur due to improper use of these devices. In the latter aspect, the intervention of a physiotherapist can be crucial to mitigate consequences arising from poor posture when using electronic devices.

METHOD

The present survey was submitted to the Research Ethics Committee of the Universidade Federal de São Carlos (the Federal University of São Carlos) (UFSCar) under number 823548. The survey, based on a convenience sample, was carried out between April and May 2014 with 30 elderly persons who complied with the inclusion criteria of being aged 60 years or older and who attended the Computer Workshop of the social-educational institution the Instituto Henrique da Silva Semente (Henrique da Silva Semente Institute) (IHESS), located in Indaiatuba, in the Campinas Metropolitan Region. This municipal district has 225,974 inhabitants, 11.90% of whom are elderly.[10]

The elderly participants were informed about the research objectives and, after signing a Free and Informed Consent Form, were interviewed and assessed individually.

The study, which was based on a convenience sample, was carried out between April and May 2014 with 30 elderly persons. The inclusion criteria elderly persons aged 60 years or more who attended the computer workshop of the socio-educational department of the Instituto Henrique da Silva Semente (IHESS) located in the city of Indaiatuba, in the metropolitan region of Campinas. This town has 225,974 inhabitants and an elderly population corresponding to 11.90%.[5]

The survey adopted a qualitative approach and applied a semi-structured script, whose theme contemplated the following aspects: socioeconomic data; the main reasons that led the elderly person to attend the computer course; whether insertion in the computer course would have interfered with their previous physical activities; what were the main difficulties encountered in computer use; what other technologies did they frequently use in their ADLs; if the elderly person, once he or she had started to use these technologies, had had some kind of postural instruction to reduce the possible consequences resulting from the time spent in an improper position; the Geriatric Depression Scale[6] (GDS) and Mini Mental State Examination (MMSE).[7] The application of the MMSE aimed to identify if there were cases of cognitive decline in the group. If such cases were identified, the values obtained from the respondent in question were not included in the search result. The survey was conducted by a geriatric physical therapist who as properly trained to perform such activities. The results were tabulated and presented in a descriptive manner, and were then converted into a sample percentage format for analysis.

RESULTS

Of the 30 respondents, 76.7% were women, of whom 63.3% were married, and the average age was 67.9 years. There was no record of illiteracy. All had a computer at home and 83.3% regularly used a computer, either to write texts or use social media. The remaining 16.7% did not use the computer mainly due to fear of breaking the machine, not knowing how to switch it on alone or because their children did not let them use it.

Table 1 shows the results of the survey of the reasons the elderly persons attended the computer course and whether it had resulted in a reduction in their previous physical activities.

Table 1. Reasons of respondents for attending the information technology course and interference in their previous physical activities, Instituto Henrique da Silva Semente (IHESS). Indaiatuba, São Paulo, 2014.

Variables	N	%
Reason for attending IHESS		
A. Social Integration	14	46.6
B. Learning	10	33.3
C. Refreshing knowledge	6	20.0
Total	30	100.0
If digital insertion had led to a reduction in previous physical activities		
Did not participate in physical activities	5	16.6
Did not suffer any alteration in physical activities	25	83.3
Total	30	100.0

Source: survey performed by researchers at IHESS, 2014.

The noteworthy result of 46.6% in "Social Integration" demonstrates the strong desire of the elderly to feel more present in society, yet without compromising the physical activities that they previously practiced regularly, which applied to 83.3% of respondents. In this sense, digital inclusion can add to and promote a better quality of social life.

As for the main difficulties encountered by the elderly in using computers, the most common were using a mouse, 60%, and using the keyboard, 46%, as shown in table 2.

Table 2. Main difficulties in using computer, Instituto Henrique da Silva Semente (IHESS). Indaiatuba, São Paulo, 2014.

Variables	N	%
Do you have difficulties when using a computer		
Yes	20	66.6
No	10	33.3
Principal difficulties reported		
Use of Mouse	18	60.0
Use of Keyboard	14	46.6
Screen brightness	4	13.3
Mouse double clicking	2	6.6
Selecting Text	1	3.3
Size of letters on screen	1	3.3
Total	30	100.0

Source: survey performed by researchers at IHESS, 2014.

In addition to computer use, other devices are associated with digital inclusion, such as: mobile phone, bank ATMs, and tablets, where elderly persons seek not just to learn about the equipment, but also to master its logic and integrate themselves as an active and motivating part of society. Table 3 shows the main results regarding the use of other technologies in the daily life of the elderly persons: 100% made use of ATMs, 86.6% had a mobile phone and 63.3% made calls with their cell phones.

Table 3. Other Technologies used in the daily life of the elderly persons, Instituto Henrique da Silva Semente (IHESS). Indaiatuba, São Paulo, 2014.

Variables	N	%
Personal use of ATMs	30	100.0
Possess cell phone	26	86.6
Make calls with cell phone	19	63.3
Only receive calls with cell phone	7	23.3
Total	30	100.0

Source: survey performed by researchers at IHESS, 2014.

A troubling point of the study was whether elderly persons who used computers had received some kind of instruction regarding posture. In this case, none of the respondents reported having received postural instruction and/or any kind of training regarding using the computer, even in the environment of the institution, which confirms this concern and highlights the need for a physiotherapist to provide instruction regarding posture.

Table 4 below demonstrates the demographic results of the GDS and MMSE.

Table 4. Demographic details of sample and GDS and MMSE test data, Instituto Henrique da Silva Semente (IHESS). Indaiatuba, São Paulo, 2014.

Variables		Mean % (n)
Gender		
Male		23.3 (7)
Female		76.6 (23)
Marital Status		
Married		63.3 (19)
Single		36.6 (11)
Tests	Cut-off Point	Mean (min – max)
GDS	5 max.	2.67 (0 – 8)
MMSE	23 min.	24.9 (15 – 28)

Source: survey performed by researchers at IHESS, 2014.

The depression and cognition evaluation results provided excellent mean scores with an average of 2.67 for the GDS test and 24.9 for the MMSE test, respectively. It should be noted that all the tests were conducted in a collaborative climate, with the participation of all the elderly persons, which provided a high degree of accuracy.

The elderly persons felt satisfied with life, which was evident in the categories of personal satisfaction and interpersonal relationships of the GDS. As for the MMSE, the two results below the threshold of 23 were due to the elderly persons having difficulty in making the calculations, which does not properly indicate a cognitive deficit. The means were within the limits specified for the respective tests.

DISCUSSION

The study data demonstrates the large-scale participation of women in the IHESS, corroborating the results of a study by Arantes[8] that identified a greater frequency among the female public in related activities. Elderly women are considered to encourage the participation of older men, so much so that the seven male participants of the study were accompanying their wives during the course.

Of the reasons that led the elderly persons to attend the computer course at the IHESS, 46.6% mentioned digital inclusion as a tool of social integration, aiming to open up ways of communicating with friends and family. This

result is an indicator that the elderly are seeking ways to interact with friends and family. The exchange of e-mail messages is the preference of many internet users.[9] When they learn to use such devices, they communicate with relatives, children, grandchildren and great-grandchildren. Moreover, the importance of learning how to use a computer to type letters and send e-cards was noted, which gave everyone a sense of achievement.[9] Learning such skills represented a source of pride for the vast majority of the elderly persons, as noted in a number of the reports of the respondents. These findings demonstrate that the elderly have a need to interact with society as widely as possible. Nowadays, society demands new behaviors, skills and languages from the elderly in order to use technology.[10] Included in this argument are simpler (basic) day to day technologies such as using TV remote controls, as well as more advanced skills which require more in depth knowledge, such as computers. In this context, it was possible during all the interviews to observe the pleasure the elderly persons took in participating in the computer course, both through their own learning and the expansion of their networks of social relationships. The statement below makes this idea clear:

> *"I think that we should be grateful every day, for our lives, for the opportunity to learn new technologies and spend time with our friends at IHESS."* (Cecília, 78 years old)

The statement by Cecilia, which was not her real name, shows that learning is a two-way street in which the elderly persons have the opportunity for educational and social growth, discovering the true value of education as they learn and teach.[11]

The concerns given by the respondents regarding computer use were fear of breaking the computer, their children not allowing them to use it, or not knowing how to turn it on. These paradigms have developed since the time when the elderly persons begin to perform activities that were previously only intended for younger people.[12] Thus, it is important that children, relatives and friends encourage the elderly to use these technologies, in order that they feel more comfortable and excited about the new discoveries of the digital age. The constant use and mastery of communication media among the elderly persons show the approximation, the interest and the connection to the technological world of such individuals, which bring benefits such as less apprehension and more confidence, due to the knowledge acquired.[13]

In terms of the involvement of the elderly with electronic devices and the assumption that this could incur a reduction in Activities of Daily Living (ADL), 83.3% said they had participated in and still performed some kind of physical activity. Thus, we can consider that the sample group is active. Among the benefits of physical activity are the preservation of cognitive function, a distancing from the need for care, and reduced frailty.[1] In this regard, the practice of physical activity becomes beneficial for the maintenance of functionality, reducing a number of deleterious effects in comparison with non-active aging.[14]

It was found that 66.6% of those interviewed demonstrated some type of difficulty in using the computer, with the most frequent being the use of the mouse, 60%, followed by the keyboard, 46.6%. Such results are understandable, as even young people, who are used to using such equipment, often experience some form of difficulty. Technological equipment does not always present a welcoming interface for the study universe and the characteristics of the elderly persons, particularly in terms of the size and type of font, the size of the icons, the contrast in colors, and the design of the interaction itself, which should be more intuitive.[15] The function of double-clicking the mouse does not work when the mouse is in motion. This is a major problem for the elderly, who often cannot stop the mouse while they attempt to double-click.[16]

In terms of the other electronic equipment associated with digital inclusion, the results indicated that all the subjects used ATMs, highlighting the size of the buttons, with highly-visible and easy to use letters and numbers. They

also described how the illustrative drawings that appeared on the monitor helped with the operation, and said that the informative sounds of the machine aided understanding and brought security to the process. Other positive factors were described by those interviewed, such as the attention which bank staff give to the elderly persons when using the ATM. This is illustrated by one of the statements:

> *"Every time I go to get my pension at the bank, there's a young lady there to help me" and "The young lady always tells me to write my passcode down on a piece of paper so I won't miss out on my payment." "If there's a mistake, there's always someone from the bank to help"* (Alice, 74 years old).

Despite the significant number of elderly persons who reported using cell phones, 86.6% claimed that they found it difficult to use the appliances because of the size of the keys, in the case of analog devices. For those who used digital devices (with touch screens), the great difficulty of users was "scrolling" the screen. The elderly individuals had difficulties in performing activities that required fine hand motor skills. The decline of motor skills affects the ability to use the keyboard and mouse[17] especially when associated with the loss of motor coordination, vision and other items that are inherent in the senescent aging process.[18]

Despite the difficulties reported, the elderly respondents demonstrated great happiness at participating in this process of digital inclusion and the chance to study and interact in a classroom with people of the same age range, contributing to a highly favorable environment, with approval from 100% of participants. In this regard, it is noteworthy that the sense of cooperation was predominant in the statements of the respondents, both with respect to their fellow students and students from other IHESS courses. This resulted in good social relations, particularly with friends and neighbors, getting along with family and spouses, being able to establish contacts with people and make new friends, and according to the elderly, having a good quality of life.[19]

Postural instruction is necessary for all computer users, not only the elderly, as an unsuitable position can result in musculoskeletal damage and impair the functional and motor capacity of individuals. With frequent computer use, people adopt a sitting posture on a daily basis, requiring less use of the lower limb muscles.[20] The results showed that none of the respondents had had any kind of postural guidance for computer use. This shows a need for a physical therapist to provide physical therapy and geriatric guidance to elderly persons involved in computational learning activities and thereby mitigate the consequences resulting from the adopting of bad posture.

The present study could have been improved by a larger sample, based on previous studies and the appropriate metrics required to give the study greater relevance and consistency. However, the results obtained reveal, in a positive manner, that insertion into the digital age is a phenomenon with a tendency to grow and promote social integration.

CONCLUSION

The insertion of elderly persons into the digital era can be considered a reality, taking into account all the difficulties arising from the reduction of the physical and psychomotor ability of some older individuals who use such technologies. The large number of elderly persons interested in the computer course and other courses taught at IHESS reflect the extent to which this group of people are interested in integrating with society and that they want to be connected to the virtual world.

The survey revealed that the elderly may have several objectives in attending computer classes. Inclusion in the digital age means that the elderly person wishes to feel equal in a society which is increasingly engaged in the discovery of new technologies. Elderly persons have shown that they want to relate to people in their family, with friends, with their own colleagues at IHESS and

finally with those who wish to interact with them. In addition, they reported having greater ease in communicating with people of the same age who have the same ideas and thoughts about life.

The lack of postural guidance is the only issue of concern for the quality of life of elderly people participating in social and educational institutions. Environmental ergonomics could be studied and used as an intervention indicator by physical therapists to reduce the possible consequences of poor conditions in the use of electronic devices and activities of everyday life of the elderly. Overall, the objectives of the study were achieved and it provides results that will add to the information of other future studies.

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Functional reserve in functionally independent elderly persons: a calculation of gait speed and physiological cost

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Abstract

Aim: To analyze the behavior of functional reserve percentage (%FR) by gender in functional elderly persons, considering speed and the physiological cost of gait. *Methods:* A total of 53 self-reliant elderly persons, 40 of whom were women (age 69.4±4.7 years old; BMI 31.2±4.3 kg/m^2) and 13 of whom were men (age 70.8±7.2 years old; BMI 28.7±3.5 kg/m^2) participated in an observational and cross-sectional study. Participants were requested to walk at comfortable (CG) and maximum gait (MG). Both modalities were performed on a 70-meter elliptical circuit over three minutes. Distance and working heart rate were recorded for the corresponding calculation of average gait speed (AGS), physiological cost index (PCI) and used working heart rate percentage (% uWHR). With this information the FR% was determined by the percentage ratio with AGS, PCI and %uWHR under comfortable versus maximum demand walk conditions. *Results:* The association between %FR and AGS was significantly higher in males (p=0.017), reaching values of +-20% in most subjects. The physiological %FR for PCI was ≈30% in both men and women (p=0.156), while for % uWHR was ≈40% in females and ≈45% in males (p=0.131). *Conclusion:* AGS is a critical threshold functionality indicator to determine FR in functionally independent Chilean elderly persons.

Key words: Activities of Daily Living; Physical Fitness; Gait; Gender Characteristics; Aging.

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INTRODUCTION

In recent years the population statistics of developing countries have demonstrated an obvious demographic transition,[1] representing a significant increase in the number of people over 60 years. Projections indicate that by 2025 the percentages of this age group in most Latin American countries will reach double digits, climbing as high as 20% in countries such as Uruguay, Cuba and Chile.[2] In this context, academic reflections to support political decisions are vital to ensure the welfare and quality of life of elderly persons (EP) in the region.

Aging has been described as an extremely complex and multifactorial process,[3] which is characterized by continuous universal, progressive and irreversible changes, which in turn are conditioned by environmental, social, educational and economic factors.[4] In this scenario, the main indicator of quality of life and health in EP is functional capacity,[5] which in its various contexts requires the skilled and efficient expression of bipedal locomotion, considered to be a milestone human motor skill.[6]

Among the most documented manners of characterizing gait among EP is the measurement of the speed[7,8] and cost of locomotion.[6,9] In the context of the first measurement approach, the proposal of Bohannon,[8] which analyzes reference values and determinates for comfortable and maximum conditions, generating knowledge which allows a range of actions for functional expression, is worthy of note. Although it is based on analyzing the energy costs associated with gait, which is currently used as a *gold standard* outcome indicator,[9] this tool presents difficulties in terms of altering its performance and kinematic standard.[10] As an alternative, there are applicable proposals for the characterization of the physiological cost of gait through the behavior of heart rate (HR), with its considering percentage of use functioning as a translator of exercise intensity.[11] Additionally, MacGregor, in 1981, proposed the Physiological Cost Index (PCI) as a mixed indicator of the cost of locomotion by measuring the relationship between working HR and gait speed.[12] In this context, the main expression of dysfunctionality in EP is known as the "frailty syndrome," which is mainly associated with the systematic deterioration of muscle mass and strength with the consequent decrease in motor efficiency for the performance of gait, with speed representing a phenotypic indicator of frailty,[13] as well as being considered the sixth vital sign for the functional analysis of EP.[7]

Within this conceptual stage, literature describes thresholds or "acceptable minimums" for the expression of functionality in EP, highlighting for the purposes of this analysis torque muscle performance in the lower limbs and aerobic ability.[9] Additionally, Arnett et al. introduced the concept of Functional Reserve (FR),[14] which is defined as the difference between the maximum physical or mental capacity of a construct and the minimum necessary to perform daily functioning. In this regard, and considering the functional importance of the skilled and efficient expression of human movement, the principles included in the theory of continuous movement[15] state that the effective expression of functionality depends, throughout the life cycle, of a systematic difference between the maximum and current capacity of movement. It is worth noting that gender conditions the amplitude of FR, with higher rates of dependence among female EP.[16]

While research has been performed into FR in EP with different systemic morbidities, mainly related to oncological[17] and renal[18] conditions, there is little information on what happens in subjects experiencing successful aging. In this regard, EP test batteries have preferentially focused on maximum physical and physiological performance, regardless of the analysis of functional contexts for natural or comfortable conditions.

Given this background, the purpose of the present study is to evaluate the behavior of the percentage (%) of FR in autonomous EP, considering the difference between maximum gait (MG) versus comfortable gait (CG) conditions for indicators of speed and physiological cost.

METHODOLOGY

Participants

This observational and cross-temporality study comprised a non-probabilistic convenience sample of 53 EP (40 women) from four social clubs in the community of Talca, in Chile, who were contacted by personal interview between the researcher responsible and the directors of the clubs. Participants were recruited in January 2014, and were requested to attend morning measuring sessions (09:00-11:30 hours) in February of the same year wearing comfortable clothes and their usual shoes. These were performed in the facilities of the Universidad Católica del Maule (Maule Catholic University), and included all the tests required for this study. Before starting measurements, each of the participants signed an informed consent form which was approved by the Scientific Ethics Committee of the Universidad Católica del Maule *(N°2/2014)*. Monitoring of the selection criteria and measurement of the study variables was performed by two physiotherapists with specific training in the field of gerontology. The inclusion criteria were controlled by applying the Examen de Medicina Preventiva del Adulto Mayor (Preventive Medicine for the Elderly Test) (EMPAM),[19] verifying an age between 60-75 years, specific anthropometry of normal weight or overweight (based on specific categorization for EP, according to BMI; using a DETECTO stadiometer, model 2392), autonomous in accordance with the Evaluación Funcional del Adulto Mayor-Chile, (Functional Evaluation of the Elderly-Chile) (EFAM-Chile) part A, a normal cognitive level (Short Mini Mental test ≥13 points) and without established depression (Yesavage Scale <5 points).[19] Subjects with decompensated chronic diseases, a risk of falls (positive Unipodal Station and *Timed up and Go* test results),[19] sequelae of neurological and cardiovascular diseases and moderate to severe pain in lower limbs (visual analogue scale >3 points) were excluded.

The demographic, anthropometric and functional characteristics are presented in Table 1.

Table 1. General characteristics of participants (N=53). Talca, Maule region, Chile, 2014.

Analysis Group	N	Age (years)	Weight (kilos)	Height (meters)	BMI (Kilos/m^2)	EFAM A (points)	MMSE (points)	Educational level (years)
Total	53	69.8 ± 5.4	73.7 ± 11.9	1.55 ± 0.08	30.6 ± 4.3	51 ± 3	17.9 ± 1.3	10.1 ± 3.5
F	40	69.4 ± 4.7	72.0 ± 11.7	1.52 ± 0.05	31.2 ± 4.3	50 ± 3	17.9 ± 1.2	10.0 ± 3.5
M	13	70.8 ± 7.2	79.1 ± 11.4	1.66 ± 0.07	28.7 ± 3.5	51 ± 2	18.1 ± 1.2	10.4 ± 3.7
P value		*0,396*	*0.045*	*<0,001*	*0.050*	*0.353*	*0.712*	*0.724*

The table shows the demographic, anthropometric and functional variables of the participants. The values are expressed as mean ± 1 standard variation for each variable. F= female; M = male; n = number of participants per group; BMI = body mass index and EFAM A = Functional Evaluation of the Elderly-Part A

Procedure

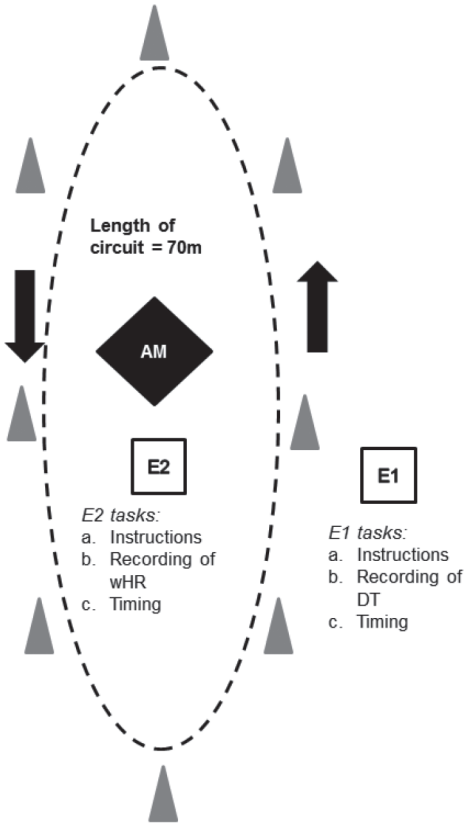
Basic anthropometric characterization included the measurement of body mass and height in a standing position, without shoes and retaining the lower edge of the orbits in the same plane as the external auditory canal (Frankfurt plane). Nutritional status was established in accordance with the specific categorizations for the elderly population.[19]

The evaluation in a physiological and perceptual state of rest was made after the elderly had remained in a supine position for five minutes, and measured HR (beats per minute, Polar® telemeter, FS3 GRY, USA/CAN), respiratory rate (RR, breathing cycles per minute, by visual observation), diastolic and systolic blood pressure (DBP and SBP, digital sphygmomanometer, Omron HEM-7114 model), pain (score 0-10, Visual Analog Scale) and the subjective sensation of fatigue (SSF, modified Borg Scale),[20] table 2. After this analysis, participants were asked to walk independently in two specific modalities. The first was entitled as comfortable gait (CG; habitual or natural speed), followed by verification of physiological and perceptual recovery in a sitting position (average rest time =3±3 minutes), and the second was considered as maximum gait (MG; speed of greatest or maximum demand). Both methods were performed for three minutes in an elliptical circuit of 70 meters comprised of a homogeneous surface (Figure 1). The time for the execution of gait has been established as sufficient to identify the steady physiological state of elderly persons in the community.[10]

Table 2. Physiological and perceived characteristics of participants at rest (N=53). Talca, Maule Region, Chile, 2014.

Analysis group	N	HR (beats/ min)	RR (v/min)	SBP (mm Hg)	DBP (mm Hg)	Pain (0-10)	SSF (0-10)
Total	53	69 ± 10	17 ± 4	139 ± 20	75 ± 10	0 (0-3)	0 (0-0)
F	40	69 ± 9	17 ± 4	136 ± 18	74 ± 9	0 (0-3)	0 (0-0)
M	13	69 ± 12	17 ± 3	151 ± 20	80 ± 11	0 (0-0)	0 (0-0)
P Value		*0,962*	*0.646*	*0.011*	*0.062*	*0.057*	*0.154*

The values are expressed as mean ± standard deviation for each variable. Pain and the subjective sensation of fatigue are median values with the minimum and maximum value obtained in parentheses. F= female; M = male; n = number of participants per group. HR = heart rate; RR = respiratory rate; SBP = systolic blood pressure; DBP = diastolic blood pressure; SSF = subjective sensation of fatigue; beats = beats; v = breaths and min = minute.



The dashed line represents the circuit. E1 = evaluator 1, E2 = evaluator 2, EP = participating elderly person, wHR = working Heart Rate and DT = distance travelled. The black arrows indicate the direction of movement and the grey triangles represent the cones marking the circuit. **Note:** marking not to scale.

Figure 1. Plan of elliptical circuit for performance of MG and CG.

Two evaluators (E1=evaluator 1; E2=evaluator 2) performed the measurement procedure. E1 recorded the distance traveled (DT; observation of markings every meter of the circuit), while E2 measured the working HR (wHR) immediately after the test. With this information, the behavior of speed and physiological cost for both types of gait was determined by the following formulas:

a) average gait speed (AGS):

AGS (m/s)=DT/180

Where DT is in meters and 180=seconds.

b) Physiological cost index (PCI)[12]:

PCI (b/m)=(wHR–bHR)/s

Where, wHR is in beats/minute; bHR in beats/minute and s = gait speed in meters/minute.

c) percentage of reserve heart rate used (RHRu%)[11]:

RHRu%=100*(wHR – bHR)/[(220 – age) - bHR]

Where age is in years, wHR in beats/minute and bHR in beats/minute.

Determination of Functional Reserve Percentage

FR was determined from the percentage relationship between the analysis indicator (AGS, PCI and RHRu%) at maximum gait (MG) versus comfortable gait (CG), modifying the proposal of *Hashidate & Uchiyama* in 2007.[21] In this context the overall formula was as follows:

%FR=100-[(CGP/MGP)*100]

Where FR%: percentage of functional reserve; CGP: comfortable gait performance; MGP: maximum gait performance. The performance indicators for the calculation of FR% associated with AGS, RHRu% and PCI were analyzed using the same measuring units as described above.

Statistical analysis

The normality of the analysis variables was performed using the Shapiro-Wilk test. The descriptive variables were analyzed by mean ± standard deviation and, in the case of calculations involving the gender of the primary study variables, was complemented with confidence intervals of 95% ($CI_{95\%}$). The comparison of the *AGS* and *PCI* by gender was calculated using the Student-t test for independent samples, while *RHRu%* was analyzed with the Mann Whitney U test. Comparison of the FR% of the speed and physiological cost of gait was analyzed using the Mann Whitney U test.

The level of statistical significance was established as $p<0.05$. Descriptive and inferential statistical analysis was performed using the *GraphPad Prism* software package version 5 (GraphPad Software Inc., San Diego, CA, USA).

RESULTS

The general characteristics of the participants described in table 1 show that the majority were aged from 65 to 75 years, irrespective of gender ($p=0.396$). The nutritional state of both groups was at the upper limits of normal weight ($p=0.050$). From a functional perspective, the subjects evaluated were all categorized as autonomous according to the EFAM-Chile, with similar scores for both genders ($p=0.353$). Furthermore, cognitive level was categorized as normal, while the level of education was classed as an incomplete high school education, with no difference between genders for either category.

The physiological and perceptual characteristics shown in table 2 comply with those declared in the selection criteria, with both groups displaying acceptable stability; although systolic blood pressure was significantly higher among men ($p=0.011$). Perceptions of pain and fatigue did not exceed mild, and were similar for both genders.

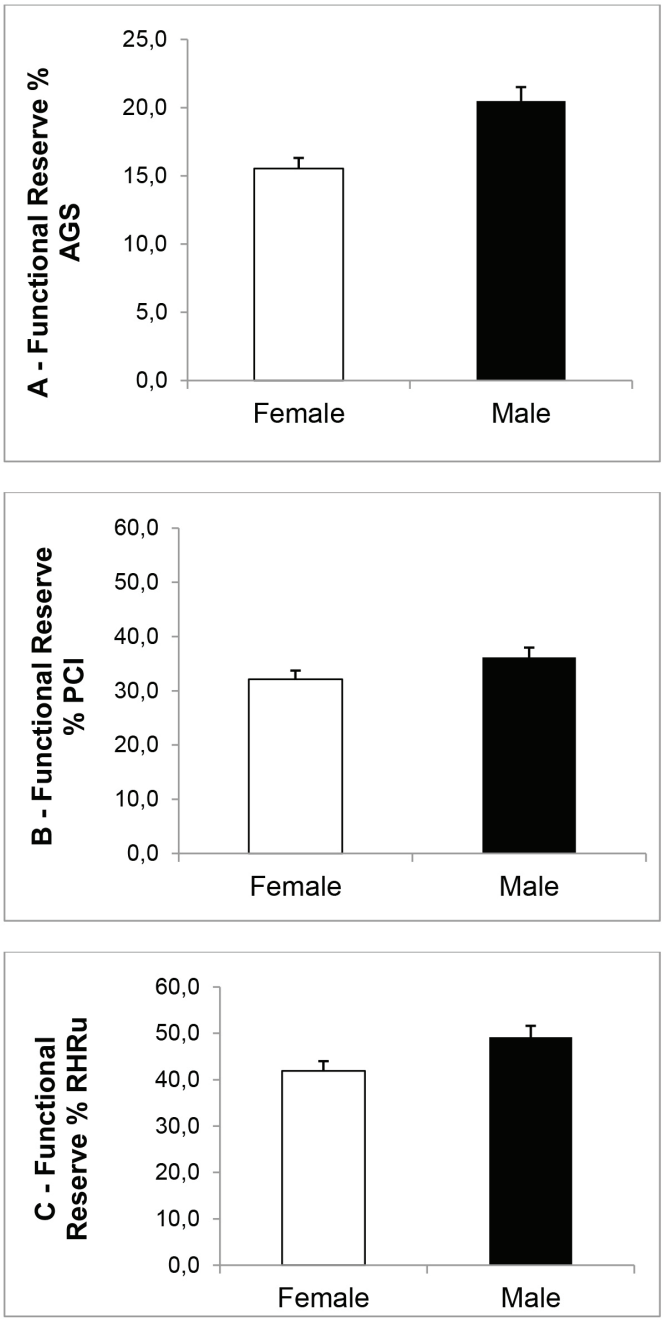
Table 3 shows the speed and physiological cost outcomes of CG and MG. AGS was significantly higher among males, for both comfortable ($p=0.027$) and maximum ($p<0.001$) gaits. When evaluating behavior by gender, cost of gait measured by PCI was significantly higher among women for both CG ($p=0.007$) and MG ($p=0.008$). The behavior of RHRu% did not vary between genders.

Table 3. Behavior of speed and physiological cost of comfortable and maximum gait (N=53).

Type		Comfortable gait			Maximum gait		
Analysis group	N	AGS (m/s)	PCI (b/m)	URHR (%)	AGS (m/s)	PCI (b/m)	URHR (%)
Total	53	1.16 ± 0.16	0.35 ± 0.17	29.8 ± 13.9	1.38 ± 0.20	0.50 ± 0.20	50,7 ± 19,9
F	40	1.13 ± 0.15	0.38 ± 0.18	31.7 ± 14.7	1.33 ± 0.18	0.53 ± 0.20	52,2 ± 20,9
M	13	1.24 ± 0.18	0.24 ± 0.12	24.1 ± 8.8	1.54 ± 0.19	0.38 ± 0.14	45,8 ± 16,0
P value		0.027	0..007	0.061	*p*<0,001	0.008	0.197

The values are expressed as mean ± standard deviation for each variable. F= female; M = male; n = number of participants per group; AGS = mean gait speed; PCI = physiological cost index and %uRHR = used reserve heart rate.

Table 4 and Figure 2 summarize FR% based on the speed and physiological cost of locomotion. In this regard, FR% associated with AGS is significantly higher among males, with a value of 20.5±5% versus 15.5±6% in women (p=0.017), Figure 2A. In terms of physiological FR, this was close to 30% for the PCI for both men (mean=36.2±12%) and women (mean=32.1±20%), (figure 2B, p=0.156). The wHR% was close to 40% for both genders, with specific percentages of 41.9±18% for women and 49.1±10% for men (figure 2C, p=0.131).



The bars represent the mean FC by gender with $CI_{95\%}$, n = 53 (female, n = 40; male n = 13). **A.** Average gate speed (AGS). **B.** Physiological cost index (PCI). **C.** Percentage of reserve heart rate used (RHRu%). The black bars represent men and the white bars represent women. *p<0.05.

Figure 2. Behavior of FR according to gender. Talca, Maule region, Chile, 2014.

Table 4. Behavior of Functional Reserve for speed and physiological cost of gait (N=53). Talca, Maule region, Chile, 2014.

% FR	Total (n = 53)		Male (n = 13)		Female (n = 40)		Differences in means		*P value*
	X ± SD	CI 95%	X ± SD	CI 95%	X ± SD	CI 95%	X ± SD	CI 95%	
AGS (%)	16.8 ± 6	15.1-18.5	20.5 ± 5	17.3-23.5	15.5 ± 6	13.6-17.5	4.9 ± 2	1.2-8.7	0.017
PCI (%)	33.1 ± 18	28.1-38.2	36.2 ± 12	29.2-43.2	32.1 ± 20	25.7-38.5	4.1 ± 6	-7.8-15.8	0.156
%URHR (%)	43.7 ± 17	39.1-48.3	49.1 ± 10	42.9-55.5	41.9 ± 18	36.1-47.8	7.2 ± 5	-3.4-18	0.131

X = mean; SD = standard deviation; CI 95% = confidence interval of 95%. FR% = functional reserve percentage; AGS = FR% associated with average gait speed; PCI = FR% associated with physiological cost index; %uRHR = FR% associated with percentage of reserve heart rate used. The calculation of FR% considered the equation: FR% = 100-[(CGP/MGP)*100

DISCUSSION

The purpose of the present study was to analyze the FR% for the performance of gait in conditions of maximum versus comfortable demand. In this sense, the main findings focus on the determination of physiological cost and speed in autonomous EP.

Average gait speed

The concept of measuring speed during the execution of CG has been much studied.[8,22-25] The values obtained in the present study are inconsistent with previous findings, which report both inferoir[8,22,23] and superior results.[24,25] This situation can be explained by the expression of confounding factors, which are based on the demographic and anthropometric aspects specific to each sample, which emerge from the use of diverse populations, such as Caucasian,[8,23,24] Asian[22] and Latin American.[25] Furthermore, indicating the importance of the measuring methodology, a high level of confidence has been demonstrated for the use of a straight unidirectional 10 meter track,[26] which is considered a sufficient distance for the expression of gait in normal execution conditions.[27] In such context, the justification of the use of an elliptical track 70 meters in length in the present study was based on clinometric factors, as it reduces the neuromotor component in accelerations and decelerations,[28] in addition to ensuring sufficient time and distance to extrapolate advanced activities of daily living[10,29] such as transport to community centers and health.

The AGS was greater among the male generation for both CG and MG (table 3). In this respect, Fritz *et al.* proposes that CG speed is systematically greater among men from the seventh decade of life onwards.[7] This specific behavior, associated with the temporal-spatial performance of gait, can be an inflection point for investigating further the apparent differences in gender documented for frailty[30] and functional dependency,[16] which are preferentially expressed among those undergoing in the process of aging. Meanwhile, previous studies have reported significantly higher maximum speed conditions than the values reported in this experiment.[8,22,23] In this context, the specific characteristics of the track and the timing used allow the EP to effectively achieve a steady gait conditions.[10,27,28]

The evaluation of FR through analysis of gait speed is notable for a lack of information. Hashidate & Uchiyama applied this concept in a Japanese study of EP using the *Timed Up and Go* (TUG) test. In comfortable versus maximum speed conditions, they found that the FR obtained using the TUG was significantly lower in dependent EP

in activities of daily living,[21] although analysis by gender was not performed. It should be noted that while this proposal adopted a similar mathematical model to the present study, the test selected only considered functional contexts within the home such as moving toward the bathroom, kitchen or dining room.[29]

Considering the calculation of FR% by gender, a higher AGS was found among men (table 4, figure 2A), confirmed by the consistently superior performance among men in both maximum and comfortable conditions (Table 3). This finding has a multifactorial explanation related to functional walking capacity in EP, which focuses mainly on the state of muscle strength in the lower limbs.[31] Reid *et al.* established that the power of the musculature of the lower limbs depends on the magnitude of the angular velocity of execution, showing a systematic increase of expression in healthy EP versus a subsequent plateau at 90°/s among those with limited mobility,[32] a result that could be extrapolated to the capacity to achieve optimum gait speeds for functional performance.

In this scenario, the difference observed between the FR values obtained using the model of the present study (Table 4) could guide decision-making relating to functional diagnosis, since the results obtained over small distances could be extrapolated for activities within the home. Meanwhile, FR for activities outside a particular environmental context would have greater validity if a longer track was used. This approach needs to be complemented with the evaluation of the performance of the EP on tracks similar to that of the proposed methodology, considering uneven terrain or obstacles.[33]

Physiological cost of gait

The measurement of the physiological cost of gait is justified by its important role as an indicator of the central and peripheral muscle phenomena that result in changes to the metabolic demands of the system. Conley *et al.*, when evaluating the oxygen consumption of the knee extensor muscles, found that EP have around 50% of the oxidative capacity by muscle volume of younger subjects.[34] In this context, the importance of measuring FR associated with the physiological behavior of gait is based on changes in peripheral demand that could be indirectly translated by the behavior of vital signs. The relationship between gait speed and wHR as an indirect indicator of oxygen consumption in people has been previously documented.[35]

Physiological cost was higher among females for both types of gait analyzed (Table 3). This statement is consistent with the findings of previous studies.[14,35] Notwithstanding the above, little information is available relating to the execution of gait in a corridor, with this proposal being a pioneer in this respect. However, FR relating to the physiological cost of gait in maximum and comfortable conditions did not differ significantly by gender according to the PCI (table 4, figure 2B) and RHRu% (table 4, figure 2C). This situation can be explained primarily by the three-minute walking time used in this experience, which although described as ideal for reaching physiologically stationary states in autonomous EP,[10] is not sufficient to discriminate differences by gender in physiological overload based on aerobic metabolism.[23] Similarly, the behavior of SBP at rest in men (Table 2), which is categorized as an initial state of hypertension,[36] diminishes their physiological reserve. Notwithstanding the foregoing, the American Thoracic Society declared a resting SBP over 180 mm Hg as a relative contraindication for the execution of the six-minute walk test,[37] evidence that supports the decision to include this group in the present study of gait. In the context of the use of antihypertensive medications, while the relative frequencies of use were similar between genders (Table 5), the divergent SBP behavior could be explained by the low adherence to medication in males.[38]

Table 5. Main types of pharmacological treatment and percentage of sample using medication according to gender (N=53). Talca, Maule region, Chile, 2014.

Chronic Pathology	Pharmacological Treatment	Total % (n = 53)	F % (n = 40)	M % (n = 13)
AHT	Angiotensin II receptor antagonists	33.9 (18)	32.5 (13)	38.5 (5)
	Angiotensin converting enzyme inhibitors	28.3 (15)	25.0 (10)	38.5 (5)
	Dihydropyridine calcium channel blockers type	9.4 (5)	10.0 (4)	7.7 (1)
	Diuretics	7.5 (4)	10.0 (4)	0
DM2	Hypoglycemic agents	11.3 (6)	10.0 (4)	15.4 (2)
	Antihyperglycemic agents	7.5 (4)	10.0 (4)	0
HC	Statins for lowering cholesterol levels	37.7 (20)	45.0 (18)	15.4 (2)
COPD	Bronchodilators	5.7 (3)	7.5 (3)	0
P CVD	Antiplatelets	13.2 (7)	10.0 (4)	23.1 (3)
MS Pain	Analgesic inhibitors of prostaglandin synthesis	15.1 (8)	17.5 (7)	7.7 (1)

Values are shown in percentage (%) form with absolute frequency in parentheses. F= female; M = male; n = number of subjects. AHT = arterial hypertension; DM2 = type 2 diabetes mellitus; HC = hypercholesterolemia; COPD = chronic obstructive pulmonary disease; P CVD = prevention of cardiovascular disease; ME = musculoskeletal.

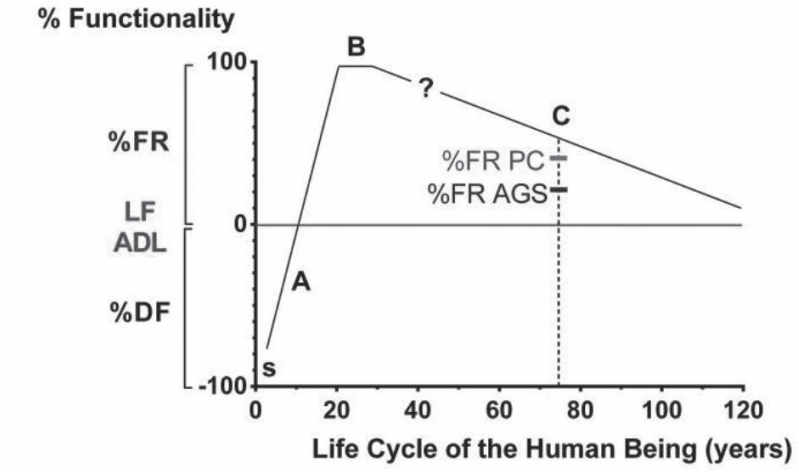
On the other hand, from a methodological point of view, the criteria for selection for participation of the EP in the sample was that given that their functional levels of autonomy were categorized as healthy aging (Table 1), this indicator may not be sensitive at this stage. Notwithstanding the foregoing, there was an emerging trend of greater physiological reserve in males (Figure 2B and C) for both variables, which could dialogue with the degree of comfortable speed achieved by this group, which is close to the optimum conditions reported.[6,7] It should be noted that the largest number of participants belonged to the female gender and the absence of categorization of the level of physical activity may be obvious sources of methodological bias for the extrapolation of these results, which are preliminary in nature. It is therefore planned to expand this research proposal with more balanced populations of EP in terms of gender, control of confounding variables and evaluation of heterogeneous factors from a demographic, anthropometric and functional perspective.

Projections

This is the first study that analyzes the behavior of FR associated with the speed and physiological cost of autonomous Chilean EP. The results presented could be considered as a framework for studies using similar methodology. In this scenario, gait has been found to be a predictor of functional loss,[39] and requires complex characterization that considers performance and the associated physiological costs. In this regard, Schrack et al. proposed that the energy loss of mobility in EP depends on various factors which are explained by biochemical processes that maintain homeostatic balance and allow the adaptability of movement based on energy conservation.[40] Thus, the projections of this study lie in its support of policies, mechanisms and the monitoring of processes with a public-health goal towards the relevant characterization of movement based on the relationship between maximum capacity and the need to engage in various functional contexts,[15] which we systematically describe as

FR based on speed,[21] muscle strength[9] and aerobic capacity[14] (figure 3). In addition, it not only focuses on scenarios of palliative care of dependent EP suffering from illness, but from a preventive perspective considers the risks of dysfunction by characterizing movement, determining the critical points or "thresholds" of functional expression,[9] and representing a timely intervention by considering environmental gait training as a real alternative for the prevention and treatment of specific disorders.[41]

Finally, the results of the present study show that speed is the earliest and most sensitive indicator for determining FR in autonomous Chilean EP living in the community.



Acquisition of skills for the development of functional gait during early life cycle, with a baseline (i) of independent march beginning during the first postnatal year. **B.** Maximum expression of functional gait considering the different systems employed. **C.** Functional reserve by age corresponding to the participants, highlighting the largest reserve by physiological cost versus speed. The question mark **(?)** reveals the lack of evidence for determining the timing and basis of ontogenetic divergence in physiological reserve contributions (≈30-40%) versus speed (≈15-20%) for the execution of independent motion during the advanced stages of the life cycle. FR% = Percentage of Functional Reserve; FL ADL = Functional Limit for Activities of Daily Living; DF% = Dysfunctional Percentage; FR% PC = Functional Reserve percentage associated with Physiological Cost; FR% AGS = Physical Reserve Percentage associated with Average Gait Speed.

Figure 3. Diagram of Functional Reserve of independent gait during the human life cycle. Talca, Maule region, Chile, 2014.

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Profile of drug spend among elderly individuals from different socioeconomic groups

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Abstract

The increase in the elderly population is associated with increased health care costs. The objective of the present study was to describe the results of research conducted in groups of elderly persons from different socioeconomic classes in Porto Alegre in the state of Rio Grande do Sul, and to compare the drugs spending profiles of different groups. A cross-sectional study was performed using a sample of individuals aged 60 years or older who participated in community groups. Analysis of variance (ANOVA) and the Tukey test were used to analyze the difference in costs of drugs among different socioeconomic classes. A total of 225 seniors were interviewed and females were predominant in all classes. The most common chronic diseases included hypertension, which occurred in 21.0%, 36.0% and 38.0% of elderly persons in social classes A, C and E, respectively. The average number of medications was 5.34 (±2.64) in social class A, 4.07 (±2.73) in social class C and 4.28 (±2.39) in social class E. The share of household income spent on medication for elderly persons in classes A, C and E was 4.0%, 5.7% and 10.0%, respectively. The drugs with the highest monthly cost for each patient in class A, C and E, respectively, were antipsychotic and anti-Parkinson's medication, diabetes medicine, and medication for the treatment of bone disease. It was concluded that there are specific differences in the cost and expenses incurred on spending on medication for the elderly of different socioeconomic classes.

Key words: health; diseases; income.

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INTRODUCTION

The growth of the elderly population is associated with an increase in healthcare costs, notably spending on drugs, due to the multiple diseases that occur among this segment of the population, most notably chronic diseases.[1-3] Elderly persons use an average of two to five drugs, a value greater than the average of the younger population.[3,4]

The use of drugs in the elderly population accounts for a substantial proportion of healthcare costs in developing countries.[5,6] An example of this consumption can be found from prescription data. In Canada, the elderly account for only 12.0% of the total population, but 40.0% of prescriptions are written for this group, while in the United States, the elderly account for only 11.7% of the population, but receive 31.0 % of drug prescriptions.[7,8]

The amount of prescriptions dispensed for the elderly can be evaluated in terms of the cost this represents for health systems and/or patients. Analyzing data from developed countries, spending per capita on medicines in Canada increased by 10.8% between 1996 and 2002. Taking into account age and the costs of acquiring drugs, population aging is responsible for 1.0 point in the annual rate of increase in health spending.[9] Another study investigated the use of drugs among Belgian elderly persons and found the average expenditure per month on the acquisition of medicines for chronic diseases was €140.[10]

In developing countries, access to medicines is a major challenge for health professionals. In public health, the available resources are insufficient to meet demand, leading to rationing and more stringent management of resources.[11,12]

In Brazil today, the population receives drugs in two ways: (1) through the public health system, in which the patient receives free medicine, provided the drug is included in a list of essential drugs established by the government or (2) through commercial pharmacies, where the cost of the drug is the responsibility of the individual. There is also the Programa Farmácia Brasil Popular (Brazil Popular Pharmacy Program), in which the patient receives some medicines for chronic use, which are included on the essential drug list, free of charge or subsidized by the government. In Brazil, while the total health expenditure increased by 9.6% from 2002 to 2006, drug related spending increased by 123.9%. In 2006, while gross domestic product (GDP) grew by 3.7%, there was a 7.5% increase in spending by the Ministry of Health, and drug-related spending rose by 26.0%, generating a discrepancy between drug expenditures and total expenditures on health.[13]

Epidemiological, population-based data about the health of elderly persons remains scarce, as it is limited to certain cities and is unrepresentative of the population as a whole. A broader survey of the population base, including issues relating to the health of the elderly, was carried out in 1998. This survey included 29,976 older people, but did not include the northern regions of the country. Among the health issues examined, spending on drugs was studied in depth, and it was found that in the month prior to interview elderly persons spent an average of US$45.50 on regular medications.[14] In terms of studies of individual cities, a survey conducted of 667 elderly persons in Belo Horizonte, Minas Gerais, evaluating the spending of the elderly population on drugs in both the public and private sector, found that the average expenditure incurred in the public sector was US $7.89, while the average spending in the private sector was US $69.48.[15]

Another Brazilian cross-sectional population based study, conducted in 2009 with 1,720 adults living in the urban area of Florianópolis, in the state of Santa Catarina in southern Brazil, noted that the average spending on drugs was US $23.70, with higher rates among women, older individuals and among the highest socioeconomic class.[16] To ensure access to medicines for the majority of the population, improve the care provided by the health services and provide specific knowledge

of the health profile of the elderly population in Brazil, it is necessary to carry out economic analysis and research in the health sector that can be used to support decisions on the allocation of financial resources.

The aim of the present study was to describe the results of research carried out in groups of different socioeconomic classes of elderly persons in the city of Porto Alegre, in the state of Rio Grande do Sul in Brazil, and to compare profiles and consumer spending on drugs between these classes.

METHOD

The study adopted a cross-sectional model and used a structured questionnaire administered between March and July 2007 as a data collection instrument.

The study population included elderly participants of social groups, which are social spaces that allow senior citizens, aged 60 years, to participate in humanitarian activities, seeking to improve social relations through a range of activities.

The sample was intentional and convenience based, selecting individuals aged over 60 years living in the city of Porto Alegre, Rio Grande do Sul, who participated in selected social groups. The sample was divided into six groups: (a) two groups from socioeconomic class A, (b) two groups from socioeconomic class C, and (c) two groups from socioeconomic class E. The classification of groups by socioeconomic status was determined using the family income of the individual respondent as a parameter.[17] The groups were chosen by district, according to the socioeconomic characteristics of the inhabitants of each region. The data for the selection of the groups was provided by the Municipal Council of the Elderly. After selecting the groups, all active participants were invited to participate and the interviews were conducted at the end of group meetings, when the elderly persons brought their medication bags, or in the homes of the participants. The interviews were conducted by trained researchers. The elderly were asked about socioeconomic characteristics, general health data and the use of medications.

The study excluded individuals who had trouble answering the questionnaire, as observed by the interviewer. Drug use was considered to be validated in situations where the original box or prescription was provided, and medications used both continuously and sporadically were included. In the present study, the direct costs incurred from spending on drugs were considered in two ways: a) the reference price of the product, according to the place of purchase (public or commercial pharmacy), which calculated the cost based on price per unit, dosage and pharmaceutical form.[18] For example, the cost of medicines in the public sector was calculated considering the purchase price of the public health system of the city of Porto Alegre, in Rio Grande do Sul. The calculation of the cost through the private sector was performed based on: a) the maximum consumer price established by the Brazilian government; b) the social cost of the drugs, irrespective of whether they were acquired via the public or private sector. The calculation considered the average price of three commercial pharmacies.[19]

In the data collection period, the minimum wage (MW) in southern Brazil was US$210.00, and the dollar was worth R$2.13. The average monthly cost was calculated as the percentage of the family income of the elderly person committed to such spending.

The drugs were categorized by the Anatomical Therapeutic Chemical classification system (ATC) at the first and third levels.[20]

Statistical analysis was performed using SPSS software, version 13. To analyze the difference in spending between socioeconomic classes, analysis of variance (ANOVA) and the Tukey test were used. The t-test for independent samples was used to verify the differences between the cost of drugs: increased age, gender and drug use. Moreover, this test was used to verify the differences between

the average cost of medications, considering the reference price and the social cost, between social classes A and E; A and C; C and E.

The project was approved by the Ethics Committee of the Universidade Federal do Rio Grande do Sul (Federal University of Rio Grande do Sul), under No. 2006647/2007. All participants signed a free and informed consent form prior to data collection.

RESULTS

A total of 225 elderly people were interviewed, 61 of whom were from socioeconomic class A, 80 from socioeconomic class C and 84 from socioeconomic class E. Females predominated in all social classes, with 84.0% in class A, 78.0% in class C and 89.0% in class E. The age of the elderly respondents ranged from 60 to 99 years and the mean age was 74.25 (±7.8) years in class A, 72.07 (±7.4) years in class C, and 71.4 (±7.8) years in class E. In class A, 56.0% of the elderly persons had studied for an average of 15 years, while in classes C and E most had studied less than eight years. This data is presented in Table 1.

In terms of the use of drugs, it was found that 100.0% of the elderly persons in class A used some kind of medication during the period in which the interview was conducted. In class C, this frequency was 91.0%, while in Class E, 94.0% of the elderly persons used medication. The number of drugs used ranged from 0 to 15. In class A, the average number of drugs used was 5.34 (±2,64), while in class C it was 4.07 (±2.73) and in class E 4.28 (±2.39).

The most common chronic diseases were hypertension, which occurred in 21.0%, 36.0% and 38.0% of the elderly persons in classes A, C and E, respectively. Diabetes occurred in 3.0%, 9.0% and 24.0% of the elderly in classes A, C, and E, respectively. Furthermore, there was a high frequency of hypercholesterolemia (38.0%, 19.0% and 23.0% in classes A, C and E, respectively) and heart problems (20.0%, 11, 0%, and 18.0% in classes A, C and E, respectively).

Table 2 shows that the reference price of medication ranged from US$31.50 to US$127.99 between the three socioeconomic classes, while the social cost ranged from US$44.21 to US$118.46 dollars.

Table 1. Socioeconomic characteristics and number of medications used by elderly persons participating in social groups. Porto Alegre, Rio Grande do Sul, 2007.

Variables	Class A (n= 61)		Class C (n= 80)		Class E (n= 84)	
	n	%	n	%	n	%
Gender						
Male	10	16	18	22	9	11
Female	51	84	62	78	75	89
Age						
60-69	19	31	34	43	39	46
70-79	28	46	35	44	31	37
80-90	14	23	11	13	14	17
Marital Status						
Single	1	2	9	11	15	18
Married	20	33	26	33	13	16
Widowed	32	52	33	41	44	52
Divorced	8	13	12	15	12	14
Educational level						
Illiterate	0	0	9	11	14	17
Incomplete primary education	0	0	28	35	57	68
Complete primary	3	5	22	28	7	8
Incomplete high school	0	0	4	5	1	1
Complete high school	21	34	13	16	5	6
Higher incomplete	3	5	0	0	0	0
Higher complete	34	56	4	5	0	0
Family income (minimum salary)						
1	0	0	8	10	53	63
2-3	0	0	46	56	28	33
>4	61	100	26	44	3	4
Number of medications						
1 to 4	21	34	42	57	45	57
≥5	40	66	32	43	34	43

Table 2. Comparison of reference cost and social cost of medications used by elderly persons from social groups. Porto Alegre, Rio Grande do Sul, 2007.

Social class	Reference cost (US$) Mean (min-max)	Social cost (US$) Mean (min-max)
Class A (n= 61)	127.9 (1.92-512.36)*	118.5 (1.81-482.08)*
Class C (n= 80)	40.9 (0.16-199.02)	48.6 (0.70-211.60)
Class E (n= 84)	31.6 (0.07-850.84)	44.2 (0.70-864.55)

US$= US dollar; *$p$<0.001; min=minimum; max=maximum; ANOVA/Tukey.

Based on the reference price, it was found that the share of family income spent on drugs for elderly persons in classes A, C and E was 4.0%, 5.7% and 10.0%, respectively.

Table 3 shows the average cost of medication for each social class, subdivided into the price of acquisition in the public system and the sales price in private establishments. In Class A, the lowest price per drug was US$0.70, while the highest price was US$371.18. In class C, prices ranged from US$0.16 to US$107.15. In social class E, prices acquired from the public sector ranged from US$0.17 to US$851.30, compared with the private sector, where the maximum price was US$62.81. These figures are calculated based on the reference price of the drugs. It is important to note that statistical analysis was not performed to see if there was a difference between spending in the public and the private sector, which can be considered a limitation of this study.

Table 3. Average monthly cost of medication acquired from the Sistema Único de Saúde (Unified Health Service) (SUS) and private establishments, consumed by elderly persons from social groups. Porto Alegre, Rio Grande do Sul, 2007.

Social class	Public system		Private system	
	Nº drugs	Mean (min-max) (US$)	Nº drugs	Mean (min-max) (US$)
Class A (n= 61)	-	-	130	50.52 (1.25-657.00)
Class C (n= 80)	36	8.82 (0.18-332.50)	92	32.10 (1.64-235.87)
Class E (n= 84)	48	5.44 (0.02-1.485)	72	20.71 (0.37-111.18)

US$= US dollar; min= minimum price; max= maximum price.

It is also noteworthy that the acquisition costs of drugs were only compared statistically between classes, but spending between the public and private sectors was not compared.

The drugs were grouped into anatomical systems, at the first level of the ATC classification, and based on the reference price, the percentages of use and the percentages of spending of each level of the ATC were calculated. Drugs to treat diseases of the cardiovascular system were the most frequently used in all social classes, and this data is presented in Table 4.

Table 4. Distribution of use and cost of drugs of elderly persons from social groups, according to the Anatomical Therapeutic Chemical Classification System (ATC). Porto Alegre, Rio Grande do Sul, 2007.

Class of drugs	Class A (n= 61)		Class C (n= 80)		Class E (n= 84)	
	Use (%)	Cost (%)*	Use (%)	Cost (%)*	Use (%)	Cost (%)*
Cardiovascular system	29.0	31.2	42.0	31.2	47.6	33.8
Central nervous system	28.0	24.2	24.1	17.6	18.6	8.2
Digestive tract and metabolism	16.0	20.8	17.0	19.0	19.0	14.9
Musculoskeletal system	11.5	11.3	7.0	6.9	7.0	4.9
Genitourinary system and sex hormones	4.0	4.2	2.0	1.8	0	0.1
Systemic hormones	3.0	1.2	2.5	6.3	2.0	0.7
Respiratory system	2.5	2.0	1.5	3.7	2.5	1.7
Blood and blood forming organs	2.0	1.1	0.5	0	0	0
Sense organs	1.5	2.9	1.0	1.6	0.5	0.2
General anti-infectives for systemic use	1.0	0.3	1.7	2.5	2.5	2.7
Dermatological	0.5	0.1	0	0.2	0.3	0.6
Antineoplastic and immunomodulating agents	0	0.7	0.7	9.2	0	33.9

*Cost= reference cost.

Table 5 shows the average monthly cost of drugs classified at the second level of the ATC, and the number of elderly people who used these drugs. The drugs that represented the highest monthly cost for each patient in classes A, C and E respectively, included: anti-Parkinsonian and antipsychotic drugs, drugs for diabetes and drugs for the treatment of bone disease.

Table 5. Average spending by pharmacological groups most used by elderly persons from social groups. Porto Alegre, Rio Grande do Sul, 2007.

Pharmacological groups	Class A (n= 61)		Class C (n= 80)		Class E (n= 84)	
	M	Mean (min-max)*	M	Mean (min-max)*	M	Mean (min-max)*
Cholesterol and triglyceride reducing agents	19	74.37 (42.36-214.38)	16	28.30 (3.45-56.33)	17	39.18 (3.45-88.90)
Analgesics	28	3.72 (1.25-13.16)	12	3.89 (0.29-12.12)	36	1.84 (0.29-6.96)
Anxiolytics and hypnotics	14	35.05 (10.09-123.18)	14	30.64 (0.9-41.86)	10	5.59 (0.13-8.74)
Antidepressants	12	102.53 (21.24-242.64)	13	18.07 (1.34-45.90)	11	13.17 (0.72-44.75)
Antihypertensives	31	50.25 (2.63-94.86)	44	24.62 (0.37-107.49)	60	12.63 (0.02-98.87)
Antiallergics	6	27.47 (9.59-102.51)	2	37.64 (5.90-45.56)	5	10.97 (2.56-17.72)
Nonsteroidal anti-inflammatory drugs	2	19.54 (19.52-19.59)	12	6.53 (0.49-23.19)	21	3.51 (0.29-13.73)
Antidiabetics	2	44.81 (38.44-51.18)	5	64.64 (0.18-189.66)	17	8.76 (0.18-36.06)
Sex hormones during menopause	7	81.64 (17.35-157.58)	3	34.45 (12.54-52.87)	0	0
Antiparkinsonian / Antipsychotics	4	215.99 (51.37-657.00)	4	14.61 (0.42-235.87)	1	6.48
Antiulcer drugs	11	45.31 (5.74-71.13)	7	19.09 (1.65-38.69)	13	10.58 (1.65-35.42)
Drugs affecting bone structure and mineralization	21	45.39 (5.00-78.76)	13	43.21 (5.35-57.28)	6	40.17 (5.00-58.47)
Vitamins	16	54.66 (16.88-132.03)	5	18.33 (10.02-33.35)	2	9.49 (1.20-11.40)
Thyroid drugs	6	27.47 (8.00-46.54)	5	9.46 (8.00-11.74)	3	10.82 (8.00-8.47)

M= number of drugs; min= minimum price; max= maximum price; values in US$; *$p$<0.001; ANOVA/Tukey.

DISCUSSION

Aging is directly associated with a rise in medical expenses. The elderly participants in the present study were from three different economic profiles, which were selected in order to analyze the differences in drug spending between different socioeconomic classes.

The means of acquiring the drugs varied according to the socioeconomic status of individuals. In Class A, the average cost of drugs consumed by the elderly people, considering both the reference price and the social cost, was higher than the same cost for classes C and E. Applying the ANOVA and Tukey test, a significant difference in the average cost of medicines was

found, in terms of both the reference price and the social cost, between social classes A and E ($F=29.59$; $p<0.001$) and between classes A and C ($F=19.09$; $p<0.001$). The cost of medications consumed in class A was significantly higher than in other classes; however, there was no significant difference between classes C and E.

The elderly persons in socioeconomic class A mainly purchased their drugs in private institutions, which contributed to the fact that their spending on drug treatment was greater than among those from classes C and E, who have direct access to free medicines distributed by the Brazilian public health system. The cost of drugs purchased from the public health system may be undervalued as it does not consider other expenses such as human resources or the logistical costs of product distribution to different health facilities.

Comparing average monthly expenditure on medicine as a percentage of family income, it was observed that the Class A group spent the most on the purchase of medicines (60.0% of the national minimum wage and 4.0% of individual incomes). These figures represent a smaller impact on this class than the other classes interviewed: 19.0% (5.7% of the minimum wage) for Class C and 15.0% (10.0% of the minimum wage) for class E. However, this data represents only an estimated calculation, as both class C and class E get part of their medicines via the public sector.

This data corroborates the study by Boing *et al.*[16] which reports that while high-income populations use drugs prescribed by doctors, preferring those that have been recently made available in the market and are therefore technologically advanced, these costs represent only a small portion of their total income. While the consumption of drugs by the middle-income population is influenced by changes in prices, the low-income population has an inelastic demand in relation to price, as even when there is a significant drop in drug prices, the limited income of class E users limits their consumption capacity. In Brazil, the use of medications by the low-income population depends on the essential drug list adopted by public authorities.

Cross-sectional studies such as this can assess the prevalence of drug use and relate it to other variables such as social and demographic factors, health conditions, health system characteristics and factors related to drug costs. A study conducted in the metropolitan region of Belo Horizonte, in the state of Minas Gerais, showed that elderly persons from lower socioeconomic levels and health problems were associated with abandoning medication, particularly due to the high cost. Among the women in this study, nonadherence was associated with a low perception of health or with deteriorating health status. On the other hand, a low perception of health was connected with different neighborhoods, with a poor perception of physical environment contributing independently to adhesion.[15]

The drugs most frequently used by respondents of this study were related to the cardiovascular system, which is connected with the fact that cardiovascular diseases are the most prevalent among the elderly, as discussed by Metge *et al* (2004).[5]

Classes of drug related to the central nervous system, digestive tract and metabolism are often used in research regarding the elderly. In class C, the use of drugs for the digestive tract and metabolism was higher than for diseases of the nervous system. This frequency of consumption is reversed in class E, with a higher consumption of drugs to treat diseases of the nervous system than those for the digestive and metabolic systems.

Although medications for the cardiovascular system were the most frequently used in all social strata, it was observed that the drugs consumed in class A differed from the other classes. Hydrochlorothiazide, captopril, propranolol, and enalapril were most frequently used by classes C and E for the treatment of hypertension. Additionally, the use of new drugs or combinations of new drugs, such as losartan and valsartan was observed in class A. Amitriptyline and fluoxetine were predominantly used to treat depression in classes C and E, while venlafaxine, a drug which has been commercially available for a shorter time, was most used in class A. Furthermore, the consumption of drugs or healthcare products that use advertising

slogans such as "preventive medicine" or "dietary supplement", such as vitamins, was observed among elderly persons in Class A. Therefore, new drugs and combinations represent an increase in the cost of pharmacological treatment[21] and may have contributed to the higher drug costs of elderly persons in class A.

The present study found that the cost of acquisition of medication is not directly related to the gender of an individual (t-test for independent samples; p=0.945). Similarly, no difference was found between greater spending on the use of drugs and the increasing age of the respondents (t-test for independent samples; p=0.139). The association between increased drug costs and age, which was not observed in this study, could be credited to the fact that older people tend to consume a larger amount of drugs due to chronic diseases.[22]

In terms of the cost of drugs purchased, the amounts spent by individuals from class A were higher than those from other classes. The highest cost per drug class was antipsychotics [US$121.80 (±191.40)] and anti-Parkinsonian medication, while the cost of treatment for elderly persons from class C was US$8.20 (±4.30), emphasizing that, in this study, the elderly with higher purchasing power used newer drugs, which tend to incur higher costs.

In class E, the two therapeutic classes with the highest cost to patients were the drugs for the treatment of bone disease and lipid modifying agents. The most frequently used medications were those containing calcium associated with vitamin D and simvastatin. Although these drugs are included in the list of essential medicines in Brazil, they are not available for free distribution in all cities. In addition, such drugs incur a relatively high cost, considering the income of the elderly, which limits their acquisition in private pharmaceutical establishments.

The main limitations of this study were that it did not monitor changes in the use of drugs, the sample was convenience based and private sector costs were not evaluated by purchase receipt, but by prevailing market values.

CONCLUSIONS

The present study showed that there are specific differences in relation to the cost and the spending on drugs by elderly persons from different socioeconomic classes.

Individuals from class A tend to purchase medications in the private sector, while classes C and E use the Brazilian public health system and private institutions to access required medicines. The most commonly purchased drugs are related to the pharmacological groups recommended for the treatment of diseases prevalent among the elderly, such as hypertension and heart problems. Nevertheless, elderly persons from class A tend to use more recently commercialized or newer drugs than those from classes C and E. This factor increases the costs of such products for Class A. If the elderly in classes C and E were to acquire all their prescription drugs in commercial establishments, there would be a negative impact on their family income of 5.7% and 10.0%, respectively. However, most products can be purchased in the Brazilian public health system.

The cost analysis presented in this study provides important action planning data for health managers in Brazil, especially with regard to elderly patients, who are potential users of polypharmacy. As the irrational use of medicines is a major problem in public health, it is necessary to consider, in addition to the costs incurred in the acquisition of medications, the need for qualified assistance to ensure improvements in the use of drugs, in order to reduce the risk of morbidity and mortality.

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Effects of Aging and Exercise on the Cardiorespiratory Fitness of Older Women

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Abstract

Purpose: The present study analyzed the effects of chronological aging and the practice of regular exercise (PRE) on the cardiorespiratory fitness (CRF) of older women. *Methods:* A descriptive study of 78 participants was performed, with longitudinal design and an initial evaluation in 2005 and a second in 2011. The PRE defined groups as Inactive (I), Insufficiently-Active (IA), and Sufficiently-Active (SA). The six-minute walking test measured CRF. MANOVA with repeated-measures was used to verify the effect of time and the PRE groups on CRF ($p<0.05$). *Results:* The participants were classified as having a low socioeconomic level and being overweight. MANOVA demonstrated the effect of time ($F_{1.74}=30.134$; $p<0.05$) and groups ($F_{2.74}=3.729$; $p<0.05$), without interaction ($F_{2.74}=0.811$; $p>0.05$). Post hoc analysis indicated that the effect of time was significant between all groups (I: t=3.786, $p<0.05$; IA: t=2.597, $p<0.05$; SA: t=3.191, $p<0.05$); and the group effect was significant only between the I and SA groups in the second evaluation (First evaluation: $F_{2.76}=1.712$; $p>0.05$; Second Evaluation: $F_{2.77}=3.239$; $p<0.05$, *post hoc* Tukey: group I vs AS =$p<0.05$). A smaller reduction in CRF was found in the SA group (8.0%), followed by the IA (10.3%) and I (14.3%) groups. *Conclusion:* The results of the present study indicated that elderly women who practice exercise regularly had a smaller reduction in CRF than those who were inactive. This suggests that the PRE at recommended levels for health purposes can attenuate the effect of aging on the CRF.

Key words: aging; cardiorespiratory fitness; women; physical exercise.

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INTRODUCTION

The effects of the passing of time, or chronological aging, have been the subject of countless studies.[1,2] One of the main bodily systems affected by this process is the cardiorespiratory system, which is indirectly related to the risk of various chronic conditions, disabilities and early death.[3-,6] Veras[7] reported that the elderly have a higher burden of chronic diseases, especially diseases of the cardiovascular system, which causes increased demands on and use of health services by increasing the cost of treatment of such conditions. According to the Instituto Brasileiro de Geografia e Estatística (the Brazilian Institute of Geography and Statistics), the Brazilian population spent more on healthcare services than did the government in this sector.[8]

Maintaining cardiorespiratory capacity can be considered a determining factor for independent living and overall health, consequently minimizing public and personal spending on the treatment of such conditions. In addition, specifically among the elderly, satisfactory cardiorespiratory fitness (CRF) is required for various activities of daily living that involve large muscle groups for long periods, such as cleaning the house, gardening, getting from one place to another or simply bathing.[9,10] Low levels of CRF represent one of the main risk factors for obesity, hypertension, dyslipidemia, metabolic and cardiovascular disease and dependency. [6,11-15]

The arguments presented highlight the need to improve knowledge of the effects of chronological aging on the CRF of the elderly. However, studies previously conducted for this purpose have presented some limitations, such as discrepancies in the values of declining CRF. Cross-sectional studies indicate a reduction of between 5 and 10% per decade from the age of 30 onwards, while longitudinal studies have found a variance of between 5 and 20%.[16-18] Pollock *et al.*[17] warned of the dangers of such contradictory results and, in order to clarify this issue, conducted a study in which subjects were monitored for 20 years, with evaluations performed at baseline and after ten and twenty years. The sample consisted of professional male runners, who were divided into three groups according to their level of training. The annual decline in CRF was 2.17% among individuals who were still professional athletes, 2.34% among those who participated in competitions occasionally and 4.17% in subjects who had altered their exercise routine from racing to jogging. These results clearly indicate that the maintenance of regular physical exercise minimizes the effect of aging on CRF, and the reduction or absence of exercise dramatically increases the decline in CRF. Consequently, active individuals tend to reduce morbidity and also delay the onset or limitations of disability[6] and thus may have a lower biological than chronological age.

The decline of CRF over time has been found to range from 5% to 20% per decade. However, Fleg *et al.*[18] indicated that the decline varies depending on the age considered as a base and that from the age of 60 there is a more rapid decline in women. Therefore, it can be considered that changes in CRF can be influenced by physical exercise, gender and also by chronological age, with such changes having been found to be greater among elderly women. The aim of this study was to analyze the effects of chronological aging and regular physical exercise on the CRF of elderly women.

METHOD

Study Design

A descriptive study with a longitudinal design and two assessments was performed. Data from the first assessment (2005-2006) was reassessed in the first semester of 2011 - a mean interval of 5.8 years.

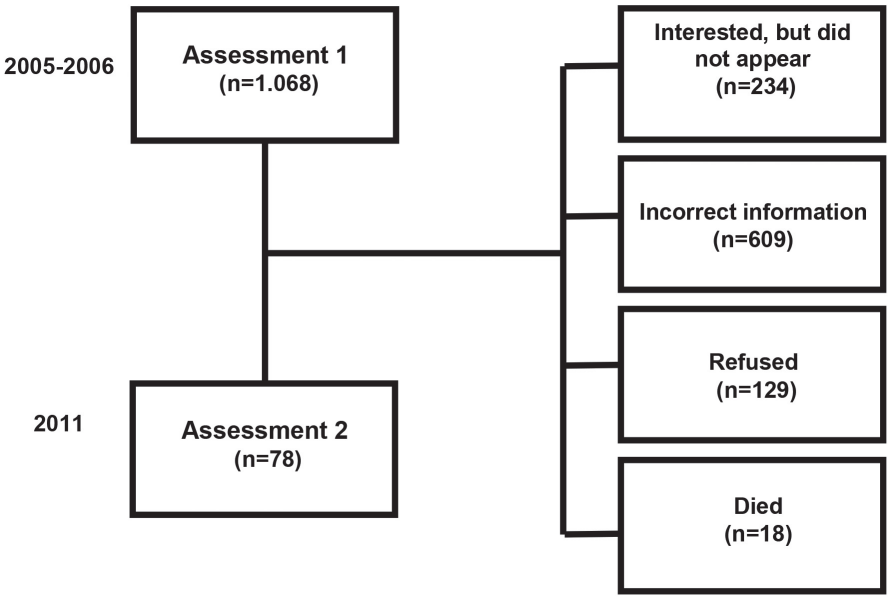


Figure 1. Flowchart of assessments. Curitiba - Parana, 2011.

Population and Sample

The present study was performed in the first semester of 2011, in the city of Curitiba, in the state of Paraná, among members of the Programa Terceira Idade Independente do Grupo de Pesquisa em Fisiologia da Atividade Física e Saúde da Universidade Tecnológica Federal do Paraná (the Independent Seniors Program of the Physiology of Physical Activity and Health Research Group of the Federal Technology University of Paraná. Those eligible (inclusion criteria) to participate in the study were women who participated in the first assessment in 2005 (n=1068) and were part of the Indepdendent Seniors program (2011). Initial contact with potential participants was conducted via telephone by a trained member of the group of researchers of this study, who described the purposes, potential benefits and associated risks of the study. After clarifying any doubts, the reassessment was scheduled. Free transportation was provided for the participants and at the time of reassessment, a researcher repeated the information related to the study and clarified any doubts that persisted. The clinical conditions of the elderly, such as which chronic diseases or disorders they suffered from and whether they were undergoing controlled medical treatment were ascertained through questioning. Some elderly women confirmed their clinical condition by presenting medical certificates, test results and the instructions of medicines used, although not all participants provided such information. Subsequently, the participant was asked to sign a clear and informed consent form, confirming their participation on a voluntary basis. The exclusion criteria were defined as elderly women who presented unfavorable psychological conditions for the tests/questionnaire, or who did not understand the procedures, thus affecting

performance test or questionnaire answers. It was not, however, necessary to exclude any of the potential participants. The final sample consisted of 78 participants (aged over 65).

The protocol of the study was submitted to and approved by the Ethics Research Committee of the Pontifícia Universidade Católica do Paraná (the Catholic University of Paraná) (CEP Nº. 0004798/11), in accordance with the guidelines of the Declaration of Helsinki and Resolution 196/96 of the National Health Council on research involving human beings.

Procedures

In order to avoid the influence of circadian variations, all evaluations were performed in the same period of the day (between 08:00 and 10:00 hours). The subjects were instructed not to perform vigorous physical activity the day before, as well as not to eat for a period of two hours prior to the assessment. All assessments were conducted at the academic office of the Physical Education Department of the Universidade Tecnológica Federal do Paraná.

Socioeconomic level

Socioeconomic status was determined by applying the Brazil economic classification criteria and was used for the descriptive characterization of the sample.[19] The results obtained from the questionnaire classifies socioeconomic level into seven classes: E (0-5 points), D (6-10 points) C (points 11-16), B2 (17-20 points), B1 (21-24 points), A2 (25-29 points) and A1 (30-34 points). For the purposes of classification, the classes were grouped into three categories: Upper (A1 and A2), Middle (B1 and B2) and Lower (C, D and E).

Anthropometric variables

Body mass and height were measured according to the procedures proposed by Lohman *et al.*[20] The individual being evaluated stood barefoot with her feet together, wearing light sports clothes (shorts, t-shirt or top) so that the measurement could be carried out with a mechanical scale with stadiometer (Welmy model 104A; resolution of 0.1 kilograms). Body mass index (BMI) was obtained by using the body mass/height ratio,[2] where the value of body weight is in kilograms and height in meters.

Practice of Regular Physical Exercise - PRE

The *Modified Baecke Questionnaire for older adults*[21] was used to measure the PRE. This instrument supplies a score based on the energetic demand of the physical activities performed by elderly persons, being subdivided into three domains of physical activity: domestic activities, sports/exercise and recreation/leisure. The score obtained in each area, as well as the sum of the areas is classified in metabolic equivalents (ME). This score is obtained from the intensity, duration in hours/week and period practiced (months previous year) of the reported activity. This study used only the sport/exercise domain in order to classify the elderly persons into three groups according to PRE score: Inactive (n=18) for those with a score of zero, Insufficiently Active (n=25), for those with scores greater than zero and less than 2.29, and Sufficiently Active (SA, n=34) for those with a score higher than 2.29 in the second assessment. The cut-off points followed the recommendations of the *American College of Sports Medicine* for the elderly,[9] which states that to be considered satisfactorily active older individuals should engage in moderate intensity physical activities (score=1.368), with a duration of 30 minutes per session and a frequency

of five weekly sessions (score=2.5); practiced for more than six months (score=0.67). The calculation was therefore performed by multiplying the scores: 1.368x2.5x0.67=2.29. Thus, the groups were classified considering only the level of physical activity specific to physical exercise, and not total physical activity level (the sum of all domains of the questionnaire). The questionnaire was conducted by previously trained evaluators in order to reduce variability among evaluators. The instrument had satisfactory validity when compared with other methods of measuring physical activity,[22] such as the Bouchard Record (a subjective measure), with a correlation of r=0.78, and the pedometer (objective measure), with a correlation of r=0.72. Reproducibility in elderly subjects was r=0.89.[23]

Cardiorespiratory Fitness

Cardiorespiratory fitness was measured by the six-minute walk test (6WT) in meters.[24] The test was conducted along a 54.4 m rectangular track (18.0 m long and 9.2 m wide). The distance walked in six minutes for each individual was recorded. The test was halted if, at any time, the participant showed signs of dizziness, pain, nausea, or undue fatigue. [Reproducibility: r=0.91 (95% CI 0.84-0.95); validation: r=0.71].

Statistical Analysis

All analyses were conducted using the Statistical Package for the Social Sciences (SPSS, 18.0) for Windows. In order to obtain the descriptive analysis of data, measurements of central tendency and variability were applied (mean and standard deviation). MANOVA with repeated measures was used to check the effect of time and of the PRE groups on cardiorespiratory fitness. For all analyzes, a significance level of $p<0.05$ was adopted.

RESULTS

The characteristics of the participants are shown in Table 1, which describes a stable socioeconomic status (SES), height and body weight and body mass index (BMI). The sample therefore comprised individuals of low SES with a nutritional status indicative of overweight.

Table 1. Descriptive characteristics of participants. Curitiba, Parana, 2011.

(n=78)	First Assessment	Second Assessment
Age (years)	67.2 (5.4)	73.2 (5.2)
SES (points)	13.8 (4.5)	14.2 (4.0)
Body Mass (kg)	68.5 (11.0)	68.4 (12.1)
Height (m)	1.54 (0.06)	1.54 (0.06)
BMI (kg/m^2)	28.5 (3.9)	28.6 (4.2)

SES: Socioeconomic Status; BMI: Body Mass Index.

Alterations in CRF are shown in Table 2. The average PRE values for the first and second assessments are shown. The groups were named according to the following characteristics: Inactive (I - no PRE), Insufficiently active (IA - PRE that does not meet recommendations for the promotion of health), and Sufficiently active (SA - meets or exceeds PRE recommendations for health promotion).

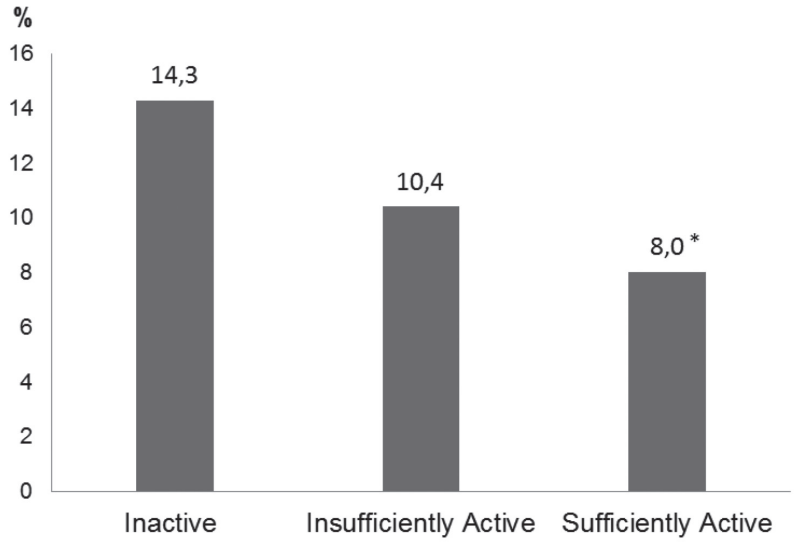
MANOVA showed an effect for time ($F_{1.74}$=30.134; p<0.05) and groups ($F_{2.74}$=3.729, p<0.05), without interaction ($F_{2.74}$=0.811, p>0.05). Further analysis indicated that there were differences between assessments for all groups (I: t =3.786, p<0.05; IA: t=2.597, p<0.05; SA: t=3.191, p<0.05). The differences between groups were only significant between I and SA in the second assessment (First Assessment: $F_{2.76}$ =1.712, p<0.05; Second Assessment: $F_{2.77}$=3.239, p<0.05, *post hoc* Tukey: group I vs SA =p<0.05)

Based on data from Table 2, the percentage decline in cardiorespiratory fitness (Figure 1) was calculated. In this figure, it can be seen that the decline was significantly higher in the group of inactive elderly persons, or those who said they did not practice regular exercise. Those who reported performing regular exercise (the sufficiently active group) achieved the smallest reduction over time.

Table 2. Alterations in cardiorespiratory fitness. Curitiba, Parana, 2011.

	Inactive – I (n=18)	**Insufficiently Active – IA (n=25)**	**Sufficiently Active – SA (n=34)**
6MWT_A1 (meters)	484.9 (60.2)	513.3 (85.9)	522.7 (62.4)
6MWT_A2 (meters)	410.6 (115.0)*	459.7 (93.3)*	480.8 (92.6)*§

Mean and standard-deviation, in brackets; 6MWT: Six-minute walk test; A1: first assessment; A2: second assessment. *Differences between A1 and A2; §Differs from inactive group_A2, p<0.05.



Mean temporal variation of 5.8 years.

Figure 2. Alterations in cardiorespiratory fitness due to chronological aging. Significant difference with Inactive group (p<0,05). Curitiba, Parana, 2011.

DISCUSSION

Although chronological aging brings an inevitable decline in cardiorespiratory fitness (CRF), the practice of regular exercise (PRE) can mitigate this process. As noted in the results, the decline in CRF was worse in the group of women classified as "inactive" in comparison with those in the "active" group. In the active group, the decline was only 8%, or 1.3% per year, statistically different to the inactive group, which exhibited a decrease of 14.0%, or 1.8% per year. Furthermore, it was observed that the CRF level of the active group during reassessment (480.8 m) was similar to that found in the inactive group in the first assessment (484.9 m). These results indicate that elderly persons who fulfilled the PRE recommendations managed to mitigate the decline in CRF and maintained fitness levels of 5.8 years earlier compared with their inactive peers.

In contrast, a cross-sectional study by Krause *et al.*[3] analyzed the decline in CRF of 960 elderly women, grouped into age groups with intervals of five years (60 to <80 years). CRF was evaluated by the six-minute walk test (6MWT). The groups were divided into: 1) did not engage in physical activity, similar to the inactive group of this study; and engaged in 2) low and 3) moderate intensity physical activity, corresponding to the groups insufficiently and sufficiently active, respectively. From the cross-sectional data, it was found that the annual decline was 0.74% for group 1 and 2, and 0.64% in group 3. However, the results of the present study showed an annual decrease of 2.46%, 1.79% and 1.37% respectively for each group. It was therefore observed that the cross-sectional data underestimated the true decline in CRF in inactive women by more than threefold, and around twice for those who practiced physical exercise. The implications of such comparisons indicate that cross-sectional surveys tend to underestimate the results of longitudinal studies. In keeping with this study, Fleg *et al.*[18] carried out a study with a sample of 435 men and 375 women aged 21-87 years who participated in the Baltimore Longitudinal Study of Aging. Oxygen consumption (VO2) was measured in a submaximal treadmill test with Balke protocol, via a metabolic analyzer, measuring gas exchange every 30 seconds. VO2 was used to determine the longitudinal rate of decline in cardiorespiratory fitness (CRF). The results show a substantially greater longitudinal decline than those shown in cross-sectional analyzes. The lesser decline reported in cross-sectional studies can be partly explained by natural selection, favoring research with genetically benefited individuals or those who maintained an active lifestyle.[18]

The study by Fleg *et al*[18] reported a rapid decline in CRF in women aged 60 years and over. For example, the CRF of women aged 40 decreased by 9.6% per decade, while the CRF of women aged over 70 years old decreased by 17.2%, with values adjusted for lean mass. Through a linear regression model, a decline in CRF of 3% to 6% per decade was found for the 20 to 30-year age group, rising substantially to over 20% per decade for the 70 or over age group in both men and women. It was therefore calculated that young and middle-aged adults exhibited an annual decline of 0.3%, while older adults aged 70 years and over had a decline of 2% a year, suggesting that there is a greater decline in CRF with age.

The maintenance of satisfactory levels of CRF can affect the independence of the elderly. These findings were investigated longitudinally (over 13 years) by Wang *et al.*[6] The study sample consisted of 961 individuals classified as runners and non-runners (who had never run), with an initial age of 50-72 years. Aiming to determine the degree to which disability could be delayed, the study compared the development of such disabilities between the groups, finding that the runners group delayed this process by approximately 8.7 years (CI 95% 5.5 to 13.7) compared to the non-runners group. The results indicate that regular physical exercise, or in this case, predominantly aerobic exercise, can delay the onset of disability, morbidity and mortality, influencing the quality of life of individuals, as disability is linked to the condition of independently performing activities of daily living.[6,15,25]

Chronic diseases are indirectly related to CRF. The CRF of elderly women suffering from two and three chronic diseases was 15% and 23% (as measured by maximal oxygen uptake in a maximum treadmill test using a metabolic analyzer, measuring gas exchange with each breath) lower, respectively, than those who did not have any chronic disease.[26] A study by Krause *et al.*[27] with 1,064 older women found a higher prevalence (53.9%) of hypertension in women with low CRF (assessed using the six-minute walk test). Furthermore, it was observed that the groups with a higher CRF had a 33% and 36% lower chance, respectively, of developing hypertension.

The results of this study exhibit some limitations, such as the sample loss between assessments and the lack of a confirmed medical diagnosis of the chronic diseases (CDs) of the participants. The main limitation was linked to the sample size, although this fact does not minimize the scientific and clinical relevance of the findings in demonstrating that the CRF of older women may be influenced by physical exercise, gender and also by chronological age; emphasizing principally that active women, or those who performed regular exercise were able to mitigate the decline of CRF to a greater degree than their inactive peers (who did not participate in exercise). It can be only be said that the main CDs self-reported by the elderly women were: hypertension (SAH), diabetes, back pain (non-specific) and arthrosis. Although due to the inaccuracy of such information these details were not included in the analysis of the study, it is clear that CDs may accelerate the decline of CRF, especially in the case of cardiovascular (such as hypertension) or metabolic (such as diabetes) diseases. It is recommended that future studies include the medical diagnosis of CDs and that this variable is included in statistical analysis in order to verify the effect of CDs on alterations in CRF.

CONCLUSION

Evidence has shown that maintaining high or satisfactory levels of CRF throughout life, including when older, can act as a protective factor against various chronic conditions.[3,11,13] The results of the present study indicate that elderly women who regularly practiced physical exercise suffered a lesser decline in CRF than their inactive peers. It was also observed that the CRF level of the active group during reassessment (480.8 m) was similar to that found in the inactive group during the first assessment (484.9 m), indicating that elderly persons who fulfilled PRE recommendations maintained levels of fitness of 5.8 years earlier than their inactive peers. This result confirms the initially presented hypothesis that the maintenance of physical exercise can positively influence the inevitable process of aging of CRF. It should be emphasized that the results presented in the present study relate 1) specifically to "exercise" and do not include definitions of "active" in various activities of daily living (in the domains: domestic, leisure, occupational or movement); and 2) longitudinal comparisons, which are more accurate than cross-sectional data, which usually exhibit underestimated values, and do not indicate the true decline in CRF among the elderly. Thus, it is recommended that older people continue to perform physical exercise at recommended levels in order to mitigate the effect of aging on CRF and avoid negative health consequences. Specific public health interventions for the elderly that guarantee the right to health and promote the practice of supervised physical exercise, rather than simply increasing the overall level of physical activity among this population, are also required. Supervision of exercise is important due to the other clinical conditions presented by the majority of elderly people, which classify this group as a unique population that requires specific guidelines for benefiting health and to avoid triggering the harmful effects of incorrectly performed exercise.

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Falls among the non-institutionalized elderly in northern Minas Gerais, Brazil: prevalence and associated factors

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Abstract

Objective: To identify the prevalence of falls and associated factors in non-institutionalized elderly persons. *Methods:* A cross-sectional study featuring a population-based sample of non-institutionalized elderly persons in a city in the north of Minas Gerais was performed. Interviews were conducted in households by trained staff using validated instruments. We investigated the associations between falls and demographic, socioeconomic and health-related factors. After bivariate analysis, the variables associated with falls to a level of 20% were analyzed together using logistic regression, assuming at this stage a significance level of 5%. *Results:* The studied population was predominantly female, married and with a low educational level. The prevalence of falls was 28.4%. The factors that were associated with falls were: female gender (OR=1.67; 95% CI:1.13 to 2.47); negative self-evaluation of health (OR=1.49; 95% CI: 1.02 to 2.20); impaired functional mobility (Timed Up and Go test >20 seconds) (OR=1.66; 95CI: 1.02-2.74); the occurrence of hospitalization in the previous 12 months (OR=1.82; 95% CI: 1.17 to 2.84); and frailty measured by the Edmonton Frail Scale (OR=1.73; 95% CI: 1.14 to 2.64). *Conclusions:* The prevalence of falls was high for the population studied and was related to the individual health conditions of the elderly.

Keywords: Aged. Accidental falls. Risk factors.

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INTRODUCTION

In recent years, the Brazilian elderly population has increased nearly twice as quickly as the general population, and is the fastest growing population segment in the country. Official records reveal that there are around 20 million people aged over 60 in Brazil at the moment, representing at least 10% of the country's population.[1] This accelerated population aging has resulted in new needs and care provisions.[2]

One aspect that stands out in the aging process is that related to physical disabilities and the degree of dependence of the elderly. Although functional disability is not inherent in the aging process,[3] as individuals age, the chance of suffering injuries caused by accidents increases.[4] Studies show that such injuries are among the leading causes of death among older people and falls account for up to two thirds of accidents involving the elderly, representing one of the main predictors of morbidity and mortality.[5-8]

Falls in elderly people may indicate the beginning of frailty or acute disease. Besides the previously mentioned risk of death, falls result in constant injuries and fractures, compromise activities of daily living, increase rates of institutionalization, generate a decline in general health and increase fear of falling among the elderly, which, in turn, increases the risk of subsequent falls.[9] Falls produce deleterious consequences not only for the elderly but also increase the cost of hospitalization and other health services, and as such represent a major public health problem.[10]

Adequate knowledge about the occurrence of falls in the elderly and devoting the necessary attention to the problem can guide more appropriate and effective preventive measures in health facilities. Some Brazilian studies have revealed that demographic variables may be associated with the problem, such as gender,[11-13] age,[10-14] the lack of a partner[15] and income,[14] as well as health-related variables such as the presence of comorbidities,[16-18] polypharmacy[15,19] and self-perception of health.[14-16]

However, there are still variables that have been little explored in Brazilian literature, such as frailty[20] and other comorbidities. There are also no studies on the subject for the northern region of Minas Gerais. This region is characterized as a transition area between the southeast and the northeast of the country, with social indicators that demonstrate major socio-economic needs. Local studies may be representative for other regions of the country. The present study aimed to assess the prevalence of the occurrence of falls and associated factors among the elderly, investigating as yet unexplored variables in a population-based sample of non-institutionalized elderly persons in a regional hub city in the north of Minas Gerais.

METHODS

A cross-sectional and analytical study of non-institutionalized elderly living in the city of Montes Claros, northern Minas Gerais, was conducted. The city has a population of approximately 400,000 inhabitants and is the main regional urban hub.

Sampling was probabilistic by cluster and performed in two stages. In the first stage, the census tract was used as the sampling unit, with 42 of the 362 urban census tracts in the city randomly selected. In the second stage, the number of households was defined, according to the population density of individuals aged 60 or over. At this stage, more households were allocated in the sectors with the highest number of elderly persons, in order to produce a more representative sample.

The sample calculation considered a total population of 30,790 elderly persons (according to IBGE data), a margin of error of 5%, a confidence level of 95% and a prevalence of 28.5%, as this is the median observed in a systematic review study.[10] As cluster sampling was employed, the identified number was multiplied by a correction factor (deff) of two and 10% was added for possible losses. Thus, the minimum number of persons in the sample size calculation of the study was 682.

Elderly persons who were considered by their caregivers/family members to be unable to answer the questions or those who refused to participate in the study were excluded. Elderly persons who were unable to participate in at least three visits on different days and times, even with prior appointments, were considered losses.

Data collection was carried out in the homes of the elderly persons between May and July 2013. Interviewers, who were graduates in nursing, were trained and a pilot study was developed before the collection of data for analysis. The census tracts were visited clockwise from a predetermined point. The data collection instrument was based on similar population-based studies. The pilot study data, from a specially drawn census tract, was not included in the final analysis.

The independent variables studied were: gender (male vs. female), age (younger than 80 years x 80 years or older), self-reported skin color, marital status (married or civil union x without partner), family income (greater than one minimum salary x equal to or lower than one minimum salary), self-perceived health (positive x negative), frailty (defined by the Edmonton Frail Scale, which evaluates nine domains with a score from zero to 17 and defines frailty as a score greater than six),[21] fear of falling (no x yes), presence of chronic comorbidities (hypertension, diabetes mellitus, osteoporosis, arthritis/arthrosis/rheumatism, heart disease, all self-reported – no x yes), polypharmacy (defined as the continuous use of five or more drugs – no x yes), hospitalization in the last year (no x yes), depressive symptoms (defined by the reduced version of the Yesevage Geriatric Depression Scale - GDS 15, wherein a score equal to or greater than six identifies depressive symptoms),[22] functional mobility through the Timed Up and Go test (where a time equal to or greater than 20 seconds is suggestive of more difficult mobility for the elderly)[23] and smoking (no x yes). All the variables were dichotomized for data analysis.

The prevalence of falls in the previous 12 months was taken as the outcome variable. Initially, bivariate associations were established between the record of falls and the variables using the chi-squared test. In a second step, variables that were associated to a level of 20% ($p<0.20$) were jointly evaluated by logistic regression. At this stage, the odds ratio was calculated (OR) with respective confidence intervals of 95%, to evaluate the magnitude of associations, assuming a significance level of 5% ($p<0.05$). Analysis was performed using the Statistical Package for the Social Sciences (SPSS), version 17.0 (SPSS for Windows, Chicago, USA) program.

All the participants were fully informed about the research and gave their consent by signing a Free and Informed Consent Form or by a digital fingerprint record, when unable to sign. The research project was approved by the Research Ethics Committee of the Universidade Estadual de Montes Claros (Montes Claros State University) (Process nº 173397).

RESULTS

The study included 683 predominantly female elderly persons, aged between 60 and 98 years, with a mean of 70.9 years (SD±8.08). Most described their skin color as brown (57.1%). There was a predominance of married elderly persons (48.6%). Among the respondents, most reported having up to four years of study, and 26.1% had no schooling. These and other features of the group are presented in Table 1.

Table 1. Sociodemographic characteristics of elderly persons in Montes Claros, Minas Gerais, 2013.

Variables	n	%
Gender		
Female	443	64.9
Male	240	35.1
Age		
60 to 69 years	340	49.8
70 to 79 years	237	34.7
More than 80 years	106	15.5
Skin color/Ethnic Background		
Brown/Mixed Race	390	57.1
Black/Afro-Brazilian	65	9.5
White/Caucasian	214	31.3
Yellow/Asian Brazilian	14	2
Marital Status		
Single	45	6.6
Married	332	48.6
Stable Union	18	2.6
Divorced/separated	54	7.9
Widowed	234	34.3
Family income*		
≤ 1 minimum wage	195	28.6
1 to 2 minimum wages	227	33.2
> 2 minimum wages	261	38.2
Personal income through retirement		
Yes	431	63.1
No	252	36.9
Religion		
Catholic	474	69.4
Evangelical Protestant	192	28.1
Other	4	0.6
None	13	1.9
Practice religion		
Yes	559	81.8
No	124	18.2

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Continuation of Table 1

Variables	n	%
Educational level		
Never studied	178	26.1
1 to 4 years	343	50.2
> 4 years	162	23.7
Living arrangement		
Live alone	82	12.0
Live only with partner	119	17.4
Live with other family members	479	70.1
Live with non-family members	3	0.4

* Minimum wage at time of study (2013) = R$ 678.00

In relation to health and healthcare, described in Table 2, the majority of respondents said the public system was the most used type of service (68.8%). Health was perceived as good or very good was cited by 291 people (42.6%). About a quarter of respondents (23.6%) reported needing to use five or more drugs of continuously. During the approach, 243 elderly persons (35.6%) were classified with some degree of frailty by the Edmonton Scale and 200 (29.3%) had scores suggestive of depression symptoms according to the Geriatric Depression Scale.

Table 2. Characteristics related to health care and health conditions among elderly persons in Montes Claros, Minas Gerais, 2013.

Variables	n	%
Type of health service most used		
Public (SUS)	470	68.8
Private	28	4.1
Healthcare plan	120	17.6
Couldn't say	65	9.5
Possess healthcare plan		
Yes	232	34.0
No	451	66.0
Use of five or more medications		
Yes	161	23.6
No	522	76.4

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Continuation of Table 2

Variables	n	%
Has caregiver		
Yes	117	17.1
No	566	82.9
Self-perceived health		
Very good or good	291	42.6
Reasonable	302	35.4
Poor or very poor	90	13.2
Smoking		
Never smoked	382	55.9
Has smoked	242	35.4
Smoker	59	8.6
Analysis of Frailty (Edmonton Frail Scale)		
Frail	243	35.6
Vulnerable	152	22.2
Not frail	288	42.2
Depressive symptoms (GDS-15)		
Yes	200	29.3
No	483	70.7
Hospitalization in previous 12 months		
Yes	121	17.7
No	562	82.3
Comorbidity reported*		
Yes	580	84.9
No	103	15.1
Fear of falls		
Yes	490	71.7
No	193	28.3
Timed Up and Go Test		
< 20 seconds	587	85.9
≥ 20 seconds	96	14.1

* Self-reported hypertension, diabetes mellitus, osteoporosis, arthritis/arthrosis/rheumatism, heart disease were evaluated.

For this sample, the prevalence of falls in the previous 12 months prior to the survey was 28.3%, with most individuals suffering a single fall in this period. The main reported cause was slipping/tripping and most fallers reported needing help to get up (Table 3).

Table 4 presents the results of the bivariate analysis between falls and the main variables. For space limitations, not all the associations investigated are shown.

Table 3. Characteristics linked to falls and postural instability of elderly persons in Montes Claros, Minas Gerais, 2013*.

Variables	n	%
Number of falls in previous 12 months		
One	85	44.0
Two to four	81	42.0
Five or more	27	14.0
Cause of falls		
Tripped/slipped	147	76.2
Loss of consciousness	22	11.4
No apparent reason	24	12.4
Help required in getting up after fall		
Yes	101	52.3
No	92	47.7
Support needed when walking		
Walks alone	167	86.5
Use of aids (canes, crutches, wheelchairs)	26	13.5
Fear of falls		
Yes	157	81.3
No	36	18.7

* Refers only to number of elderly persons who reported falling in last 12 months (n=194)

Table 4. Bivariate analysis for variables associated with falls in previous 12 months among elderly persons in Montes Claros, Minas Gerais, 2013.

Independent variables	Falls					
	Yes		No			
	(n)	(%)	(n)	(%)	OR (CI95%)	p-valor
Gender						< 0.001
Male	50	25.8	190	38.9	1	
Female	144	74.2	299	61.1	1.83 (1.26; 2.65)	
Age						0.020
< 80 years	154	79.4	423	86.5	1	
≥ 80 years	40	20.6	66	13.5	1.66 (1.08; 2.57)	
Marital situation						
Married/Stable Union	84	43.3	266	54.4	1	0.009
Lived Alone	110	56.7	223	45.6	1.56 (1.12; 2.18)	
Income						0.654
> 1 minimum wage	141	72.7	347	71.0	1	
≤ 1 minimum wage	53	27.3	142	29.0	0.92 (0.63; 1.33)	
Self-perceived health*						< 0.001
Positive	60	30.9	230	47.0	1	
Negative	134	69.1	259	53.0	1.98(1.39; 2.82)	
Frailty scale						< 0.001
Not frail	50	25.8	238	51.3	1	
Frail/Vulnerable	144	74.2	251	48.7	2.73 (1.89; 3.94)	
Fear of falls						< 0.001
No	36	18.6	157	32.1	1	
Yes	158	81.4	332	67.9	2.08 (1.38; 3.12)	
Osteoporosis**						0.005
No	121	66.5	371	77.4	1	
Yes	61	33.5	108	22.6	1.73 (1.19; 2.52)	
Hypertension**						0.221
No	49	25.3	148	30.3	1	
Yes	145	74.7	340	69.7	1.28 (0.88; 1.88)	
Diabetes Mellitus**						0.176
No	144	74.2	384	79.0	1	
Yes	50	25.8	102	21.0	1.31 (0.89;1.93)	

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Continuation of Table 4

Independent variables	Falls					
	Yes		No			
	(n)	(%)	(n)	(%)	OR (CI95%)	p-valor
Cardiac disease**						0.051
No	134	70.2	373	77.7	1	
Yes	57	29.8	107	22.3	1.48 (1.02;2.16)	
Arthritis /rheumatism / arthrosis**						< 0.001
No	99	52.7	331	68.7	1	
Yes	89	47.3	151	31.3	1.97 (1.39; 2.78)	
Polypharmacy						< 0.001
No	130	67.0	392	80.2	1	
Yes	64	33.0	97	19.8	1.99 (1.37; 2.89)	
Hospitalization in previous year						< 0.001
No	145	74.7	428	87.5	1	
Yes	49	25.3	61	12.5	2.37 (1.56;3.61)	
Depressive symptoms						0.029
No	125	64.4	358	73.2	1	
Yes	69	35.6	131	26.8	1.50 (1.06; 2.15)	
Timed Up and Go Test						< 0.001
< 20 seconds	152	78.4	435	89.0	1	
≥ 20 seconds	42	21.6	54	11.0	2.23 (1.43; 3.47)	
Smoking						0.040
Never smoked	121	62.4	261	53.4	1	
Smoker/ex-smoker	73	37.6	228	46.6	0.69 (0.49; 0.97)	

* The categories regular/poor/very poor were considered as a negative self-perception of health. ** Incomplete information was excluded (patients that did not know about disease)

Table 5 shows the variables in the final model, after multivariate analysis. Female gender, a negative self-perception of health, functional mobility impairment (Timed Up and Go test ≥20 seconds), record of hospitalization in the previous 12 months and frailty according to the Edmonton Frail Scale were associated with the occurrence of falls in the previous 12 months.

Table 5. Variables associated with the occurrence of falls among elderly persons in Montes Claros, Minas Gerais, 2013.

Independent Variables	OR (CI95%)	P
Gender		0.011
Male	1	
Female	1.67 (1.13; 2.47)	
Self-perception of health		0.040
Positive (Very good/Good)	1	
Negative (Regular/Poor/Very Poor)	1.49 (1.02; 2.20)	
Frailty scale		0.011
Not frail	1	
Frail/vulnerable	1.73 (1.14; 2.64)	
Timed Up and Go Test		0.046
< 20 seconds	1	
≥ 20 seconds	1.66 (1.02; 2.74)	
Hospitalization in previous year		0.008
No	1	
Yes	1.82 (1.17; 2.84)	

DISCUSSION

The prevalence of falls in the previous 12 months reported by the elderly persons in the present study was very close to that revealed by a Brazilian study which sampled 100 municipalities in 23 states.[11] Other Brazilian studies have reported a higher prevalence of falls among the elderly, although these dealt with institutionalized populations.[13,14] In a review of the topic, the authors observed studies where the prevalence ranged from 15.9% to 56.3%, although it should be noted that this broad range included samples limited to the institutionalized population and larger studies with a population-based analysis.[10]

Among the sociodemographic variables, only the female gender was associated with falls. This result has been observed by other authors.[11-13,16,18] There are no specific explanations for this finding, but other authors have highlighted characteristics specific to women such as reduced muscle strength and muscle mass and a higher prevalence of degenerative chronic diseases. [11,24] It is worth noting that one study found that the female gender is also associated with recurrent falls.[17]

As for the variable of hospitalization in the year preceding the survey, which was also present in the final model, the risk of falls was greater among elderly persons who had been hospitalized at least once. It was not possible in the present study to verify whether these hospitalizations were directly related to falls or not. However, it can be inferred that this apparent association may be either because a fall is a cause for hospitalization, or as a serious indicator of morbidity and frailty. In this case, immobility, the medications used or the underlying disease, when present, could predispose the individual to falls. Although the association between falls and hospitalizations is common,[24,25] the association between records of hospitalization in the previous year and the occurrence of falls was observed in one Brazilian

study, which addressed the occurrence of falls in institutionalized elderly persons.[5] This finding should be further investigated in future research.

A negative perception of health (classified here as "regular", "poor" or "very poor") was also revealed to be associated with a greater chance of falls. The same association was found in other studies.[14-16] It is possible that the indicator is closely related to difficulties with balance.[14] Self-rated health is considered an important health indicator, and is widely used in research and health surveys due to its easy applicability and low cost, compared to other more complex methods. It is a subjective health measure, but reflects the presence of diseases and their impact on the quality of life of individuals.[26] In Brazil, the development of further research in this area is desirable, according to a recent review on the subject.[27]

The impairment of functional mobility as measured by the Timed Up and Go test was also associated with the occurrence of falls in the present study. This result has also been recorded in other studies.[14,28] The test is simple to perform and can quickly identify disorders in balance and mobility. It is therefore an essential aspect of geriatric evaluation.[23] It is imperative, therefore, that this test is routinely implemented in assessments of older people, in order to identify situations of risk and anticipate specific advice and care.

The greater incidence of falls in elder persons with some degree of frailty has been little investigated in Brazilian literature. Only one study conducted in São Paulo recorded a positive association between the variables, with the authors highlighting the possibility of a two-way relationship – in other words, that falls can make elderly persons frail and frailty can cause elderly persons to fall.[20] Literature from outside Brazil shows this association more frequently, although there is no standardization of studies on how to assess frailty.[29,30] In the present study, analysis of the studied population by the Edmonton Frail Scale confirmed the association between falls and frailty. This scale is a culturally-adapted instrument validated for the Portuguese language which evaluates nine domains (cognition, health, functional independence, social support, medication, nutrition, mood, urinary continence and functional performance), and is considered a robust instrument due to its multidimensional character.[21,31]

Other variables identified in literature as associated with the occurrence of falls in the elderly were not identified in this study. Some studies investigated morbidities, for example, which revealed an association in bivariate analysis but did not remain in the final model. An association with osteoporosis, arthritis/arthrosis/rheumatism and falls was identified in another study.[17] It is natural to assume that such conditions lead to uncomfortable situations, with increased sensitivity and stiffness, among other symptoms, contributing to decreased physical ability, affecting mobility and leading to falls. However, these authors did not evaluate functional mobility or frailty, aspects which may include the aforementioned morbidities, in joint multivariate analysis.

The identification of fear of falling as a variable associated with the occurrence of falls in some studies[9,32] was also not maintained in the final model of the present study. It should be noted, however, that such studies involved a small sample, a fact that may explain the difference observed. Still, we must emphasize that fear of falling is a common profile among the elderly and can make older people feel less confident in performing their daily activities, increasing immobility and postural instability.[33]

The present study did not find a relationship between the presence of depressive symptoms/depression and the occurrence of falls, unlike other Brazilian[13,17] and non-Brazilian[34,35] studies. This is an important relationship and deserves greater attention from researchers and practitioners. There is not always enough information in studies about the prior exclusion of elderly patients using antidepressant medication, an aspect that can affect comparisons between studies.

This study has some significant limitations, such as the fact that the data was obtained from the responses of respondents. Moreover, the consequences of the falls were not included, which could further contribute to defining the impact on health of the elderly in the region, justifying

more emphatically the need for intervention and more effective prevention measures. Environmental aspects related to falls, such as the characteristics of the site of the fall or the circumstances associated with the event, were not investigated. Also, although there were few losses and refusals relating to participation, the fact that some elderly persons were not at home restricts the more general interpretation of the data. However, it should be emphasized that the study featured a large sample, allowing knowledge to be obtained of a health issue for the elderly that had not been studied in the region.

CONCLUSION

The study found that falls are a common event among elderly persons living in the community in the north of Minas Gerais. Knowledge of associated variables can contribute to the implementation of more effective preventive measures, as such variables are at least partly subject to intervention. Changes in these factors may decrease the risk of falling and its consequences. To achieve this, comprehensive and multidisciplinary care of the elderly is required.

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Effects of age on the frequency of micronuclei and degenerative nuclear abnormalities

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Abstract

The effects of aging, gender and lifestyle factors on inducing chromosomal damage (micronuclei) and nuclear degenerative changes were assessed using the micronucleus test on exfoliated cells of the oral mucosa. The sample included 80 healthy subjects divided into four groups according to age and gender: men and women aged 19-29 years (M19, W19) and men and women aged over sixty years (M60, W60). An interview questionnaire was used to characterize the sample and to determine an index reflecting lifestyle (HLI). The frequency of micronuclei and nuclear degenerative changes was significantly higher among the elderly ($p<0.001$) and did not differ by gender among young people ($p>0.05$). The occurrence of micronuclei was similar among elderly men and women ($p>0.10$), but karyorrhexis and karyolysis were more frequent among men ($p<0.005$ and $p<0.025$, respectively), who also had a lower HLI than the other groups ($p<0.0004$). The results of the study indicate that age is the main factor associated with the induction of genetic material damage.

Keywords: Age Groups; Gender; Micronucleus; Apoptosis

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INTRODUCTION

Advancing age is characterized by a general reduction in physiological efficiency, resulting in homeostatic imbalance and the subsequent onset of illnesses inherent to the aging process. Studies suggest that this process is associated with an increase in genomic instability due to the reduced capacity to repair damaged DNA.[1,2] It has been reported that, in old age, biomarkers of genomic instability, such as micronuclei (MN), are more common in the peripheral lymphocytes[3,4] and exfoliated epithelial cells.[5,6]

The accumulation of DNA damage is a significant event in the aging of cells. During this process, there is a progressive decrease in metabolic enzymes and DNA-repair enzymes, which increases the predisposition and susceptibility of the cells to exogenous and/or endogenous genotoxic agents. These factors contribute to an increase in age-related spontaneous DNA damage.[7,8]

Therefore, modifications to genetic material do not only occur as a result of exposure to mutagens. They can also be caused by chemical reactions related to physiological processes.[9] In addition to age, studies have shown that differences in the occurrence of genetic damage can also be related to gender.[10-12] Trzeciak *et al.*[11] reported that the removal of active carcinogens through tobacco is lower in women, thereby indicating biochemical differences between the genders. Larmarcovai *et al.*[10] and Kažimírová *et al.*[12] reported a greater occurrence of MN as a result of age and gender.

The prevalence of DNA damage is also influenced by factors related to lifestyle. Smoking, drinking alcohol, working long hours, not sleeping enough, physical inactivity, type of diet and psychological stress contribute to an increased prevalence and the consequent development of illnesses, including cancer.[13,14,15]

Cancer leads to alterations in the genes involved in controlling cellular proliferation, cellular differentiation, DNA repair and apoptosis. Thus, the quantification of genetic damage is important when assessing the risks of developing cancer.[16,17]

The micronucleus test for exfoliated cells from the oral mucosa is considered an effective method of identifying genetic damage through chromosomal losses and breaks, particularly when conducted in accordance with the protocols described by Tolbert *et al.*[18,19] and Thomas *et al.*[17] These protocols calculate MN and degenerative nuclear alterations that are indicative of apoptosis and necrosis.

Therefore, the aim of the present study was to assess the effects of age and gender on the prevalence of micronuclei and degenerative nuclear alterations, while also considering lifestyle factors.

METHODS

Ethical aspects

The present study was conducted in accordance with the legislation of the Brazilian National Health Council (CNS 196/96), which is based on the Declarations of Helsinki/Hong Kong. The research received approval from the Research Ethics Committee of the Universidade Estadual de Feira de Santana (Feira de Santana State University) (Protocol 063/2009). All of the participants signed a free and informed consent form.

Study period

The present study was conducted between March and November of 2010.

Sample

The sample contained 80 individuals, who were divided into four groups of twenty:

- M19: men aged between 19 and 29 years;
- W19: women aged between 19 and 29 years;
- M60: men aged 60 years or more;
- W60: women aged 60 years or more.

Characterization of the sample

The sample was characterized using an interview questionnaire (adapted from Caires[20]) that contained questions about gender, age, diet, smoking, alcohol consumption, hours of sleep, professional occupation, physical exercise, stress levels, the use of oral antiseptics, chronic illnesses and exposure to genotoxic agents and/or toxic products. All of the variables except age and gender were used to calculate the Healthy Living Index.

Healthy living index

Lifestyle was assessed using the Healthy Living Index (HLI), based on the parameters adopted by Morimoto *et al.*,[21] which are: don't smoke; don't consume alcoholic beverages on a daily basis; eat breakfast every day; sleep between seven and eight hours per night; work less than ten hours per day; exercise at least once a week; maintain a nutritionally-balanced diet; and suffer a moderate level of mental stress (self-reported by the interviewee). The following extra variables were also considered: the use of oral antiseptics; the absence of chronic illnesses and the non-exposure to genotoxic agents and toxic products. One (1) point was attributed for each of the variables classified as healthy. Answers that differed from these specifications were attributed a score of zero (0). The HLI of each participant was calculated by summing the scores obtained in the abovementioned parameters. Three HLI categories were applied: good (11-12 points); moderate (9-10 points) and poor (0-8 points).

Micronucleus test

Exfoliated cells of the oral mucosa of each individual were collected using an endocervical brush and transferred by smear to microscopic slides containing two drops of physiological saline (0.9% NaCl). After drying to room temperature, the slides were submerged in methanol / acetic acid (3:1) for fixation. After 24 hours, the material was stained using the reactive shift method and counter-stained using fast green (1%).

Cytological analysis of the data obtained via the questionnaires was conducted under an optical microscope (blind test). In total, 2000 cells were analyzed for each individual. The MN identification criteria described by Sarto *et al.*[22] were adopted. Thus, MN structures were considered to be morphologically similar to a nucleus when they exhibited up to 1/3 of its size and were visible on the same plane. Degenerative nuclear alterations (NA) indicative of apoptosis (karyorrhexis, condensed chromatin, pyknosis) and necrosis (karyolysis) were also calculated.

Statistical analysis

The mean age and HLI values for the groups were compared using the Kruskal-Wallis test. The occurrence of MN and NA in the groups was compared using a conditional test for the comparison of proportions in situations of rare events.[23] The Kruskal-Wallis test was also used to assess the (mean) occurrence of MN and NA in relation to HLI and age group.

RESULTS

Table 1 displays the mean ± standard deviation values for the age and HLI of the participants.

The Kruskal-Wallis test showed that the mean age of the individuals in the younger groups was significantly lower than that of the older groups (p<0.00001). In a single age group, men and women did not differ in terms of age. Individuals in the M19, W19 and W60 groups exhibited a significantly higher HLI value (p<0.0004).

The statistical analysis comparing the frequencies of MN and NA (Fig. 01) confirmed significant differences between the individuals aged between 19-29 years and those aged 60 years or more (Table 2).

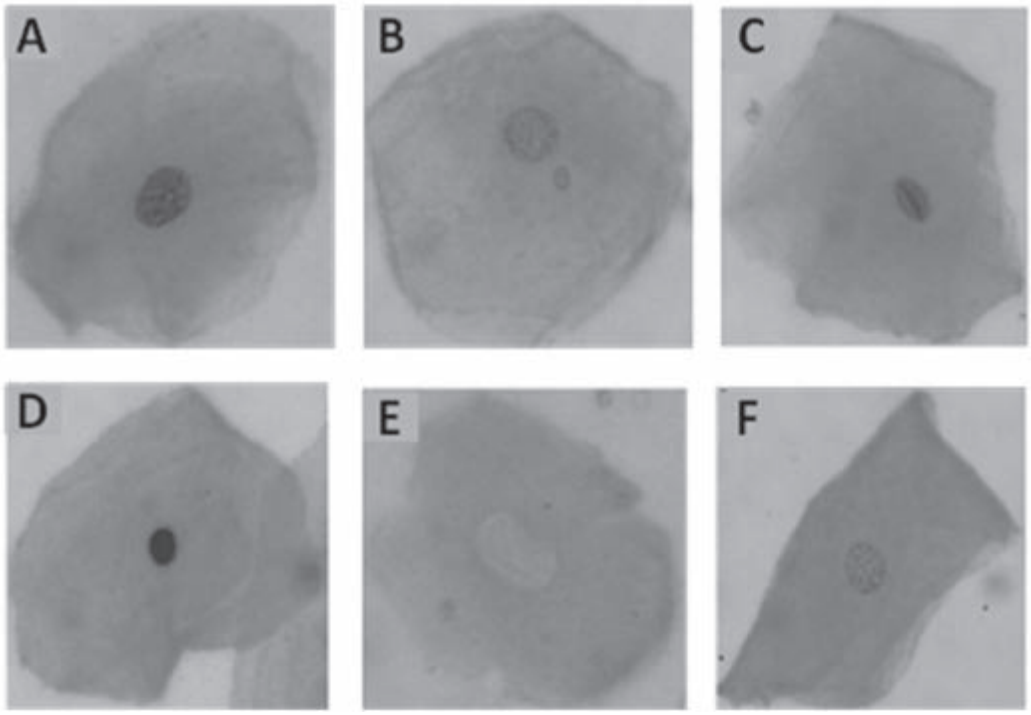

Figure 1. Photomicrographs of cells exfoliated from the oral mucosa (stained using the Felgen/Fast green method) exhibiting normal nuclear morphology: (A) a micronucleus (B); condensed chromatin ©; pyknosis (D); karyolysis (E); karyorrhexis.

Table 1. Mean age and HLI of the sample. Feira de Santana, Bahia, 2010.

Group	Mean age ± standard deviation	Mean HLI ± standard deviation
M60	69.00 ± 9.30	7.65 ± 1.31
W60	81.25 ± 9.11	8.65 ± 0.81
M19	22.20 ± 1.79	9.15 ± 0.99
W19	21.90 ± 1.71	9.20 ± 1.11

HLI = Healthy Life Index.

Table 2. Occurrence of micronuclei and nuclear alterations in individuals from two different age groups. Feira de Santana, Bahia, 2010.

Endpoints	Observed		Expected		χ^2	*p*
	19-29	≥ 60	19-29	≥ 60		
Micronuclei	5	38	21.50	21.50	25.3256	<0.001
Karyolysis	2	56	29.00	29.00	50.2758	<0.001
Karyorrhexis	12	209	110.50	110.50	175.6064	<0.0001
Condensed chromatin	192	533	362.50	362.50	160.3876	<0.0001
Pyknosis	151	740	445.50	445.50	389.3614	<0.00001

Endpoints = markers of chromosomal damage (micronuclei) and nuclear alterations (karyolysis, karyorrhexis, condensed chromatin and pyknosis).

No differences were found between men and women in the younger group for the occurrence of any of the endpoints. In the elderly group, the frequency of karyolysis and karyorrhexis was higher among men (Table 3).

The assessment of the occurrence of MN and NA in relation to HLI and age was conducted by dividing the sample into two groups (poor HLI and moderate HLI), since only three individuals (one man and two women from the younger group) were classified with a good HLI. These groups were divided into two subgroups based on age group. The analysis revealed that there were no significant differences in the frequency of MN and NA in the same age group, regardless of HLI score. Conversely, older individuals exhibited a greater occurrence of the endpoints analyzed, irrespective of their HLI score (Table 4).

Table 3. Occurrence of micronuclei and nuclear alterations in men and women aged ≥60. Feira de Santana, Bahia, 2010.

Endpoints	Observed		Expected		χ^2	*p*
	Men	Women	Men	Women		
Micronuclei	23	15	19.00	19.00	1.6842	> 0.10
Karyolysis	37	19	28.00	28.00	5.7857	< 0.025
Karyorrhexis	130	79	104.50	104.50	12.4450	< 0.005
Condensed chromatin	264	269	266.59	266.59	0.0469	> 0.10
Pyknosis	370	370	370.00	370.00	0.0000	= 1.000

Endpoints = markers of chromosomal damage (micronuclei) and nuclear alterations (karyolysis, karyorrhexis, condensed chromatin and pyknosis).

Table 4. Mean quantity of micronuclei and nuclear alterations caused by the Healthy Living Index (HLI) and age. Feira de Santana/BA. 2010.

Endpoints	Poor HLI		Moderate HLI	
	Above 60 (n = 15)	Between 19 and 29 (n = 15)	Above 60 (n = 25)	Between 19 and 29 (n = 22)
Micronuclei	1.09 ± 0.90^{A}	0.00 ± 0.00^{B}	0.76 ± 0.66^{A}	0.12 ± 0.33^{B}
Karyolysis	1.30 ± 1.46^{A}	0.00 ± 0.00^{B}	1.53 ± 2.35^{A}	0.04 ± 0.20^{B}
Karyorrhexis	5.04 ± 3.43^{A}	0.30 ± 0.67^{B}	5.47 ± 5.37^{A}	0.23 ± 0.51^{B}
Condensed Chromatin	12.48 ± 4.47^{A}	5.20 ± 2.15^{B}	10.53 ± 4.05^{A}	4.50 ± 2.35^{B}
Pyknosis	18.91 ± 6.63^{A}	3.00 ± 1.63^{B}	17.94 ± 13.22^{A}	3.88 ± 2.67^{B}

Endpoints = markers of chromosomal damage (micronuclei) and nuclear alterations (karyolysis, karyorrhexis, condensed chromatin and pyknosis); Different letters on the same line indicate a statistical difference ($p<0.05$).

DISCUSSION

The micronucleus test of exfoliated cells is an effective method of detecting genetic damage and has been widely used in population biomonitoring.[24] Micronuclei are structures that cause chromosomal breaks or complete chromosomes that fail to bond with the spindle during cellular division and are not included in the nucleus of daughter cells. Therefore, the micronucleus is an endpoint of chromosomal damage caused by a clastogenic or aneugenic event.

As well as chromosomal damage, other endpoints that are indicative of apoptosis and necrosis can be identified by this test. Alterations in the level of apoptosis, inferred by the occurrence of karyorrhexis, condensed chromatin and pyknosis, demonstrate genotoxic effects and have been correlated with the onset of cancer.[17-19] Necrosis, in turn, is inferred by the occurrence of karyolysis, which demonstrates the cytotoxic effect associated with cancer promotion.[17] In this context, the calculation of these endpoints is significant in order to increase the sensitivity of the micronucleus test.

One of the many possible applications of this test includes the assessment of the mutagenic effects of smoking and/or consuming alcoholic beverages,[25,26] as well as the effects of the depletion of nutrients in the diet.[27] The effects of age and gender on the prevalence of micronuclei have been more commonly assessed in lymphocytes than in isolation (as was the case in the present study). This may have affected the results of studies related to other variables.[28,29]

According to Bonassi *et al.*,[27] the effects of gender on the frequency of MN in exfoliated cells are not significant, unlike those observed with lymphocytes (where women tend to exhibit higher frequencies). In the present study, gender did not affect the frequency of MN, although karyolysis and karyorrhexis were more common among men aged ≥60 years, which may be associated with the lower HLI scores exhibited by this group. The assessments of associations between the occurrence of micronuclei, nuclear alterations and lifestyle (inferred by the HLI) recorded no significant differences in the present study. Further investigations of the influence of gender and lifestyle on the occurrence of nuclear alterations are required, given that a greater occurrence of MN has previously been associated with an unhealthy lifestlye.[15]

The influence of age on the promotion of damage to genetic material has been widely discussed in literature. In terms of this association, the results of the present study corroborate the findings of several other authors who have reported a higher occurrence of genetic damage among more elderly individuals.[12,28,29] According to Huang *et al.*,[15] this is due to the fact that aging is linked with genetic instability. However, further studies with larger samples are required, given that the quantity of individuals analyzed could be considered a limitation of the present study.

According to Fenech and Bonassi,[30] the increase of MN over time is probably due to a combination of factors, including: (a) the cumulative effect of mutations in genes involved in DNA repair, chromosomal segregation and checkpoints of the cellular cycle; and (b) numerical and structural alterations in chromosomes that are induced by endogenous and/or exogenous genotoxins, as well as a wide range of unhealthy lifestyle factors.

Thus, the effects of aging seem to be a combination of genetically programmed processes and genetic alterations caused by exogenous and endogenous factors. During the aging process, the enzymes involved in DNA repair become less and less common, which increases the susceptibility of cells to genotoxic agents.[31,32] Kirsch-Volders *et al.*[33] suggested that flaws in the cellular defense systems that protect against DNA damage, as well as the reduced efficiency of DNA repair, can lead to an accumulation of mutations. These mutations, either in isolation or in combination with other age-related alterations, can contribute to aging and the development of age-related illnesses.

CONCLUSION

The results of the present study suggest that age is consistently associated with damage to genetic material. Thus, the adoption of healthy lifestyle habits could help minimize the effects of aging, thereby reducing the risks of developing degenerative illnesses.

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Influence of body mass index and age on the lung function of obese women

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Abstract

Introduction: Obesity and aging may cause changes in lung function. *Objective:* to assess whether body mass, body mass index (BMI) and age influences vital capacity (VC) and forced expiratory volume in the first second (FEV_1) in women. *Methods:* 81 women aged between 30 and 75 years participated in the study. The sample included obese and morbidly obese, non-smoking, sedentary individuals without chronic lung disorders. Anamnesis, anthropometric and spirometric evaluations were performed. Statistical analysis was carried out using the Pearson correlation and Spearman tests, adopting a significance level of 5%. *Results:* It was observed that age had significant and negative correlations with VC and its components: inspiratory reserve volume (IRV), expiratory reserve volume (ERV) and tidal volume (TV), and with FEV_1. There was also a significant positive correlation between body mass and VC and IRV and a significant negative correlation between BMI and ERV. *Conclusion:* Pulmonary function declines over time. Body mass appears to exert a greater influence on IRV, whereas a greater BMI is associated with a decline in ERV.

Key words: Aging; Obesity; Spirometry; Physiotherapy.

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INTRODUCTION

Obesity is a chronic disease that has grown rapidly in recent years and is related to several factors such as hereditariness, poor diet, physical inactivity and hormonal factors[1]. In Brazil, 56.9% of the adult population is overweight, representing 82 million people, with 13% classified as obese[2]. The condition is associated with several chronic and/or degenerative co-morbidities such as type II diabetes, systemic arterial hypertension, coronary heart disease and strokes[3].

It can also promote changes in lung function and reductions in functional residual capacity (FRC), tidal volume (TV), lung compliance and thoracic expandibility[4] as well as decreased expiratory reserve volume (ERV). This has been described as the key finding related to alterations in lung function due to obesity[5], as abdominal fat exerts a mechanical effect on the chest and diaphragm, reducing lung volumes even in individuals with no changes in lung function[6].

Aging can also affect lung function due to physical changes associated with increased age such as loss of height, weight and the replacement of muscles with adipose tissue, triggering muscle weakness, and leading to changes in lung mechanics.[7-9]

According to Sekhri *et al*,[10] obesity may have a greater impact on lung function in older individuals due to the deposition of body fat which varies with increasing age. As the body ages, there is reduced secretion of the growth hormone and a reduction in the basal metabolic rate, reducing lean body mass and increasing body fat, especially in women.[11]

Therefore, the hypothesis of the present study is that excess body fat and age can be causative factors of alterations in lung function behavior in women.

The aim of the study was to evaluate if body mass, BMI and age influence the vital capacity (VC) and forced expiratory volume in the first second (FEV_1) in women.

METODOLOGY

Subjects

An observational cross-sectional study based on a convenience sample was carried out at the Cardiorespiratory and Physiotherapy Evaluation and Intervention Laboratory of the Universidade Metodista de Piracicaba (the Piracicaba Methodist University) (UNIMEP). The study evaluated 81 sedentary women aged between 30 and 75 years with a body mass index (BMI) between 30 and 55 kg/m^2, from August 2012 to July 2013.

The study was approved by the Ethics Research Committee of the Universidade Metodista de Piracicaba (UNIMEP), under protocol 48/12, in accordance with the guidelines of Resolution 196/96 of the National Health Council. The objectives of the study were explained to all the participants, all of whom signed a Free and Informed Consent Form.

Sample Calculation

The calculation of sample size was based on a pilot study and a significant correlation between BMI and ERV. An r value of -0.60 and the linear correlation test were used for the calculation, with a statistical power of 95% and an alpha of 0.05 applied. A minimum of 31 volunteers in each group was determined to analyze BMI. The sample calculation for each group according to BMI and age was also carried out, and a minimum of eight volunteers per group was established. The sample size calculation was performed using the BioEstat software version 5.3 (Belém, Brazil).

The women evaluated and included in the study were from obesity treatment centers in the city of Piracicaba in the state of Sao Paulo and presented recent and normal clinical, laboratory and spirometry test results, in accordance with medical evaluations, before being included in the groups.

Women with a BMI between 30 and 55 kg/m^2, aged between 30 and 75 years, with a sedentary lifestyle,[12] who were non-smoking, capable of

understanding how to carry out the evaluations and with an absence of systemic arterial hypertension, diabetes, cardiovascular and pulmonary diseases and respiratory infections in the previous two weeks were included in the study.

The women studied were divided into four groups according to BMI and age: 38 obese women (BMI between 30.0 and 39.9 kg/m^2), of whom 27 were aged between 30 and 55 years and 11 were aged between 56 and 75 years, and 43 morbidly obese women (BMI>40 kg/m^2), of whom 28 were aged between 30 and 55 years and 15 were aged between 56 and 75 years.

Experimental Procedure

The volunteers underwent anamnesis for the collection of clinical data, the evaluation of anthropometric measurements and subsequently the evaluation of lung volume and capacity by spirometry. Each volunteer attended the lab once and evaluations were carried out in a single day by researchers previously trained for the experimental procedure. To carry out the experimental procedure, the laboratory was properly prepared and air conditioned with the room temperature controlled by Split air conditioning equipment (Trane; Curitiba, Paraná, Brazil) to between 22 and 24° C and the relative humidity maintained by a humidifier at between 40 and 60%.

During the anthropometric evaluation, the volunteers remained in the orthostatic position without shoes or heavy clothing. Body mass was measured by a digital scale (Welmy; Santa Bárbara D'Oeste, São Paulo, Brazil), with a maximum capacity of 300 Kg. Height was measured by the stadiometer of the scale and BMI was calculated using the equation: body mass (kg)/height^2 (m).[13]

A computerized spirometer with a flow sensor, calibrated daily, was used to measure lung function (Microquark; Cosmed, Roma, Italy). The volunteers remained seated and used a nasal clip during the realization of slow vital capacity (SVC) and forced vital capacity (FVC) maneuvers, in accordance with the guidelines of the American Thoracic Society[14] and norms for the tests of lung function.[15]

The maneuvers were performed until three acceptable and two reproducible curves were achieved, without exceeding eight attempts. The values are expressed in liters and percentage of predicted, according to the equations established for the Brazilian population.[16]

Statistical Analysis

The BioEstat version 5.3 program was used for statistical analysis. To verify the normality of the data the Kolgomorov-Smirnov normality test was used. For intragroup and intergroup comparison of age, anthropometric characteristics and the spirometric variable values, the Student t and Mann-Whitney tests were used. For analysis of the correlation of body mass, BMI and age with spirometric variables, the Pearson and the Spearman correlations were used. A significance level of 5% was adopted for all analyses.

RESULTS

Table 1 shows the data of the age and anthropometric characteristics of the study volunteers divided into groups.

Table 2 shows the lung capacity and volumes of the study volunteers.

Table 1. Age and anthropometric characteristics of the volunteers studied. Piracicaba, São Paulo, 2012-2013.

	Obese (n=38)		Morbidly obese (n=43)	
	30 and 55 years (n=27)	56 and 75 years (n=11)	30 and 55 years (n=28)	56 and 75 years (n=15)
Age (years)	43.37±8.06	62±6.09	41.96±8.02	58.53±5.35
Height (m)	1.60±0.06	1.56±0.04	1.60±0.05	1.52 ± 0.03
Body Mass (Kg)	92.51±11.01	82.15±6.59	120.37±17.98	106.74±13.35
BMI (Kg/m²)	35.58±2.71	33.48±3.08	46.84±5.34	44.82±3.05

BMI: body mass index.

Table 2. spirometric variable values in absolute and percentage of predicted form of the studied volunteers. Piracicaba, São Paulo, 2012-2013.

	Obese (n=38)			Morbidly obese (n=43)			
	30 to 55 years (n=27)	*p* intragroup value	56 to 75 years (n=11)	30 to 55 years (n=28)	*p* intragroup value	56 to 75 years (n=15)	*p* intergroup value
VC (L)	2.99 ±0.65	0.02*	2.43 ±0.66	2.85 ±0.39	0.0056*	2.49 ±0.36	0.42
%Pred	90.40±15.22	0.56	86.79±22.27	87.26±9.38	0.22	91.21±11.03	0.82
ERV (L)	0.44±0.27	0.05	0.27±0.08	0.39± 0.11	0.29	0.23±0.13	0.04*
%Pred	41.21±22.73	0.25	36.51±11.45	37.36±14.44	0.05	21.64±12.51	0.02*
IRV (L)	1.52±0.54	0.42	1.35±0.64	1.78±0.37	0.02*	1.43±0.56	0.02*
TV (L)	0.98±0.42	0.27	0.83±0.24	0.81±0.32	0.1	0.65±0.26	0.04*
FEV_1 (L)	2.63±0.61	0.09	2.25 ±0.64	2.50 ±0.43	0.01*	2.16 ±0.32	0.27
%Pred	94.94±16.70	0.37	101.34±26.43	90.99±13.19	0.07	98.69±13.42	0.41

FEV_1: forced expiratory volume in one second; VC: vital capacity; ERV: expiratory reserve volume; IRV: inspiratory reserve volume; TV: tidal volume, %Pred: percentage of predicted. *p<0.05.

In intragroup analysis, it was observed that VC suffered a decline over the years, irrespective of the level of obesity.

In terms of intergroup analysis, it was evident that irrespective of age, the morbidly obese presented a decline in lung function when compared to the obese.

Table 3 shows the effect of age, body mass and BMI on lung function.

Table 3. Correlation between age and anthropometric characteristics and spirometric variables of the volunteers studied (n=81). Piracicaba, São Paulo, 2012-2013.

	Age		Body Mass		BMI	
VC	r=-0.55	p<0.0001*	r=0.29	p=0.0078*	r=0.07	p=0.4802
ERV	r=-0.25	p=0.020*	r=-0.04	p=0.7223	r=-0.30	p=0.029*
IRV	r=-0.37	p=0.0006*	r=0.29	p=0.0076*	r=0.19	p=0.0785
TV	r=-0.15	p=0.15	r=0.13	p=0.2316	r=-0.03	p=0.7566
FEV_1	r=-0.50	p<0.0001*	r=0.16	p=0.1382	r=-0.06	p=0.5627

VC: vital capacity; ERV: expiratory reserve volume; IRV: inspiratory reserve volume; TV: tidal volume; BMI: Body Mass Index; * significant correlation.

Therefore, the greater the age, the lower the spirometric variable values, while VC and IRV values increased with body weight. As BMI values increased, so ERV values declined.

DISCUSSION

The purpose of the study was to determine whether body mass, BMI and age have an influence on VC and FEV_1 in women. As ERV is part of VC and is the marker volume of morbid obesity, it was decided to present and discuss not only the results of VC but also its development, represented by IRV, ERV and TV.

In this context, the results obtained in this study showed a significant negative correlation between age and VC, IRV, ERV, TV and FEV_1, with the higher the age, the lower the respective variable values.

Fabron *et al.*[17] analyzed the spirometric measurements of the participants of groups of elderly persons and identified a significant correlation between age and VC, suggesting a decrease in VC values with increasing age, corroborating the results of the present study. The decrease in SVC due to aging was also observed by Matsudo *et al.*[18] and Ruivo *et al.*[8] who described the influence of age on both VC and FEV_1 in healthy subjects, suggesting that aging causes a genuine impact on lung function, leading to a decrease in VC and FEV_1.

FEV_1 is a variable of interest when studying lung function and is considered to be a reproducible measure as it is effort-independent. According to the ATS,[14] the severity of ventilator disorders is characterized by changes in FEV_1 percentage, and this value is commonly used to stratify severity in patients with an obstructive, restrictive or mixed component. The reduction in FEV_1 in the elderly may signify obstructive changes, which can be explained by a decrease in elastic lung retractility, a reduction in chest wall compliance and a reduction in the strength of the respiratory muscles, leading to the progressive decline in lung function over time.[19,20] With respect to the decrease in respiratory muscle strength, Santos *et al.*[21] suggested the application of respiratory muscle training among this population, as this can potentiate the respiratory muscles of the elderly and thus constitute a preventive strategy against the decline of respiratory muscle strength and pulmonary function.

In a study aimed at evaluating the harm obesity can cause to lung function, Melo *et al.*[22] found significant differences in FVC and FEV_1 between the obese and normal weight groups. The authors demonstrated pulmonary damage through the concept of lung age and found that this measure increases in patients with morbid obesity, suggesting early damage and accelerated lung aging in these individuals.

In the present study, there was also a significant and positive correlation between body mass and VC and IRV, demonstrating that

VC and IRV increase with body mass and that there is a negative correlation between BMI and ERV, where a higher BMI results in a lower ERV. Similar results were described by Melo *et al.*[23] who observed that the higher the BMI, the greater the degree of lung function impairment, corroborating the present study.

In the study by Rasslan *et al.*,[24] the aim of which was to correlate BMI and waist circumference with spirometric values in obese individuals, ERV was also significantly lower in men with increased abdominal fat deposition. As in the study of Jones and Nzekwu,[25] it was observed that ERV decreased exponentially with an increase in BMI.

Guimarães, Martins and Santos,[26] evaluated the lung function of morbidly obese individuals and concluded that obesity influenced ERV and FRC. The authors explained that the reduction of ERV and FRC in obesity occurs due to mechanical changes in the chest wall, a decrease in total respiratory compliance, and reduced lung flow and volume.

Clinically, this change is important as morbidly obese individuals are more prone to the appearance of atelectasis, which can be explained by the reduction of ERV and consequently FRC.[27]

Rasslan *et al.*[24] reported that VC and FEV_1 were significantly lower in obese women than in normal-weight women, arguing that obesity can reduce VC as it can interfere with the movement of the diaphragm and excursion of the chest wall.

However, according to Benício *et al.*[28] there were no differences between obtained and predicted VC and FEV_1 values in subjects with varying degrees of obesity. According to the authors there is controversy regarding pulmonary function and obesity, as some studies have found decreased lung volumes and capacities, while others report that these volumes remain constant.

Among the limitations of this study were the absence of men, since the results are limited to a population of obese women and cannot be extrapolated to other BMI classifications nor to the male gender.

CONCLUSION

Based on these results, it can be concluded that as obese and morbidly obese women age there is a decline in VC, ERV, IRV and FEV_1. Body mass in isolation can increase VC and IRV, however, as the BMI increases, there is a decline in ERV.

Therefore, obesity combined with aging can increase the deterioration of pulmonary function, especially with regard to a reduction in ERV. Thus, preventive strategies should be proposed for the population studied.

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Analysis of the functional capacity of elderly residents of communities with a rapid population aging rate

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Abstract

Introduction: The elderly population has risen sharply in Brazil, increasing the need for a health policy focused on health promotion and disease prevention. Attention should also be focused on functional capacity because of the personal and family suffering caused by dependency, as well as the increased demand placed on public services. *Objective:* To check the health and functional capacity of elderly residents in a small town with a high population aging rate. *Methods:* A cross-sectional, analytical and non-probabilistic study was performed of 528 elderly persons aged ≥60 years, of both genders, who were evaluated in their home environment. The variables of interest were general health and functional capacity, assessed by the adapted Katz and Lawton and Brody scales. Data analysis was carried out using descriptive and analytical statistical tools. To assess the association between variables the chi-squared test was used, accepting the hypothesis of dependency of variables with p=0.05. *Results:* The mean age was 72.24±9.33 years. Functional capacity assessment identified that most of the elderly persons carried out activities of daily living (ADLs) and instrumental activities of daily living (IADL) independently; with percentages of 90% and 83.7%, respectively. A statistically significant association was observed (p=0.001) between reports of falls and functional capacity levels. *Conclusion:* The results show that the elderly of this municipality are mostly independent in performing their daily tasks, representing successful aging.

Key words: Health profile. Elderly persons. Demographic aging. Public health. Cross-sectional studies.

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INTRODUCTION

The elderly population has risen sharply in Brazil. Since the 1940s, the highest rates of population growth have been associated with the elderly. Between 1980 and 2005, the growth of the elderly population reached 126.3%, whereas overall population growth was 55.3%.[1] According to the Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics) (IBGE),[2] in 2010, the proportion of elderly individuals among the Brazilian population was 10.8%, with the highest proportions recorded in the south of the country (12.0%). The southern state of Rio Grande do Sul had the highest growth rate (13.6%). Statistical projections for 2050 indicate that Brazil will have the sixth largest elderly population in the world: more than 32 million elderly individuals (16% of the total population of the country).[3]

Another important indicator linked to the phenomenon of an aging population is life expectancy at birth. This indicator has also increased in recent years. In 2000, life expectancy at birth was 69.8 years, whereas in 2012, this value had risen to 74.5 years.[4]

However, analysis of these indicators should involve looking beyond the numbers, since the factors that favor the aging of the Brazilian population differ from those found in other countries. This is partly due to the social, economic, cultural and environmental heterogeneity that characterizes Brazil. While on one hand, this increased life expectancy is to be celebrated, on the other, it creates demands that society will need to face in order to ensure that an increase in life expectancy represents a genuine improvement.

Veras[5] stated that society seeks to prolong life, but quality of life must be maintained in the additional years of life so that this increase in life expectancy can be considered an improvement rather than a problem. This statement is centered on the idea that population aging should be sustained by a health policy that is strongly focused on health promotion and the prevention of illnesses, rather than curative programs that are linked to the aging of the population.

According to Küchemann,[1] an increase in life expectancy reflects cultural changes, technological advances in the health sector and improvements in living conditions. However, an increase in life expectancy leads to a greater prevalence of chronic and degenerative illnesses, which consequently cause a gradual loss in functional capacity.

Functional capacity means the ability of an individual to maintain the physical and mental functions required to preserve their independence. Functional capacity is one of the most studied dimensions in gerontology, due to the suffering of the individual and their family members. The latter suffer as a result of the dependence of the elderly individual and the increased demand for medical and social services. Among the elderly Brazilian population, the prevalence of incapacity related to activities of daily living (ADLs) was 6.5% in 1998, 6.4% in 2003 and 6.9% in 2008.[6] This data suggests that the advances in health care services for the elderly, particularly in basic healthcare, have not been reflected in the maintenance of the functional capacity of elderly individuals. In other words, the actions implemented may be reducing hospitalizations, which improves the perception of health conditions, but there are no preventive actions focused on the maintenance and restoration of functional capacity.

Considering the socio-demographic differences found in Brazil, the relevance of the present study lies in the lack of epidemiological data for elderly populations living in small municipalities where many people reside in rural areas. In general, studies of the elderly Brazilian population are conducted in large urban centers.

Thus, the present study aimed to identify differences in the aging conditions of populations that reside far from these urban centers. In addition, this research is important as it provides data referring to the health conditions of these elderly individuals. This data, together with diagnoses,

favors the proposal of promotion, prevention and geriatric rehabilitation measures that aim to prevent the development of functional capacity or restore this capacity when it has been impaired.

The aim of the present study was to ascertain the health conditions and functional capacity of elderly individuals living in a small municipality with a high rate of population aging.

METHOD

A cross-sectional, analytical and observational study of elderly residents was performed in the municipality of Independência, in the state of Rio Grande do Sul (Brazil). The data was collected between August and October 2009.

This small municipality is located in the northeast of the Brazilian state of Rio Grande do Sul. The main economic activity in the municipality is agriculture. According to data from the Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics) (IBGE), the total population of the municipality was 6618 inhabitants in 2010 (3293 men and 3325 women). The municipality contained 1233 elderly individuals (572 men and 661 women). Thus, elderly individuals represented 18.6% of the population of the municipality. Notably, the rate of population aging (approximately 10%) was higher than that of the state of Rio Grande do Sul. Table 1 displays the distribution of the elderly individuals according to age group, gender, study population and representativity.

Table 1. Distribution of elderly individuals in the municipality of Independência, Rio Grande do Sul, according to age, gender, sample size and representativity, 2010.

Age group	Men	Women	Total	Population of the study	Representativity
60 to 64 years	185	184	369	131	35.5%
65 to 69 years	144	136	280	104	37.1%
70 to 74 years	99	129	228	106	46.4%
75 to 79 years	79	100	179	74	41.3%
≥80 years	65	112	177	113	63.8%
Total	572	661	1233	528	42.8%

In total, 528 elderly individuals (60 years or more) of both genders were visited in their homes. This sample represented 42.8% of the elderly population in the municipality. The participants were selected based on convenience.

The entire population (100%) of the municipality of Independência is covered by the Estratégia da Saúde da Família (Family Health Strategy), which involves two health teams. Each team deals with one territory, which is divided into eight micro-regions. The research was helped by the Municipal Council of Independência through the Municipal Health Secretary, which consented to the participation of community health workers (CHW) in the collection of data and ensured that adequate conditions were available for training activities and data collection. In total, 16 CHWs participated in the data collection stage: eight from each health team; and one from each micro-region.

The training involved discussions concerning population aging, healthcare policies for the elderly, functional capacity, assessment protocols and the application methods used for these protocols. In order to certify the observers (CHW) and prevent system errors, 16 elderly individuals were selected (one per micro-region) for the application of the research instruments. These 16 elderly individuals were excluded from the study population.

An interview that addressed the socio-demographic data (age, gender and education) and general health conditions (presence of comorbidities and illnesses, use of drugs and history of falls) was conducted to obtain the data required.

The Katz scale for independence in ADLs[7] and the adapted Lawton and Brody scale[8] were used to assess the functional capacity of the elderly individuals.

The Katz scale is used to measure the ability of an individual to perform their daily activities independently, thereby determining the rehabilitation interventions required. The Katz scale focuses on the performance of the elderly individual and the degree of assistance they require in six basic categories: bathing; dressing; going to the bathroom; moving around; continence and eating. Each task receives a score of between zero (independent) and three (complete dependence). A score of one indicates that the elderly individual needs an object to perform the task, while a score of two indicates that they need human help to perform the task.[9]

The Lawton and Brody scale was proposed to assess instrumental activities of daily living (IADLs), which are considered more complex than basic ADLs. Independence while performing these activities is directly correlated with the capacity of the individual to experience independent community life. The Lawton scale analyzes the capacity of the elderly individual to adapt to their environment and includes a wide range of activities, including using the telephone, going shopping, preparing meals, cleaning the house, washing clothes, gardening, using modes of transport, climbing stairs, taking medication and financial planning. The adapted version of the scale was used, with a maximum score of 21 points and the following possibilities for each item: performs the activities independently (3 points); needs help with some part of the task (2 points); and cannot perform the activity (1 point).[10]

The Statistical Package for Social Sciences (SPSS) software was used to process the data. Descriptive statistics used central tendency and dispersion measurements to analyze the quantitative variables and the absolute and relative frequencies for the qualitative variables. The chi-squared test of associations for categorical variables was used in the statistical analysis, in which the hypothesis of dependence for the variables was set at $p \leq 0.05$.

The present study received approval from the Ethics Committee of Unijuí under protocol number 241/2009. All of the elderly individuals who agreed to participate signed a free and informed consent form.

RESULTS

In total, 528 elderly individuals, with a mean age of 72.24±9.33 years, participated in the present study (minimum age of 60 years and maximum age of 99 years). The vast majority (95%) of the participants were aged between 71.44 and 73.04 years. When comparing the mean age in accordance with gender, no significant differences were found between the groups ($p=0.90$). The study population contained more women than men (51.7%).

Each elderly participant exhibited a mean of 3.25±2.39 comorbidities and illnesses, while the confidence interval showed that 95% of the elderly individuals exhibited between 3.05 and 3.46 such conditions. Notably, 13.4% (71) did not exhibit comorbidities or illnesses, while 44.4% (234) had between one and three, 31.7% (168) had between four and six and 10.5% (55) had more than six.

Concerning the general health conditions of the sample, the most common comorbidities and illnesses were: systemic arterial hypertension (SAH) (53.9%); dizziness (41.9%), loss of sight (39.4%) and loss of memory (38.4%). All other comorbidities and illnesses were less than 30%.

In total, 371 of the 528 elderly participants used some form of medication, which is equal to

70.4% of the study population. Analysis of the use of medication according to gender confirmed that 78.3% (213) of the women and 62% (158) of the men took some form of drug. The chi-squared test confirmed an association between gender and the use of medication (0.000).

Analysis of the quantity of falls suffered in the year prior to the interview confirmed that 19.9% (105) of the participants had suffered at least one fall in the time period in question. The history of falls was higher for women than for men, with results of 25.4% (69) and 14.1% (36), respectively.

The Katz scale for ADLs confirmed the following results: 94.1% (497) of the elderly participants were classified as independent for "bathing"; 94.7% (500) "were able to dress themselves without help"; 97% (512) were able to perform activities related to "personal hygiene"; 97% (512) were "able to move around without the help of others"; 85% (449) were "continent"; and 96.4% (509) could feed themselves without help from others.

Analysis of the distribution of frequencies of the levels of functional capacity for bathing, dressing, personal hygiene, getting around, continence and eating confirmed that more than 90% of the men and women in the study performed their ADLs independently, whereas less than 4% required some form of assistance.

According to the assessment of IADLs in accordance with the categorization of the Lawton scale, 83.7% (442) of the participants were independent, 13.8% (73) were semi-dependent and 2.5% (13) were dependent. Analysis by gender showed that the majority of the men and women were classified as independent in relation to IADLs (85.1% and 82.4%, respectively).

The assessment of IADLs for telephone use confirmed that 62.9% (332) *"can receive and make telephone calls without any assistance"*. As for getting around, 67.8% (358) *"travel alone"*. Concerning the ability to go shopping, 75.4% (398) of the interviewees *"go shopping if transport is provided"*. With regards to the preparation of meals, 75.9% (401) "*are able to plan and prepare complete meals"*.

Concerning domestic tasks, 46.4% (245) could *"perform difficult tasks"*. As for the ability to take care of their own medication, 84.3% (445) *"take their medication without assistance"*. In relation to using their money, 63.6% (336) of the interviewees *"pay their own bills and/or use checks without assistance"*.

In order to assess the association between a history of falls and the level of functional capacity for IADLs, dependent/semi-dependent and independent groups were established. The results obtained confirmed that 28 of the 105 elderly individuals who had suffered falls (26.7%) were dependent or required assistance to perform their IADLs, while 73.3% (77) were independent. A statistically significant association (p=0.001) was found between falls and functional capacity related to the performance of IADLs.

DISCUSSION

The mean age of the participants in the present study was 72.24±9.33 years. The standard deviation value confirmed that there was very little variability between the ages of the elderly individuals, as confirmed by the confidence interval of 95% (71.44 and 73.04 years). This investigation contained more women than men. However, when comparing this result to others found in literature, there was a greater percentage difference between genders: Barbosa *et. al.*[11] and Santos and Griep[12] reported a greater prevalence of women, with 63.3% and 71%, respectively.

The issue of gender and old age has been widely discussed, particularly due to the fact that women tend to live longer than men. This phenomenon was addressed in the above mentioned studies and has been labelled the feminization of the elderly. Several other studies[13, 14] have addressed this issue, which deserves special attention given that we cannot interpret the fact that women live longer as

meaning that they maintain a satisfactory quality of life and desirable health conditions. Until now at least, studies have shown that these variables are not associated in such a positive light.

Neri[13] stated that gender is a more significant risk factor than age when analyzing health, physical functionality and perceived health, since elderly women are more frail (and know that they are more frail) than elderly men. The authors concluded that when the effects of physical frailty are added to the effects of certain socio-demographic variables, such as living alone, having less education, caring for others or requiring care, the quality of life of elderly women tends to decline.

When gender issues are associated with age and dependence, studies have reported that the social involvement of women is more negatively affected by advancing age due to their greater longevity and the increased risk of dependence. Elderly women tend to experience more isolation and loneliness. They have a more negative image of themselves, old age and other elderly individuals than elderly men.[15]

The phenomenon of the feminization of the elderly is seen as a medical and social problem. Conversely, the prevalence of chronic illnesses is higher among elderly men, although this is likely change in future generations, given that contemporary women are exposed to the same type of risk factors as men today.[13]

Concerning gender and functional capacity, a study by Virtuoso and Guerra[16] reported that several factors can decrease the quality of life of elderly women, including older age groups, when accompanied by functional limitations. Functional conditions affect the performance of ADLs when associated with morbidities.[17]

Based on the functional capacity results for the participants of the present study, more than 90% of the elderly individuals in the municipality had preserved their functional capacity for ADLs. This result could be explained by the characteristics of this population (elderly individuals with an active lifestyle). The women performed daily household tasks and looked after the outside of the house (garden, yard etc.), while also caring for animals and collecting milk. The men were involved in tasks that demanded physical strength. In addition, these individuals tend to travel short or medium distances on foot or on a bicycle, as is common in rural areas where agriculture is the most significant economic activity (such as the municipality of Independencia).

Functional capacity involves much more than performing daily tasks and consists of maintaining the physical and mental skills required to have an independent life. Thus, functional capacity means complete autonomy so that an individual can do all the things they want, and is related to physical, intellectual, emotional and cognitive aspects.[18]

In theory, age associated with disabling diseases would increase the risk of developing functional dependence. Conversely, an environment that stimulates an active lifestyle reduces the impact of illnesses on functional capacity.

Studies such as those by Rosa *et al.* (2003) and Kattainen *et al.* (2004) demonstrated significant associations between chronic illnesses and the functional incapacity of elderly individuals.[19,20] When multiple chronic conditions exist, disabilities can develop as a result of a single illness or a combination of illnesses, causing the elderly individual to become progressively more fragile and dependent for ADLs.[21]

Systemic arterial hypertension (SAH) was the most common chronic illness identified among the participants of the present study. This finding corroborates the results of Focchesatto, Rockett and Perry,[22] who found SAH in 64.3% of the elderly individuals studied. During the process of senescence, the arteries suffer multiple alterations that affect the predisposition by increasing blood pressure. Over time, this increase can have deleterious effects on vital organs such as the heart and brain.

SAH is a multifactorial condition and one of the factors that affects physical activity. It can also affect functional capacity. According to HAJAR

et al.,[23] elderly individuals with SAH are at an increased risk of developing functional incapacity for functions related to normal blood pressure. The same authors also showed that individuals with hypertension, particularly uncontrolled arterial hypertension, are significantly more likely to develop a disability, irrespective of other risk factors and comorbidities.

Physical inactivity in old age may be correlated to the health conditions of the individual or their failure to adopt an active lifestyle. In the present study, the high prevalence of SAH could be the result of senescence or cardiovascular illnesses, since the study population was characterized as active.[24]

When studying elderly populations, functional incapacity is one of the most common indicators used as a health predictor. It is particularly useful when assessing social requirements and the use of health services. This indicator has been used to assess the performance of elderly individuals during basic and instrumental activities of daily living, which are considered determinants of personal independence and the capacity of an individual to socialize, interact and work.[25]

When the functional capacity of an elderly individual is impaired, there are significant implications for their family members, the community, the health system and their life. Incapacity leads to greater vulnerability and dependence in old age, thereby contributing to a decrease in the wellbeing and quality of life of elderly individuals.[26]

Leite *et al.*[27] assessed the functional capacity and cognitive level of elderly individuals living in a municipality of Rio Grande do Sul, Brazil and found that most of the participants (93.8%) were independent, both in terms of performing IADLs and ADLs. These results are similar to those found in the present study. Fiedler and Peres also studied elderly individuals in the south of Brazil and found that 37.1% of the sample exhibited limitations in relation to their functional capacity.[28]

Barbosa *et al.*[29] studied 286 elderly individual aged between 60 and 103 years (mean age of 71.2 years) and found that 6.6% of the participants were dependent for up to three basic activities and 5.6% were dependent for more than three activities. The elderly individuals mainly required help with micturition (9.4%), dressing (7.6%) and bathing (6.6%). For IADLs, we considered individuals who were only dependent in relation to IADLs and those who were dependent for both IADLs and basic ADLs. The greatest dependence was recorded for travelling longer distances alone (24.1%), washing and ironing clothes (22.0%) and using the telephone (18.9%).

Fialho *et al.*[30] studied 1624 individuals aged between 60 and 97 years and reported the following results: 64.2% of the sample were independent for all IADLs and basic ADLs; 19.6% had some degree of difficulty with at least one IADL; and 16.2% had some degree of difficulty with one or more basic ADLs. All of the individuals who exhibited some degree of difficulty with a basic ADL also had some degree of difficulty with at least one IADL.

ADLs and IADLs are activities that present a certain degree of difficulty for elderly individuals, especially those who have a health issue. However, it is clear that IADLs are more complex than basic ADLs, mainly due to the social involvement element. Thus, many elderly individuals are capable of performing all of the tasks in their home but feel useless when they must perform an activity that involves social contact that is not part of their daily lives.

As chronological age increases, people tend to become less active and their functional capacity is reduced. Chronic illnesses are very common among individuals aged 75 years or more, which contributes to the degenerative process, thereby reducing the independence of elderly individuals. Studies have shown that approximately 25% of all elderly individuals worldwide depend on the help of others to perform ADLs.[31]

According to Costa, Porto and Soares,[32] between 30 and 50% of very old individuals (85 years or more) are unable to perform at least five ADLs and require full-time care. This condition

worsens when illnesses are involved, particularly if they are neurological in nature.

Wellbeing in old age, or health in a broader sense, is the result of a balance between the different dimensions of the functional capacity of the elderly individual. These dimensions address biological, social, emotional and spiritual factors equally.[33]

Estimates for 2020 predict an increase of between 84% and 167% in the number of elderly individuals with moderate or severe incapacity.[34] This highlights the importance of proposing health programs that address all levels of healthcare for the elderly, particularly at primary and secondary levels, at which point worsening health conditions can be detected at the earliest stages, thereby preventing the development of disabilities that lead to dependence.[35]

The aim of active aging policies is to increase healthy life expectancy while ensuring quality of life, even for individuals who are frail, physically disabled or require care.[36] However, the environment in which the individual lives can stimulate or inhibit the adoption of an active lifestyle. When considering this concept in terms of the present study, it is possible to infer that the environment in which the elderly individuals live (the municipality of Independência) stimulates an active lifestyle.

Analysis of the data obtained from the present study identified a number of limitations, although they do not affect the validity of the results presented. Further studies with other populations could expand our understanding of the phenomenon in question. The limitations of this research include: frailty indicators among the elderly individuals were not identified; and frailty was not assessed by considering unintentional weight loss in the previous year, handgrip strength and gait speed, as described by Fried.[37] The phenotype of frailty in the elderly population would help our understanding of dependence or semi-dependence situations related to the performance of ADLs, while also enabling the health service of the municipality to deal with demand in a hierarchical manner, subsidize the planning of health teams and define promotion, prevention and intervention programs (individually or collectively) in order to prevent, maintain or restore the functional capacity of the elderly and preserve their independence, thereby ensuring a dignified old age and a satisfactory quality of life.

CONCLUSION

The results of the present study showed that elderly individuals from the municipality of Independência in the state of Rio Grande do Sul exhibited no functional limitations for instrumental and basic activities of daily living. However, they exhibited a high prevalence of illnesses and comorbidities, which could affect their functional capacity over time and lead to dependence for ADLs.

In order to maintain the functional capacity of the elderly population throughout the longer lives they are living today, it is important to implement basic healthcare strategies and programs that stimulate the active aging of these populations and detect conditions that can lead to disabilities as early as possible. Furthermore, due to the complexity of healthcare for the elderly, care networks that ensure full-time, continuous and resolute care are required for the health of these populations.

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Analysis of total calorie, calcium and protein intake and relationship with bone mineral density in postmenopausal women

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Abstract

Introduction: the adequate intake of nutrients involved in bone metabolism can prevent and even reduce the risk of osteoporosis. *Objective:* verify the intake of total calories, protein and calcium in women diagnosed with osteopenia and osteoporosis after menopause. *Method:* a study of 25 women diagnosed with osteopenia (n=17) or osteoporosis (n=8) in the postmenopausal period, who were members of the Prática de Exercícios Físicos na Osteoporose (Practice of Physical Exercise Against Osteoporosis) (PEFO) study group of the Universidade Tecnológica Federal do Paraná (the Federal Technology University of Paraná) (UTFPR). The study was divided into two data collection phases: assessment of body composition and bone mineral density by Dual-energy X-ray Absorptiometry (DXA) and the recording of food consumption over the previous 72 hours by means of a structured interview. *Results:* there was a difference between the reference values and the average values found for caloric, protein and calcium intake. There were higher values for protein, while calcium intake was low. The osteoporosis group (mean 59.24+80.07, $p<0.05$) ingested significantly more protein than the osteopenia group (mean 15.14+16.53, $p<0.05$). The results showed a significant negative correlation between protein intake and hip BMD ($r=-0.416$, $p<0.05$). *Conclusion:* adequate intake of protein should be recognized as a protective factor for osteoporosis and considered by nutritionists, as well as being widely featured in public health campaigns.

Keywords: Osteoporosis, Menopause, Nutrition.

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INTRODUCTION

The increase in chronic diseases such as osteoporosis is a major consequence of the phenomenon of population aging and is currently regarded as a serious public health problem.[1]

Osteoporosis is understood to be a skeletal disorder associated with decreased mass and the deterioration of bone microarchitecture, leading to an increased risk of fractures.[2] It is estimated that osteoporosis affects over 75 million people worldwide.[1]

It is believed that osteoporosis affects 35% to 52% of women aged over fifty and that twenty per cent of women are affected by the condition. This high prevalence means that more than $1 billion is spent on treatment per year.[1]

The risk factors for osteoporosis include lifestyle; endocrine status; genetic factors; surgery; medicines and dietary habits.[3] Estrogen deficiency is acknowledged as being directly related to menopause, characterized by marked bone loss.[3]

One of the factors that influence the onset of osteoporosis is poor eating habits. The adequate intake of nutrients involved in bone metabolism can prevent and even reduce the risk of the onset of the condition. The intake and absorption of bone building nutrients is required even after the onset of osteoporosis. These nutrients include proteins, minerals (calcium, phosphorus, potassium) and vitamins (D, K, B12).[4]

However, the excessive intake of protein, sodium and vitamin A can promote bone demineralization, making the bone more prone to fracture.[4] Therefore, proper dietary balance is a major factor in preventing osteoporosis.[5]

The objective of the present study was to assess the intake of total calories, protein and calcium in women diagnosed with osteopenia and osteoporosis after menopause.

METHODS

We conducted a study of 25 women in the post-menopausal period diagnosed with osteopenia or osteoporosis, who were participants in the Prática de Exercícios Físicos na Osteoporose (Practice of Physical Exercise Against Osteoporosis) (PEFO) study group of the Universidade Tecnológica Federal do Paraná (Federal Technology University of Paraná) (UTFPR), in the city of Curitiba, in the state of Paraná. The selection of participants was performed in an automatic and random manner, comprising women participating in the PEFO group. The inclusion criteria were: suffer from osteopenia and/or osteoporosis confirmed by Dual-energy X-ray Absorptiometry (DXA), and be in the postmenopausal period. Women who could not perform the DXA examination for assessment of bone mineral density for any reason and those who used some sort of measure that could interfere with bone resorption were excluded.

The study was divided into two data collection phases: assessment of body composition and bone mineral density by Dual-energy X-ray Absorptiometry (DXA) and completion of a food consumption record for the previous 72 hours by means of a structured interview. These two phases were carried out on the same day, aiming to facilitate the transport arrangements of participants.

The DXA evaluation was performed with volunteers wearing only clothes of light fabric, barefoot, without any metallic materials. They were made comfortable on the table in a supine position, remaining motionless throughout the complete body measurement. This review was carried out by an experienced professional skilled in the performance of such exams.

To evaluate food consumption recall, analysis of each separate meal was performed (breakfast, morning snack, lunch, afternoon snack, dinner and supper). For the calculation of indicators of

total calorie intake, carbohydrates (calories and grams), protein (calories and grams), lipids (calories and grams) calcium (mg), zinc (mg), caffeine (mg) sodium (mg) manganese (mg), magnesium (mg), phosphorus (mg), dietary fiber (g), vitamin d (μg/d), iron (mg) and copper (mg) the Diet Pro 4® software incorporating the formula from *Long & Harris-Benedict*[6] (Equation 1) was used.

(1) BEE=655+(9.6 x Wt)+(1.85 x Ht) - (4.676 x age)

BEE = basal energy expenditure; Wt= current weight in kg; Ht = height in cm; age = age in years.

In cases where the food described by the interviewee was not found in the software database, the Tabela Brasileira de Composição de Alimentos (Brazilian Food Composition Table) (TACO) as a reference. The Dietary Reference Intake by age (women aged 50 or more) table was also used. The record was created by a professional nutritionist.

The measurement of the weight of the participants was performed using a Geratherm brand digital scale with a maximum capacity of 150 kg and a range of 100g. Height was measured with a Wiso stadiometer with precision in mm, fixed to a wall with no baseboard, with an extension of two meters.

Data collection was performed in the first quarter of 2014 in the Biochemistry and Densitometry Research Laboratory (LABDEN) of UTFPR in a designated room to ensure the privacy of the women during all processes. The evaluations were scheduled with the women seven (7) days in advance and confirmed by phone 24 hours prior to the assessment.

The data was analyzed according to the following parameters: ideal calorie consumption estimated by the Long & Harris-Benedict formula (Equation 1); individual protein requirement, using the reference of the National Research Council[7] which suggests a 0.8g/kg (protein/weight) ratio; individual calcium requirement, using Dietary Reference Intakes (DRI), which suggests that those aged over 50 should have at least 1,200 mg of calcium per day; and classification of bone mineral density values, based on the parameters of the World Health Organization, which considers osteopenia to be BMD results in the range between populational mean -1.1 standard deviations and populational mean -2.49 standard deviations, and osteoporosis mineral bone densities lower than the populational mean -2.5 standard deviations.

As this study involved human beings, the guidelines of National Health Council resolution 466 dated December 12, 2012, were followed. All the participants were fully informed about the objectives of the study, and their participation was voluntary and did not involve onuses or bonuses. All the participants signed a free and informed consent form. The study was approved under Opinion No. CAAE: 21751513.0.0000.5547 on February 13, 2014 by the Research Ethics Committee of the Federal Technology University of Paraná.

The data was evaluated using descriptive and analytical statistical analysis using the Statistical Package for the Social Sciences (SPSS) software package, considering a level of significance of $p<0.05$. To analyze the differences between the two groups of the sample (osteopenia/osteoporosis) the *Wilcoxon-Mann-Whitney* Test for independent samples was used.

RESULTS

25 volunteers were evaluated, of which 17 had osteopenia and eight had osteoporosis. Table 1 shows the profile of the study sample.

Table 1. Characterization of 25 women diagnosed with osteopenia or osteoporosis in the post-menopause period, who were participants of the Practice of Physical Exercise Against Osteoporosis (PEFO) study group of the Universidade Tecnológica Federal do Paraná (the Federal Technology University of Paraná) (UTFPR). Curitiba, Paraná, 2014.

Variable	Group	n	Minimum	Maximum	Mean	Standard deviation
Age	Osteopenia	17	46.00	68.00	58.24	6.08
	Osteoporosis	8	48.00	73.00	62.38	7.91
Height	Osteopenia	17	1.43	1.68	1.57	0.07
	Osteoporosis	8	1.48	1.64	1.56	0.07
Weight	Osteopenia	17	45.50	103.30	67.08	14.34
	Osteoporosis	8	49.50	80.50	64.15	8.82
Waist circumference	Osteopenia	17	65.00	131.00	89.00	15.80
	Osteoporosis	8	75.00	103.00	89.75	9.62
Hip circumference	Osteopenia	17	79.00	127.00	99.53	11.42
	Osteoporosis	8	90.00	105.00	96.75	6.04
Waist-Hip Ratio	Osteopenia	17	0.71	1.03	0.85	0.09
	Osteoporosis	8	0.82	1.01	0.89	0.07
Difference in Kcal intake (Referred - Ideal)	Osteopenia	17	-463.82	885.46	191.92	443.95
	Osteoporosis	8	-318.41	1109.07	406.58	480.52
Difference in Protein Intake * (Referred - Ideal)	Osteopenia	17	-16.50	48.69	15.14	16.53
	Osteoporosis	8	-10.35	250.04	59.24	80.07
Difference in Calcium Intake (Referred - Ideal)	Osteopenia	17	-1178.40	128.54	-805.05	363.02
	Osteoporosis	8	-1119.30	1.05	-611.35	407.64

* Variable representing significant statistical difference between osteoporosis and osteopenia groups in the *Wilcoxon-Mann-Whitney* Test (p=0.023).
Kcal=kilocalories

Differences were observed between the reference values and the measured caloric intake, protein intake and calcium values. The most significant values were the high protein and the low calcium intake. Both groups had high Waist-Hip Ratio (WHR) values. It was observed that the osteoporosis group ingested significantly more protein (p=0.023) than the osteopenia group. There were no significant differences between the groups for the variables total caloric intake and calcium intake, however.

The Kolmogorov-Smirnov test was used for sample distribution analysis, and determined that the variables “difference between protein intake" and "protein consumption difference" did not approach Gaussian distribution. Considering the size of the study groups, it was decided to use non-parametric statistics for data analysis. Table 2 shows these variables.

Table 2. *Spearman* correlation between intake variables and BMD of 25 women diagnosed with osteopenia or osteoporosis in the post-menopausal period, participants of the Practice of Physical Exercise Against Osteoporosis (PEFO) study group of the Universidade Tecnológica Federal do Paraná (the Federal Technology University of Paraná) (UTFPR). Curitiba, Paraná, 2014.

Variables	Difference in kilocalorie intake	Difference in protein intake	Difference in calcium intake	BMD Femur	BMD Spine
Difference in kilocalorie intake	1.000	0.668**	0.148	-0.290	-0.162
Difference in protein intake		1.000	0.212	-0.416*	-0.255
Difference in calcium intake			1.000	-0.078	-0.145
BMD Femur				1.000	0.182
BMD Spine					1.000

* Significant correlation at 0.05 level (2 extremities). ** significant correlation at 0.01 level (2 extremities).

The Bone Mineral Density (BMD) values were analyzed in absolute terms (g/cm²). The results displayed a negative correlation between the intake of proteins and the BMD of the femur (-0.416).

DISCUSSION

Osteoporosis is a disease characterized by reduced bone mass and the microarchitectural disruption of the bone. This occurrence leads to an increased risk of fractures. It is closely related to the menopausal and postmenopausal periods.[8]

The physiological process of bone growth remodeling requires the involvement of many nutrients. These include calcium, vitamin D and proteins, as well as other nutrients such as potassium, magnesium and vitamin K, which may also be related to benefits for bone health.[9]

These nutrients initially originate from a suitable food intake. In the women analyzed the parameters relating to food consumption denoted a nutritional imbalance in terms of the actual situation of bone demineralization presented by the sample.

Calcium is the most abundant mineral in the human body, mainly located in the bones and teeth (99%). The intake of an appropriate amount of calcium is essential for the maintenance of healthy bones. The calcium intake from the diet is absorbed in the intestinal tract, and is divided into two parts: the active saturable part, mediated by vitamin D and the calcium-binding protein, and the passive part, through simple or facilitated diffusion.[10]

In this regard, it is noteworthy that the only source of calcium available to the human body comes from the diet. The main dietary source of calcium comes from milk and milk products and dark green leaf vegetables. Data indicates that in Brazil calcium intake is below ideal, with a national average of 300 to 500 mg/day.[11]

The women performed in this study had a high protein and a low calcium intake. Similarly, in the study by Pinheiro *et al.*,[12] which evaluated 2420 subjects aged over 40 years and sought to evaluate the relationship between nutrient intake and osteoporotic fractures, the authors found that 99% of this population had a calcium intake below the recommended level (1200 mg/day).

A study by Straub[13] which evaluated 142 healthy women in the pre-menopausal period, found that the average absorption of calcium was only 35%, ranging from 17% to 58%. It is also notable that the absorption of calcium was inversely related to the total intake of dietary fiber and calcium.

A number of factors influence calcium absorption, including: levels of vitamin D, gastric acidity, age, estrogen levels and dietary fiber intake. In case of low levels of vitamin D, it is estimated that only 10 to 15% of calcium is absorbed.[13]

Another variable analyzed was protein intake. The protein intake observed in women was considerably higher than ideal levels, which can result in losses in bone mineral density. A greater preference among women for protein-rich foods was observed. Thus, attention should be paid to the fact that excessive protein intake can lead to increased loss of calcium, especially through increased renal excretion, and consequently damage the bone health of these women.[14-15]

The consumption of hyperprotein diets can lead to metabolic acidosis, promoting bone resorption and inhibiting the action of osteoblasts, thus damaging bone structure. On this basis, Silva *et al.,*[16] proposed to evaluate possible changes in the bone tissue of Wistar rats when fed with a so-called "protein diet". They concluded that this type of diet (high-protein) caused changes in bone remodeling, presumably due to decreased bone formation activity and greater demineralization. It is therefore suggested that adult women in the pre-menopausal and menopausal periods tend to develop osteopenia and osteoporosis due to a high protein intake.[16]

However, calcium and protein, are primarily responsible for bone tissue construction. There are therefore positive and negative effects of protein intake. These positive effects are more common in older people with a high intake of calcium rich foods than people with lower consumption.[17] This reality was not found in the group of women studied, as the calcium intake was below ideal levels.

A study by Zhong *et al.,*[18] investigated the association between calcium and protein intake and the risk of fractures. More than two thousand women in the post-menopausal period evaluated in the National Health and Nutrition Examination Survey 1999-2002 took part in the study. The results showed that women with a total calcium intake ≥1200 mg/day and a protein consumption <46 g/day were at a greater risk of fractures than those with a lower calcium intake. The ratio between calcium and protein intake should be investigated more fully, primarily among older women.

It is estimated that for every 50 g of protein consumed there is an increase in urinary calcium of 60 mg/day. This is due to the fact that excess dietary protein increases urinary calcium by about 50%. In other words, for every gram of protein metabolized there is an increase in urinary calcium concentration of 1.75 mg. It should be noted that the negative effect of protein on bone metabolism is seen only if the calcium intake is below the ideal level.[19] This finding is in line with the results for the women evaluated in the present study (high protein and low calcium intake). It is estimated that a ratio of calcium to protein greater than 20:1 can protect the bones.[19]

In this context, the inadequate intake of calcium and protein represents a greater risk of the development of osteopenia and osteoporosis. This situation can lead to fractures that are often very serious, depending on anatomical location.

A review by Pinheiro and Eis[20] found a moderate incidence of hip fractures in subjects aged over 50, representing between 11% and 23.8% of fractures in all anatomical locations. It should be noted that according to Brazilian studies, the mortality rate 12 months after the occurrence of fractures ranged from 21.5% to 30%. In this sense, it is clear that osteoporosis should be considered a serious public health problem.[20]

It is estimated that there are approximately 9 million fractures caused by osteoporosis worldwide each year. Of these, 1.6 million affect the hip, 1.7 million occur at the distal end of the forearm and 1.4 million are in the vertebrae. It is noteworthy that the risk of women over 50 suffering fractures is 32% in the vertebral region and 16% for the distal end of the femur.[21]

Therefore, it is suggested that when there is insufficient calcium intake, high protein intake and osteoporosis/osteopenia identified by DXA analysis, the risk of fractures occurring should be

considered and, in the first instance, prevented by educational actions and the improvement of food consumption levels.

In terms of the limitations of this study, possible bias related to the recall of food intake should be mentioned, as the method depends on the memory of the participant regarding what was consumed at each meal, as well as the cross-sectional nature of the study, with a limited number of participants with the profile stipulated for analysis.

CONCLUSION

Bone structure is dependent on complex processes which involve intake, absorption capacity and the need for fixation of the organic and inorganic substances involved in constant bone remodeling. Therefore, the lack of nutritional control of the evaluated women is directly linked to their reduced BMD. This factor is explained by their high protein intake and the mineral consumption below reference values, especially in the low BMD group.

Finally, the results suggest that adequate calcium intake alone is not sufficient for the protection of bones. Regular protein intake associated with other protective factors (sun, vitamin D, physical activity) is essential and this information should be disseminated widely to health professionals and via public health campaigns. We recommend further research with larger samples and the daily recording of food intake in order to verify the results found in the present study.

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Factors associated with the frequency of polypathology among elderly persons receiving care at a referral center in Montes Claros, Minas Gerais

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Abstract

Objective: To investigate polypathology among elderly persons treated at a referral center in the state of Minas Gerais, Brazil. *Methodology:* An analytical documentary study with a cross-sectional quantitative approach was performed. The records of referral and care of 668 elderly persons who were treated at the referral center were analyzed. Bivariate and multivariate analysis was performed using logistic regression. *Results:* 278 medical records were analyzed. Polypathology was the main reason for seeking care in 114 (41.0%) cases. There was a statistically significant association between the characteristics of being male and less educated and polypathology. In multivariate analysis, polypathology was higher among men and lower among elderly persons with a high school or higher education. *Conclusion:* The findings identify a situation with a predominance of polypathology among the elderly. This is at a worrying level among elderly men and less educated older persons, and should be addressed carefully by health professionals, in the search for more specific and appropriate care.

Key words: Elderly; Health of the Elderly; Aging; Health Services for the Aged.

INTRODUCTION

The diseases that arise due to aging are affected not only by the vulnerability that arises from advanced age, but also by associated risk factors. Such diseases therefore have various causes, which in turn result in polypathologies of the various systems and functions of the body. Polypathology is defined as the state where a person suffers from more than five morbidities, or non-transmissible chronic diseases (NTCDs), such as systemic arterial hypertension (SAH), diabetes *mellitus* (DM), cerebrovascular accidents (CVA), and osteoporosis, among other diseases.[1-3]

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The chronicity that characterizes the majority of these diseases causes organic and functional limitations among the elderly that impede them from engaging in activities which were once routine, forcing them to seek help from others or from devices that provide them more safety. The elderly are at risk of being affected by some form of pathology, be it physical, mental or social, placing them in a state of vulnerability or worse, in which they suffer from polypathologies.[2,3]

A significant portion of people that are 60 or older suffer from various diseases that are comorbid, and, in the majority, NTCDs, which may be associated or not with performance limitations that arise from these diseases or from their sequelae. However, even those that suffer from at least one NTCD can live normally if their conditions are kept under control. The maintenance of autonomy is essential for a healthy old age. This can be summed up by the capacity of the elderly person to determine and execute his or her own daily activities. If NTCDs go unmonitored, certain sequelae or forms of incapacitation can arise.[4,5]

Understanding the diseases and the level of impairment they impart on the performance of the daily activities of elderly individuals and, at the same time, identifying what kinds of assistance the elderly person needs is the best path for treating each patient.[4] Health care professionals should strive to promote activities that postpone limitations to the lifestyle of the elderly. The implementation of the National Policy for the Health of the Elderly Individual is also necessary to encourage the prioritization of healthy living, to prevent aggravating factors from arising and, furthermore, to offer systematic and adequate care with the aim of maintaining the functional capacity of the elderly.[6]

The identification of the characteristics and the factors that are associated with polypathologies among Brazilian elderly persons may help in the planning of activities to promote the rational use of medications and other raw materials in health care centers. Furthermore, such aspects may become factors that can predict the emergence of polypathologies and other health-disease related conditions among the elderly.[1,3-5,7,8] This knowledge will allow health care services to effectively plan activities and implement new strategies for increasing the amount of attention that is given to the elderly population, especially with respect to polypathologies. In addition, this could be beneficial to the promotion of initiatives that aim to improve the quality of life of this demographic group, especially considering knowledge gaps still exist regarding the phenomenon of polypathology within this population.[7,8]

In this context, the present study aimed to investigate polypathology among elderly patients that are treated at a referral center located in the state of Minas Gerais, Brazil.

METHODOLOGY

This paper describes an analytical documentary study featuring a cross-sectional quantitative approach. The study was undertaken at the Centro de Referência em Assistência à Saúde do Idoso Eny Faria de Oliveira (Eny Faria de Oliveira Referral Center for Elderly Health Care) (CRASI-EFO), which is located in the city of Montes Claros, in the state of Minas Gerais.

This Center is a branch of the Elderly Health Care Network that cares for high-risk, or vulnerable, elderly patients. In its regulations, the State Health Secretariat of Minas Gerais defines as vulnerable any elderly person exposed to risk factors that can be detected during an evaluation of his or her profile, such as elderly persons that are at least 80 years old and/or elderly persons that are at least 60 years old that suffer from: polypathologies (beginning at five diagnoses), polypharmacy (those who ingest at least five different drugs per day), partial or total immobility, postural instability or repeated falls, urinary or bowel incontinence, cognitive incapacitation (upon presenting cognitive decline, dementia syndrome, depression or *delirium*), a history of frequent hospitalization and/or post-discharge hospitalization, being dependent on others to conduct their basic activities of daily living (Basic ADLs), familial insufficiency, and specifically elderly persons that are socially vulnerable, not only in their family lives, but also as residents of extended care facilities for the elderly.[9]

These elderly patients are referred by teams from the Atenção Primária à Saúde (Primary Health Monitoring Service) (APS), or some other such service, through an appointment that is made by the Central de Regulação Assistencial (Care Regulation Center) under the supervision of the Municipal Health Secretariat of Montes Claros.

Because the research study followed the analytical documentary format, it made use of the following documents: Referral Forms and Patient Care Forms from 668 elderly persons residing in Montes Claros, Minas Gerais, who received primary care at the CRASI-EFO during the period of June to August, 2012. The 668 medical records were distributed among the elderly patients as follows: July (295 consultations) and August (373 consultations). Among these, researchers found that 278 medical records (42.0%) contained information regarding the motive of the consultation at CRASI-EFO, while the rest of the records did not contain information regarding polypathologies.

The dependent variable - polypathology - was constructed based on the categorization of the quantity of diseases that were described in the medical treatment records of the elderly patients. According to the Ministry of Health, a diagnosis of five or more simultaneous diseases is sufficient to prescribe a diagnosis of polypathology, in addition to the fact that the treatment of one disease may interfere with the treatment of another. As such, researchers considered the elderly persons that were diagnosed with five or more diseases as a *positive result* for polypathology, while a *negative result* for polypathology was considered to be those elderly persons that were diagnosed with less than five diseases.[10]

As a result, only those medical records that stated the motive for a medical consultation at CRASI-EFO were included, which made it possible to identify the presence, or lack thereof, of polypathologies.

To guide the collection of data, a data collection spreadsheet was used which was adapted from the Elderly Patient Care Forms and the Elderly Referral Forms. Based on these documents, the following variables were obtained: the APS that referred the elderly person to the CRASI; the motive for the referral; age; gender; marital status; academic background; color/race according to the elderly person or caregiver; whether the elderly person had a retirement fund; who accompanied the elderly person during the medical consultation; the health care professionals that provided treatment at the CRASI-EFO; which medications the elderly person takes and information regarding pathology. These variables were selected because they are contained in the data collection documents, in addition to being present in the literature about this subject matter. [1,3-5,7,8,11-13]

The Elderly Patient Care Form information was collected from the digital database *software* of CRASI-EFO, while the Elderly Referral Form information, which was found on hard copies, was obtained from the file repository of the institution.

The data was analyzed in the *Predictive Analytics Software* (*PASW*®), version 18.0, for Windows. The data was submitted to descriptive analyzes that verified for relative and absolute frequencies, measurements of central tendency and dispersion, and the association of discrete variables using the Pearson Chi-squared test. The Student's t-test was used for the numerical variables in order to compare mean values. The association between polypathology and the independent variables was studied through a bivariate multiple analysis that included Logistic Regression. Initially, the variables that were associated with polypathology in the bivariate analysis were included in the multiple analysis at a p value of <0.20. Afterwards, each of the variables was included one by one to adjust the final model. A 5% ($p \leq 0.05$) significance level was stipulated for the final model.

The study was conducted in accordance with the ethical standards regarding research studies with human participants, in accordance with the guidelines of Resolution No. 466/2012 of the National Health Council. The necessary debriefing regarding the execution of the study and regarding ethical principles was provided to the Coordenação de Apoio à Pesquisa do Hospital Universitário Clemente Faria (the Department of Support for Research of the Clemente Faria University Hospital), which administers CRASI-

EFO. Department officials were then asked to read and sign the Term of Institutional Agreement to Participate in a Research Study. The research project was approved by the Research Ethics Committee of the Universidade Estadual de Montes Claros, as per consolidated normative statement No. 275.228/2013 and Presentation Certificate for Ethical Authorization: 15859813.3.0000.5146.

RESULTS

Six hundred and sixty-eight medical records were examined, of which 278 (42.0%) contained information regarding the motive for the consultation. In the remaining medical records, no such information was encountered, thereby eliminating these records from the study. Among 114 (41.0%) of the 278 medical records, polypathology was the main reason believed to explain why medical treatment was sought at the CRASI-EFO. The characterization of the 278 elderly persons was distributed according to sociodemographic aspects and the characteristics of the treatment given (table 1).

The characteristics associated with polypathology in the bivariate analysis ($p<0.20$) were gender and academic background (table 2).

Multiple analysis revealed that the variables of gender and academic background were associated ($p\leq0.05$). It was noted that polypathology was more frequent among men. On the other hand, polypathology was less frequent among elderly persons who had graduated from high school or had a higher or further education (table 3).

Table 1. Characterization of elderly persons treated (N=278) at the CRASI-EFO. Montes Claros, Minas Gerais, 2012.

Variables	n	%
Sociodemographic		
Gender		
Female	195	70.1
Male	83	29.9
Marital Status		
Single	34	12.2
Married	112	40.3
Widow/Widower	132	47.5
Academic Background		
Illiterate	125	45.0
Elementary schooling	133	47.8
High school and further	20	7.2
Age		
Between 60 and 70	92	33.1
Between 71 and 79	100	36.0
Over 80 years old	86	30.9
Color/race (self-declared)		
Dark-skinned	220	79.1
Other	58	20.9
Treatment characteristics		
Presence of a caregiver during consultation		
Family members	142	51.1
Other (caretakers/neighbors)	136	48.9

continues on next page

Continuation of Table 1

Variables	n	%
Unit that referred the patient		
Family Health Strategy	155	55.8
Health Care Center	123	44.2
Staff that provided treatment		
Doctor or nurse	146	52.5
Multi-professional team	132	47.5

Table 2. Results of the bivariate analysis of polypathology and sociodemographic variables and the characteristics of the treatment that the elderly received (N=278)) at the CRASI-EFO. Montes Claros, Minas Gerais, 2012.

		Polypathology			
		Yes	No		p-*value*
Variables	N	%	n	%	
Sociodemographic					
Gender					
Female	72	36.9	123	63.1	
Male	42	50.6	41	49.4	**0.02**
Marital Status					
Single	15	44.1	19	55.9	
Married	44	39.3	68	60.7	
Widow/Widower	55	41.7	77	58.3	0.86
Academic Background					
Illiterate	51	40.8	74	59.2	
Elementary schooling	60	45.1	73	54.9	**0.03**
High school and further	3	15.0	17	85.0	**0.02**
Age					
Between 60 and 70	42	45.7	50	54.3	
Between 71 and 79	36	36.0	64	64.0	0.39
Over 80 years old	36	41.9	50	58.1	0.38
Color/race (self-declared)					
Dark-skinned	21	36.2	37	63.8	
Other	93	42.3	127	57.7	0.24
Treatment characteristics					
Presence of a caregiver during consultation					
Family members	62	43.7	80	56.3	
Other (caretakers/neighbors)	52	38.2	84	61.8	0.21
Unit that referred the patient					
Family Health Strategy	61	36.4	94	60.6	
Health Care Center	53	43.1	70	56.9	0.30

continues on next page

Continuation of Table 2

	Polypathology				
	Yes		No		p-*value*
Variables	N	%	n	%	
Staff that provided treatment					
Doctor or Nurse	62	42.5	84	57.5	
Multi-professional Team	52	39.4	80	60.6	0.34

Table 3. Final model of the factors associated with polypathology among the elderly persons treated (N=278) at the CRASI-EFO. Montes Claros, Minas Gerais, 2012.

Independent variables	OR adjusted	CI 95%	p-*value*
Gender			
Female	1		
Male	1.68	1.09-2.85	0.05
Academic Background			
Illiterate	1		
Elementary schooling	1.16	0.70-1.91	0.55
High school and further	0.26	0.07-0.95	0.04

DISCUSSION

The findings of the present study were similar to those encountered in a domiciliary study that was undertaken in the urban area of the municipality of Uberaba, in the state of Minas Gerais, whose aim was to compare the number of morbidities among the elderly with the variables of gender, academic background, individual income, their use of health care services and their number of functional incapacitations. This analysis found that the largest number of morbidities was proportionally larger among women; among elderly persons with less education; among those with a lower individual income; among those that seek out health care services more often; among those that were hospitalized more frequently and among those that had more functional incapacitations.[11]

The present study, however, found that polypathology predominated among men. Such a finding may be the result of factors that are related to behavior, to the use of health care services or to gender relations among the men that were studied. Because of these factors, men seek out health care services less frequently, adopt unhealthy behaviors, and, as a result, display a greater propensity to develop polypathologies when they become elderly.[1,8,12]

Similarly, a cross-sectional study that identified the profile of morbidity and the use of health care services among elderly persons treated by the Family Health Strategy (FHS) of Antônio Estevão de Carvalho in the state of São Paulo, found that health problems were described by 93.5% of the elderly, of whom 52.3% described suffering from two to five NTCDs. However, in contrast with that study, a greater number of elderly women were found to have from two to five pathologies, whereas men predominantly suffered from just one.[12]

A salient characteristic in terms of elderly health care is related to the use of the services that are offered by the APS and FHS. In the present study, the majority of the elderly were referred by the FHS. It should be noted that, according to a study that investigated the tendencies of the health status of Brazilian elderly persons over a period of ten

years, which was characterized by the Pesquisa Nacional por Amostra de Domicílios (National Study of Household Sampling), results showed positive tendencies in the health conditions of the Brazilian elderly population with respect to various, but not all, domains. The changes in the use of health services occurred as expected due to the expansion of the activities of the APS in Brazil.[13]

These changes may explain the results that were observed during this study, since similar parameters were found in Montes Claros: the municipality has achieved a positive restructuring of the service network of the FHS in addition to overall improvements in the coverage of the population. Expansion regarding such services has also been noted in municipalities in the northern region of the state of Minas Gerais, which certainly provides the elderly population with better access to the health care network of the area. The CRASI-EFO is a key institution in this network. In addition, Montes Claros is considered to be a model city in terms of its regional network of health care facilities. In this sense, the impact that quality health care for the elderly has on morbidity and mortality indicators among this demographic can clearly be observed.

Polypathologies can make the elderly person more vulnerable to factors that contribute to a dependency on others to perform basic daily living activities.[14] In this sense, the polypathology phenomenon, which is one of the issues that arises from aging populations, is, today, a reality that health care professionals should be aware of. As such, health care staff must be qualified to deal with this particular aspect of the daily lives of elderly people.[11] Polypathology is therefore a complicated issue within the field of geriatrics. Therefore, continual education and training of health care professionals to deal with polypathologies is required, allowing them to provide higher quality care.

In the present study, the parameter of gender was significantly associated with polypathology, a finding which differed from the results of a study conducted in the city of Fortaleza, in the state of Ceará, where polypathologies were prevalent among women.[15] Among the polypathologies found, cardiovascular diseases were the most prevalent and have been found to be responsible for a third of all deaths among women worldwide, and half of all deaths among women over the age of 50 in developing countries, just as in the United States and Canada. This fact may be associated with greater tendencies in terms of sedentariness and obesity, the loss of sex hormone protection due to menopause, and the sociodemographic and clinical conditions found among elderly women.[15,16]

On the other hand, the results of the present study regarding gender reflect the fact that women live longer on average than men. The fact that women attend health care clinics more often than men should also be considered, as they seek out the services of the FHS with greater frequency. The tendency for women to live longer, as they have a lower rate of mortality than men, occurs all over the world, but this does not mean that women are necessarily exposed to better health care conditions.[12,17,18] As a result, it should be considered that, while women are exposed to factors that preserve their health, and, in this study, presented lower frequencies of polypathology, this does not remove the responsibility of medical professionals to care for elderly women. This scenario strengthens the fact that quality, permanent care is required for this segment of the population.

The multiple analysis performed during the present study revealed that the incidence of polypathology was lower among elderly persons who had graduated from high school or college. This result corroborates with the findings of a study that showed that fewer years of education resulted in cognitive deficiencies.[14] In a study that was undertaken in the municipality of Uberaba, in the state of Minas Gerais, where the incidence of morbidities was compared to years of education, a greater proportion of elderly persons with less education suffered from more than three morbidities, whereas those that had more than eight years of study did not suffer from any morbidities. Various factors may be related to these findings, one of the most notable being greater access to, and a better comprehension of, health-related information.[11]

The parameter academic background is highly influential on the health status of a population.

Elderly persons who have more education enjoy greater autonomy and are more apt to care for themselves and to use various modes of transportation and communication. On the other hand, elderly persons with less education are more susceptible to diseases and, as such, impose greater demands on the health care community, an important fact which must be recognized. The influence of socioeconomic factors must also be noted in this context since, during the infant years of many of these elderly individuals, schooling was a privilege available to few. Within the conditions in which the majority were raised, younger boys had to cultivate the land, while girls had to help their mothers with household chores,[15] which was a common lifestyle in the north of Minas Gerais during the youth of many elderly people.

Elderly individuals with less education may have difficulty in accessing health care services and may not be as aware of the risks that polypathology can pose.[1] This parameter is relevant, because it strengthens the importance of providing people with orientation, especially elderly individuals that are facing a stage of their lives where they require much more attention and care. This is especially true when challenges arise from insufficient schooling, as these limitations can exacerbate health issues among the elderly.[19]

The association between years of education, better quality of life and being able to care for oneself has been discussed in literature concerning this subject matter.[1,3,4,6-8,11,13,14,17,18] From this perspective, both regarding the care context of the present study and that of other health care services, the association mentioned above must be considered. Whenever health care education activities are undertaken, health care professionals should address the elderly patient with language and terminology that they can readily comprehend. Similarly, visual communication must be emphasized during the production of posters with the aim of reaching the target audience. Unfortunately, the process of human aging may bring about reductions in hearing and sight, which can interfere with communication. It is therefore necessary to improve interpersonal relationships and maintain regular dialogue with elderly individuals.[11]

With elderly populations on the rise and increases in the average age of the elderly, the impact of this segment of the population on specialized health care services will also increase in addition to how much is spent on them, making this scenario one of the greatest economic challenges Brazil will face in the coming decades. From this point the necessity of an inversion of the current logic of the country's health care system, currently focused on the treatment of diseases that already exist, rather than on activities that encourage healthy living and disease prevention, emerges. The current status of the system engenders poor quality of life,[20,21] as evidenced by the polypathologies found in this study.

The present study was limited by its cross-sectional design, making cause and effect statements and statements concerning the documentary evidence impossible due to problems in the proper completion of the medical records. Because of these limitations, further studies concerning this subject matter should be undertaken in order to investigate it more comprehensively.

CONCLUSIONS

This study investigated a troubling reality: in the majority of cases in which treatment was sought at the referral center for elderly health care in question, polypathology was found to be the prevalent motive. Elderly men and those elderly persons that had less education were shown to be even more vulnerable, since these parameters were shown to be associated with a greater incidence of polypathologies.

These findings define a scenario of concern not only to health care professionals, but also those individuals that care for elderly persons in the Atenção Primária à Saúde (Primary Health Monitoring Service) network, with the aim of developing more specific care that is effective in treating the condition of polypathology.

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Prevalence of violence against the elderly and associated factors – a population based study in Florianópolis, Santa Catarina

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Abstract

Objective: To estimate the prevalence of violence among the elderly and to analyze its association with demographic, socioeconomic and health conditions. Method: A cross sectional population-based study was conducted of 1,705 individuals aged 60 years or older living in the city of Florianópolis in the state of Santa Catarina, between 2009 to 2010. Verbal, psychological, physical and financial violence was evaluated with a questionnaire used in the Pesquisa Saúde Bem-estar e Envelhecimento (Health and Well-being in Aging Survey) (SABE). Prevalence was calculated for each type of violence and the overall prevalence of violence was identified using the categories of the explanatory variables. Logistic regression was used to identify the factors associated with violence. *Results:* The general prevalence of violence was approximately 13.0%, while verbal violence occurred among 11.0% of respondents. The adjusted analysis showed that being female (OR=2.08) and elderly persons who were single or divorced were 66% more likely to suffer violence. Those who lived with their children or grandchildren were twice as likely to suffer violence (95% CI: 1:40 to 3:40). *Conclusions:* Although the results showed that the prevalence of violence against the elderly was greater than predicted by the WHO, we suspect that this number may be even higher. Due to the complexity of the theme, it is possible that elderly persons are afraid to reveal that they are victims of violence, as in most cases, the aggressors are family members.

Keywords: elderly; violence; domestic violence; abuse of the elderly; violence against the elderly; cross-sectional studies.

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INTRODUCTION

Population aging is a global phenomenon. The fastest growing section of the Brazilian population is the elderly.[1] A number of strategies are required to ensure the dignity of these elderly individuals, including: the promotion of healthy and active aging; consideration during the creation and execution of specific public policies and acts such as the Política Nacional de Saúde da Pessoa Idosa (National Health Policy for the Elderly) and the Estatuto do Idoso (the Statute of the Elderly);[2,3] and the denouncing and prevention of violence against the elderly.

Violence against the elderly is defined as an act of aggression or an omission that may be intentional or involuntary. This abuse can be psychological or physical in nature and may involve financial or material mistreatment.[4]

A study conducted in Spain demonstrated reported the following types of violence: emotional (4.6%); physical (1.6%); sexual (0.6%); and financial (5.6%).[5] In Nigeria, 30% of the elderly participants in a study claimed to have suffered from some form of violence.[6]

In Brazil, a study conducted in the city of Niterói investigated the prevalence of violence against individuals aged 60 years or more, confirming that 43% of this aggression was psychological and 9.6% was physical.[7] Other studies have shown that elderly individuals who are subjected to violence are generally single women of an advanced age with a low level of education and some form of physical or psychological dependence which has led to them living with either their children, grandchildren or daughters-in-law.[8, 9]

In western culture, violence against the elderly occurs irrespective of socioeconomic level and is linked to the socially-accepted idea that the elderly are unproductive and cannot learn.[10, 11] It is believed that this violence damages the functional capacity of the elderly and any type of abuse causes unnecessary suffering, injury, pain and loss, while violating the human rights of individuals and reducing their quality of life.[4,12]

Violence against the elderly is often hidden. One form of investigating this phenomenon is to conduct research in order to publicize the issue and adopt measures to prevent it.[10] Therefore, the aim of the present study was to estimate the prevalence of violence against the elderly and to analyze correlations with demographic, socioeconomic and health factors in a capital city in the south of Brazil.

METHOD

Study design and population

This home-based cross-sectional population study addressed all individuals aged 60 years or more in the city of Florianópolis, in the state of Santa Catarina. This research is part of the inquest into the health conditions of the elderly known as *EpiFloripa Idoso* (2009-2010), which was financed by the Conselho Nacional de Desenvolvimento Cientifico e Tecnológico (the National Council for Scientific Development and Technology) (CNPq).

In 2010, the population of Florianópolis, capital of the state of Santa Catarina, was 421,240, of which 47,076 were aged 60 years or more (19,786 men and 27,289 women). Thus, the elderly represent 11.1% of the total population. At the time of this survey, the city had been awarded a human development index of 0.88, which is the third highest in Brazil. Life expectancy in the city was 72.8 years.

Sampling

The following parameters were considered when calculating the sample size: a population of 44,460; an unknown prevalence of 50%; a sampling error of four percentage points; a confidence interval of 95% and a design effect of two. In addition, 20% was added for predicted losses and 15% for studies of association, giving a desirable sample of at least 1,599 people. Version 6.04 of Epi-Info software (public domain) was used in these calculations.

The sampling was conducted by conglomerates in two stages. Based on the data from the Instituto

Brasileiro de Geografia e Estatística (the Brazilian Institute of Geography and Statistics) (IBGE), the 420 urban census sectors of the city were ordered by the mean monthly income of the head of the household (residing in the sector) and stratified into deciles. In the following stage, 80 sectors were systematically drawn (eight from each income decile). The domiciles were considered as second stage units. Since the record of domiciles in each sector was outdated (the last census prior to the present study was conducted in 2000), the quantity of private inhabited domiciles in each unit was counted.

The number of domiciles ranged from 61 to 725. In order to decrease the coefficient of variation for the quantity of domiciles in the sampling units, the sectors were fused and divided, respecting the corresponding income decile and geographic proximity. Thus, the initial coefficient of variation decreased from 52.7% (n=80 sectors) to 35.2% (n=83 sectors). Subsequently, the domiciles were drawn systematically and all elderly individuals residing in the domiciles selected were invited to participate in the study. Due to the financial resources available, an estimated 23 interviews were conducted per census sector, which allowed a greater variability of the sample. In total, 1911 elderly individuals were eligible for the study. The non-response rate was 10.9%, which led to a final sample of 1705 elderly individuals, all of whom were effectively interviewed. Institutionalized elderly individuals were excluded from the present study.

Individuals who were travelling or not contacted after four visits from the interviewers (at least once at night and once on the weekend) were considered as losses. Those who refused to answer the questionnaire were classified as refusals.

Data collection

A standardized and pre-tested questionnaire was applied by fully-trained and educated interviewers who were available on a full-time basis for the field research. Prior to the collection, a pilot study was conducted with 99 elderly individuals in sectors that were not sampled in the present study. The interview was conducted face to face and a Personal Digital Assistant (PDA) was used to record the data.

On a weekly basis, the consistency of the data was confirmed and the quality control of the interviews was monitored by telephone, based on the application of a reduced questionnaire (10%) from the randomly selected interviews.

Four types of violence were investigated in the present study (verbal, psychological, physical and financial) using the same questionnaire that was used in the Health, Wellbeing and Aging Survey (SABE),[13] which was a longitudinal study of the living conditions of elderly individuals in the city of São Paulo (2006). This questionnaire contains questions that determine whether the elderly individual had been subjected to verbal, financial, psychological or physical violence.

The following questions were used to form the variables of domestic violence against the elderly: 1) *"Have you suffered any type of violence?"; 2) "In the last year, have any of your friends or family shouted at you for no reason?"; 3) "In the last year, have any of your friends or family called you a name that you don't like?"; 4) "In the last year, have any of your friends or family touched or spent your money without your permission?"; 5) "In the last year, have any of your friends or family threatened you because you did not do what they wanted you to do?"; 6) "In the last year, have any of your friends or family hit or slapped you?"; 7) "In the last year, have any of your friends or family shaken you?", and 8) "In the last year, have any of your friends or family stolen your money or something else belonging to you?"*. Each question had three possible answers: yes; no; or ignored. The construction of the variable outcome, which was general violence, only required the participant to answer yes to one of these questions. For the present study, questions 2 and 3 were classified as verbal violence, while questions 4 and 8 were characterized as financial violence. Question 5 was considered to represent psychological violence and questions 6 and 7 were classified as physical violence.

Based on a literature review, the following exploratory variables were selected: gender; age (60 to 69 years, 70 to 79 years and 80 or more years); self-reported skin color (white, brown or black,

with those who described themselves as yellow or Asian Brazilian (n=12) or indigenous (n=16) excluded due to the reduced sample); education (≥12 years of study, 9 to 11 years, 5 to 8 years, ≤4 years) and *per capita* family income, which was stratified into quartiles (1st quartile: ≤R$ 327.50; 2nd quartile: between R$ 327.50 and R$ 700.00; 3rd quartile: between R$ 700.00 and R$1,500.00 and 4th quartile: >R$ 1,500.00).

Health conditions and functional capacity were concomitantly determined by applying the basic and instrumental activities of daily living (ADL) scale. The following classifications were made: independent (no disability/difficulty with any of the activities); mild dependence (disability/difficulty with 1-3 activities); and moderate/severe dependence (disability/difficulty with four or more activities).[14] The cognitive state of the participant was determined using the Mini-Mental State Examination (MMSE)[15] and dichotomized into "absence of cognitive deficits" and "probable cognitive deficits" using cutoff points that considered the level of education of the individual and self-perceptions of their health (very good/good, regular or poor/very poor).

Questions were also asked to determine if the participants had a caregiver (yes or no) and who was their main caregiver (spouse/partner, child/grandchild, formal caregiver or other). The participants were also asked to specify who they lived with (spouse/other people of their own age, alone or with children/grandchildren).

Data analysis

The prevalence of each type of violence (general violence) was calculated in accordance with the categories of the exploratory variables. Subsequently, logistical regression was used to determine the factors associated with general violence. This provided the odds ratio (OR) for the bivariate and multivariate analysis, together with their respective confidence intervals (CI95%). Based on the results from the univariate analysis, all variables that exhibited $p \leq 0.20$ were included in the multivariate analysis. Only those that exhibited $p \leq 0.05$ remained in the final model.

Modeling blocks were used to input the variables: the first block contained the demographic variables; the second contained the socioeconomic variables; the third block contained the health conditions; and the final block contained the variables related to the caregiver and who lived with the participant.

The analysis was conducted considering the effect of the sampling design (conglomerates) and incorporating the sampling weights. This analysis was conducted using Stata 11.0 software (Stata Corp., College Station, USA).

Ethical aspects

This project followed the regulations of resolution 466/2012 of the Conselho Nacional de Saúde (the National Health Council) and was approved by the Human Research Ethics Committee of the Universidade Federal de Santa Catarina (Santa Catarina Federal University) (protocol 352/2008). The interviewees signed a free and informed consent form.

RESULTS

The domiciles that were drawn contained 1911 eligible elderly individuals, of whom 1705 were effectively interviewed (response rate of 89.2%). In total, there were 206 losses and refusals for the following reasons: "*nobody was home*"; "*the elderly individual was away*"; "*an interview was scheduled but they did not show up*"; "*they were on holidays*"; "*they were very sick*"; "*there was a dangerous dog on the premises*". Three losses were due to the hospitalization of the participant at the time of the interview, although these did not affect the results. The main reasons given for refusal to participate were: "they didn't want to be interviewed"; "the interview would take too long"; "they didn't have time to do the interview"; "they thought that interviews were a waste of time"; "they didn't believe in surveys".

The quality control confirmed that the reproducibility of the questions investigated in the reduced questionnaire was satisfactory (Kappa values ranging between 0.6 and 0.9).

In the present study, most of the participants were female and the mean age was 70.4 years (standard deviation =7.8 and median =69 years), with an age range from 60 to 102 years. Many of these women claimed to be married or in a relationship and 87.0% classified their skin color as white. Concerning the socioeconomic characteristics, an expressive proportion of the participants had completed a maximum of four years of study. However, approximately 25% of the participants had a complete higher level education. The mean *per capita* income was R$1,348.97 (standard deviation =R$2,596.28; median =R$700.00). Most of the participants considered their health condition to be good or very good. More than half reported some form of dependence in relation to their activities of daily living (Table 1).

The prevalence of general violence was 12.4% (CI95%: 10.8-14.0), while verbal violence was the most common form of violence used against the elderly participants (10.7%; CI95%: 9.2-12.2) (Figure 1).

Table 1. Prevalence of violence among the elderly according to sociodemographic variables and health conditions. Florianópolis, Santa Catarina, Brazil, 2009/2010.

Variables	Sample		Prevalence of violence	p
	N	%	n (%)	
Gender				0.000
Female	1072	63.8	158 (14.7)	
Male	608	36.2	51 (8.4)	
Age group				0.335
60-69 years	851	50.6	115 (13.5)	
70-79 years	604	35.9	71 (11.7)	
80 or more	225	13.4	23 (10.2)	
Marital status				0.042
Married/in a relationship	984	58.5	111 (11.3)	
Single/divorced/separated	230	13.7	40 (17.4)	
Widowed	466	27.7	58 (12.4)	
Self-reported skin color				0.786
White	1432	87.0	171 (11.9)	
Brown	131	7.9	18 (13.7)	
Black	84	5.1	9 (10.8)	
Education in years of study				0.005
12 or more	392	23.4	29 (7.4)	
9 to 11	233	13.9	30 (12.9)	
5 to 8	317	19.0	49 (15.5)	
0 to 4	730	43.7	99 (13.5)	

continues on next page

Continuation of Table 1

Variables	Sample		Prevalence of violence	p
Income				0.324
Quartile 1 (lowest)	421	25.1	60 (14.2)	
Quartile 2	426	25.4	56 (13.1)	
Quartile 3	418	24.9	51 (12.2)	
Quartile 4 (highest)	415	24.7	42 (10.1)	
Functional capacity				0.003
Independent	457	27.2	49 (10.7)	
Mild dependence	709	42.2	75 (10.6)	
Moderate/severe dependence	514	30.6	85 (16.5)	
Cognitive deficit				0.195
No	878	52.5	100 (11.4)	
Yes	794	47.5	107 (13.5	
Self-perception of health				0.001
Good/very good	860	51.3	88 (10.2)	
Regular	645	38.5	86 (13.3)	
Poor/very poor	172	10.3	34 (19.8)	
Caregiver				0.877
No	1547	92.1	193 (12.5)	
Yes	133	7.9	16 (12.0)	
Main caregiver				0.531
Spouse/partner	35	26.3	3 (8.5)	
Child/grandchild	62	46.6	9 (14.5)	
Formal caregiver	23	17.3	4 (17.4)	
Other	13	9.8	-	
Lives with				0.001
Alone	269	16.0	36 (13.4)	
Professional caregiver	12	0.7	2 (16.7)	
Partner/ others of their own age	705	42.0	61 (8.7)	
Children or grandchildren	692	41.2	109 (15.7)	

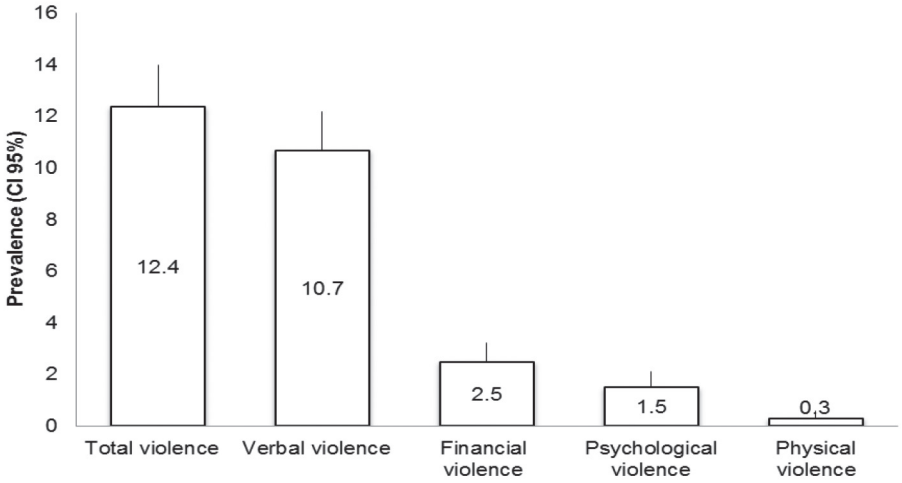

Figure 1. Prevalence of violence against the elderly. Florianópolis, Santa Catarina, Brazil, 2009/2010.

It was found that women are subjected to more violence than men. Single or divorced individuals exhibited a higher frequency of the outcome. Similarly, violence was more common among those with a lower level of education, those with moderate/severe dependence in relation to ADLs and those with a poor perception of their own health. The participants who lived alone, with a caregiver or with children/grandchildren reported higher levels of violence than those who lived with a spouse or other people of their own age (Table 1).

The crude analysis revealed that the variables correlated with the outcome were: the female gender (OR=2.15; CI95%: 1.37-3.38); being married, single or divorced (OR=1.91; CI95%: 1.28-2.86) and having completed less than 11 years of study. The chances of being subjected to violence were higher among individuals who exhibited moderate or severe dependence (OR=1.72; CI95%: 1.11-2.66), had a poor or very poor self-perception of their own health (OR=1.85; CI95%: 1.15-2.99) and lived with their children or grandchildren (OR=2.52; CI95%: 1.58-4.03).

The female gender remained associated with the outcome in the multivariate analysis, with twice as much chance of being subjected to violence than men (CI95%: 1.3-3.2). Single or divorced elderly individuals had a 66% greater chance of being subjected to violence (CI95%: 1.10-2.49). Participants with lower levels of education were also more likely to be subjected to violence. Similarly, elderly individuals that exhibited moderate to severe dependence were 70% more likely to be subjected to some form of violence (CI95%: 1.08-2.66) and those that lived with their children or grandchildren were twice as likely to be subjected to violence (CI95%: 1.40-3.40) (Table 2).

Table 2. Bivariate and multivariate analysis of the factors associated with reports of violence among the elderly (≥60 years). Florianópolis, Santa Catarina, Brazil, 2009/2010.

Variables	**Bivariate analysis**		Multivariate analysis	
	OR (CI 95%)	p	OR (CI 95%)	p
Gender (n=1678)		0.011*		0.002
Male	1.00		1.00	
Female	2.1 (1.3-3.3)		2.0 (1.3-3.2)	
Age group (n=1678)		0.196*		0.114
60-69	1.00		1.00	
70-79	0.7 (0.5-1.0)		0.7 (0.5-1.0)	
80 or more	0.7 (0.4-1.3)		0.7 (0.4-1.3)	
Marital status (n=1678)		0.110*		0.500
Married	1.00		1.00	
Single/divorced	1.9 (1.2-2.8)		1.6 (1.1-2.4)	
Widowed	1.3 (0.8-2.0)		1.0 (0.6-1.7)	
Education (n=1670)		0.005*		0.023
12 years or more	1.00		1.00	
9 to 11 years	1.6 (0.7-3.6)		1.5 (0.7-3.4)	
5 to 8 years	2.4 (1.2- 4.9)		2.1 (1.0-4.2)	
0 to 4 years	2.1 (1.2-3.7)		1.8 (1.0-3.3)	
Income (n=1678)		0.066*		0.449
Quartile 1	1.00		1.00	
Quartile 2	1.0 (0.6-1.6)		1.0 (0.6-1.6)	
Quartile 3	0.8 (0.5-1.2)		0.8 (0.5-1.4)	
Quartile 4	0.5 (0.3-1.1)		0.7 (0.4-1.4)	
Functional capacity (n=1678)		0.011*		0.018
Independent	1.00		1.00	
Mild dependence	0.8 (0.5-1.3)		0.9 (0.6-1.4)	
Moderate/severe dependence	1.7 (1.1-2.6)		1.7 (1.0-2.6)	
Cognitive deficiency (n=1670)		0.060*		0.110
No	1.00		1.00	
Yes	1.3 (0.9-1.9)		1.3 (1.0-1.9)	
Self-perception of health (n=1675)		0.019*		0.807
Good/ very good	1.00		1.00	
Regular	1.3 (0.8-1.9)		0.9 (0.6-1.5)	
Poor/very poor	1.8 (1.1-2.9)		1.1 (0.5-2.1)	
Caregiver (n=1678)		0.803		-

Variables	Bivariate analysis		Multivariate analysis	
	OR (CI 95%)	p	OR (CI 95%)	p
No	1.00			
Yes	0.9 (0.5-1.6)			
Main caregiver (n=120)		0.589		-
Spouse/partner	1.00			
Child/grandchild	2.8 (0.6-11.9)			
Formal caregiver	2.8 (0.5-15.1)			
Lives with (n=1691)		< 0.001*		< 0.001
Partner/ others of their own age	1.00		1.00	
Alone	1.6 (1.0-2.8)		1.4 (0.8-2.3)	
Children or grandchildren	2.5 (1.5-4.0)		2.1 (1.4-3.3)	
Professional caregiver	3.1 (0.5-16.6)		3.9 (0.7-20.6)	

(*) Variables included in the multivariate analysis (p<0.20). (-) Variables not included in the multivariate analysis due to p>0.20.

DISCUSSION

Population-based studies on the prevalence of violence against the elderly in Brazil are incipient and this was the first study of this type in the city of Florianópolis. The size of the sample and the methodology used ensured that the results would be representative of the elderly population living in the urban zone of Florianópolis.

Approximately 12.4% of the participants in the present study reported being subjected to some form of violence. This result is double the WHO estimate for the elderly population.[4] However, other studies have shown that the prevalence of violence can range between 2.2% and 40.4%.[16,17] This variation in estimates could be due to the methods applied in studies and interviews, especially considering that the interview may be conducted in the presence of caregivers and/or family members. The results could also be affected by the understanding of the concept of violence of the elderly individual.

Psychological violence was the most common form of violence in the present study. Previous studies[17,18] have also confirmed this to be the most common form, while suggesting that this type of violence increases the possibility of other types of violence occurring, since it places the elderly individual in a situation of humiliation and fear, which allows the aggressor to continue or commit other types of abuse.

Financial violence was the second most common form of violence in the present study. Adams[19] reported that this was the most common form of abuse among elderly individuals in Australia, as it was so difficult to detect. The person responsible for the violence is usually somebody close to the elderly individual, which reduces the chances of the victim reporting the abuse.

In the present study, women were subjected to more violence than men, as reported in several previous studies of violence.[20,21] This association was maintained in the adjusted analysis, showing that women were twice as likely to be subjected to violence as men. A recent systematic review[21] indicated that women are subjected to violence at all ages and are more susceptible to violence, particularly when they are elderly.

The present study contained a high prevalence of elderly individuals with a higher level education (23.4%), when compared with other regions in Brazil (12%). It was notable that elderly individuals with higher education levels were subjected to less violence than those with lower education levels.

Single or widowed elderly individuals with a low level of education were more likely to be subjected to violence. The absence of a companion is potentially associated with neglect among the elderly,[22] while education is associated with an increase in the chances of the individual being subjected to violence.[23]

Moderate and severe dependence were strongly correlated with the outcome, possibly due to the fact that speech and/or locomotion dependence make an individual more susceptible to violence and decrease the likelihood of the aggressor being reported or arrested. Significant causes of inter-generational conflict include: the elderly individual's need for care as he or she gets older; the onset of an illness; forgetfulness; mental confusion; sleep disorders; incontinence; locomotion difficulties; and impaired functional capacity. All of these issues can create problems and increase the demand for care from children and grandchildren.[24]

A study conducted in São Paulo demonstrated that moderate or severe dependence is a potential factor associated with the negligence of this population.[22] A greater dependence in the performance of activities of daily living leads to a greater risk of the elderly individual in question being subjected to some form of violence.[9]

In the present study, living with children or grandchildren significantly increased the chances of being subjected to violence. Amstadter[25] reported that approximately 10% of all elderly individuals are subjected to some form of mistreatment, and the aggressor generally lives with the victim. This finding has been corroborated by other authors who have shown that elderly individuals living with their children or close relatives are more commonly mistreated by these family members, when compared to others.[26,27] Other international results corroborate these findings, indicating that the perpetrators of violence against the elderly were: children (50%); other relatives (24%); spouses or partners (20%); friends (4%) and caregivers (2%).[16]

The gradual increase in reports and studies of these cases of violence can be partly explained by a transformation in the elderly assistance policy, the statute of which indicates that it is a duty of all Brazilians to prevent the rights of the elderly from being threatened or violated.[28] The domestic environment is a suitable place to investigate violence against the elderly. The frequency of this violence and the factors associated with this phenomenon are essential in studies of this nature.[20]

Violence causes irreversible sequelae for the victims. Studies have shown that the consequences of violence include: poor health conditions; stomach problems; headaches; obesity; allergies; anxiety; sleep disorders and stress.[29]

Therefore, the complexity of violence, as well as its causes, perpetrators and forms of expression, make it a challenging subject to discuss and tackle. The first step in preventing violence is to identify it through public health policies and programs.[30]

The strong points of the present study include the population coverage and the representativeness of the sample. The limitations include the cross-sectional design, which did not favor the establishment of causality – such as knowing whether the elderly individual classified their health as poor/very poor or if an illness was present prior to the mistreatment. Other limitations include the performance of the interview in the home of the participant and the fact that the instrument used to investigate violence against the elderly has not been validated, although it has been used in previous studies.[13]

In closing, the present study provided a panorama of the situation of violence to which the elderly residents of Florianópolis are subjected.

CONCLUSION

The results of the present study indicate that violence against the elderly is higher than the levels expected by the WHO or other studies. These differences could be due to the distinct methods adopted in research projects, although it is probable that the estimates are even higher, since this is a delicate issue. Elderly individuals are often afraid to admit that they are being subjected to violence. In general, the perpetrators of the violence are family members, which leads to the elderly individual hiding the real facts of the situation.

Elderly individuals who live with their children and grandchildren are subjected to more violence than those who live with others. Violence is more common against single/divorced women with a low level of education and some form of functional dependence. These results show that family members who are caregivers must receive support if these rates are to fall. The results also demonstrate the significant social inequalities involved in violence against elderly individuals in Florianópolis.

Public policies and planning strategies are required to provide a structure so that elderly individuals, as well as their families and/or caregivers, are supported and violence levels are reduced. Health professionals and police officers must protect and advise elderly individuals who are subjected to violence, while also seeking to identify, monitor and prevent the occurrence of violence.

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Impact of cognitive stimulation on depression, anxiety, cognition and functional capacity among adults and elderly participants of an open university for senior citizens

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Abstract

Objective: this study evaluated the effectiveness of a Gerontological Cognitive Stimulation workshop, aimed at improving the cognitive and functional performance and mood symptoms of senescent participants in an Open University for Senior Citizens. *Method:* An open controlled clinical trial with a wait list was performed, with 15 people participating in the intervention group and 16 people in the control group. At the beginning and end of the study (six months later) the Digit span, ACE-R, Anxiety Inventory and Beck Depression, and Functional Independence Measure (FIM) tests were applied. *Results:* In the intervention group, there was improvement in the variables evaluated, with significant differences in the visuospatial domain (p=0.022), symptoms of depression (p=0.048) and anxiety (p=0.002). In the control group the symptoms of depression and anxiety deteriorated. *Conclusion:* The results suggest that the cognitive stimulation program has a beneficial effect on the mood symptoms of adults and elderly members of an Open University Program for Senior Citizens.

Key words: Elderly; Cognition; Depression; Anxiety

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INTRODUCTION

Maintaining cognition is important for the independence of elderly individuals, and its stimulation can prevent or delay the degenerative process in the brain.[1] As the science and practice of care for the elderly, gerontology can and should strive not only to avoid or delay illness, but also to promote healthy aging, which requires maintaining and strengthening the physical and psychic functions of the elderly, as well as their social engagement in productive activities and significant interpersonal relationships.[2]

Cognitive stimulation workshops train individuals to live with, accept, reduce and overcome cognitive deficits, as well as to value the personal desires, subjectivities and life stories of each participant. The goal of these workshops is to improve the quality of life of the participants.[3] The workshops involve performing different types of exercises, which seek to improve or compensate for deficits. These exercises include word memorization (to train the memory), searching for differences between images (to train attention to detail) and the completion of puzzles (to train constructive capacity), among others.[4]

In Brazil, Yassuda *et al.*[5] sought to confirm the effects of four sessions of an episodic memory stimulation program on 69 healthy elderly individuals. The post-test results showed that the individuals in the experimental group performed better, in terms of remembering the text and using memory strategies, than those in the control group.

In the Netherlands, Valentijn *et al.*[6] studied healthy elderly individuals with subjective memory complaints, seeking to determine the effects of two different types of memory stimulation (collective and individual). The results showed that, after the intervention, the participants of the collective training group exhibited more stability, less anxiety and less stress related to memory function.

Affective factors are believed to play an important role in cognitive performance. Consequently, these variables should be measured in studies of cognitive stimulation. The correlation between depressive states and cognitive performance is well known.[7] Thus, it is plausible that a decrease in depressive symptoms, as a result of participation in group training sessions, could be responsible for the improvement in performance after training.[5]

It has been reported that the provision of a stimulating and collective environment can lead to social inclusion and improved cognition in several domains. This hypothesis was argued by Marioni *et al.*,[8] who assessed engagement in social, physical and intellectual activities, as well as social support, the self-perception of how well one is understood, and the degree of satisfaction with social relationships among 2854 elderly individuals in France. The authors used a longitudinal study and correlated these factors with incident dementia and cognitive alterations over a period of 20 years. The research showed that there was a correlation between engagement in social, physical and intellectual activities and increased (or stable) cognitive capacity.

In Brazil, the study of cognitive stimulation (CS) in old age is in its initial stages and has received little attention from researchers. It is believed that satisfactory cognitive function is essential so that the elderly can continue to live independently and maintain their quality of life. Thus, the search for gerontological interventions, such as cognitive training workshops, is extremely important for the promotion of physical, psychic and emotional health, as well as the prevention of problems related to cognitive deficits and the social inclusion of these individuals.

Therefore, the aim of the present study was to determine the effects of CS on the cognition, mood and functional capacity of adults and elderly individuals who actively participated in a permanent education program in the Universidade Aberta à Terceira Idade – Fundação Educacional de São Carlos (Open University for Senior Citizens of the de São Carlos Educational Foundation) (UATI-FESC) through pre- and post-intervention assessments.

METHOD

This research involved an open, controlled clinical trial with a wait list. The base population

for the samples from the experimental and control groups was composed of participants in the Universidade da Terceira Idade de São Carlos (São Carlos Open University for Senior Citizens) (UATI/FESC). The UATI/FESC has been in operation for 20 years and is a community-based public project of the Fundação Educacional São Carlos (São Carlos Educational Foundation) (FESC), which seeks to educate adults and elderly individuals through permanent courses in health, culture, sport, leisure, citizenship and work.[8]

In 2013, the population base of the UATI/FESC was 458, and the participants exhibited very similar characteristics to the populations of other Universities for Senior Citizens (USCs) in Brazil: mostly female (92%); with a mean age of 63.3±10.4 years. The oldest participant was 89 years old and the youngest was 40 years old. The majority of these individuals are middle class and their education levels vary (from illiterate individuals to those with doctorate qualifications).[9]

The subjects were selected as follows: the cognitive stimulation (CS) gerontological workshop was advertised and 40 individuals expressed an interest in participating. These individuals (n=40) were assessed in line with the study protocol. After this assessment, the first group of interested parties (20) completed the workshop and made up the Intervention Group (IG). The second group (n=20) was placed on a wait list for another workshop and was called the Control Group (CG).

Based on the inclusion and exclusion criteria, five participants were excluded from the IG as they did not complete 75% of the workshop. Four individuals were excluded from the CG as they were under 50 years of age. Therefore, 31 subjects were divided into two groups: the IG contained 15 individuals who participated in the CS workshop and the CG contained 16 individuals who did not participate in the workshop (wait list).

Inclusion criteria: individuals aged 50 years or more (confirmed by valid Brazilian identity documents) who were present for at least 75% of the workshop.

Exclusion criteria: severe visual or auditory deficits that would hinder the understanding of the individual of the workshop and tests; a severe clinical comorbidity; or a cognitive deficit, as measured by the ACE-R (less than 78 points). Figure 1 displays a fluxogram of the participants.

All stages of this research followed the guidelines contained in resolutions 466 (12/12/2012) and 251 (07/08/97) of the Conselho Nacional de Saúde (Brazilian National Health Council). The present study received approval from the Human Research Ethics Committee of the Universidade Federal de São Carlos (São Carlos Federal University) under protocol number 874.213/2014.

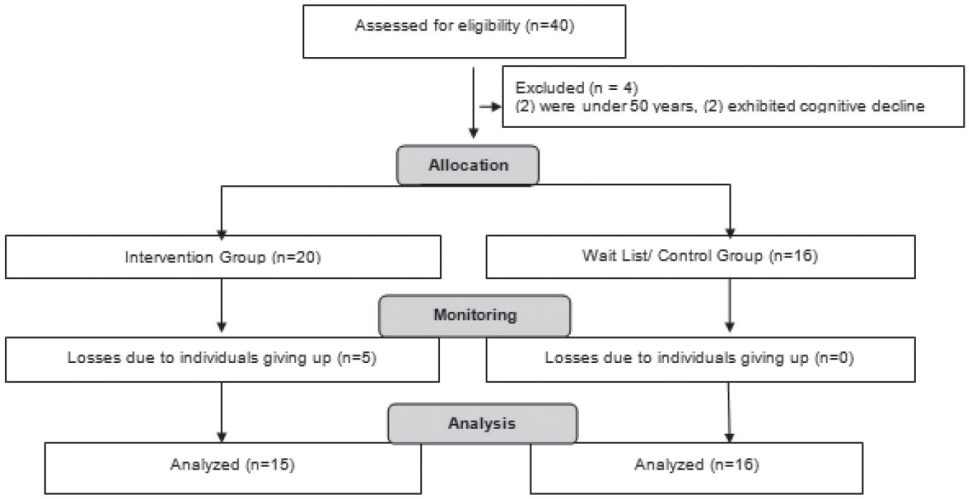

Figure 1. Fluxogram of the participants. São Carlos, 2015.

Assessment of the subjects

An interview was conducted with the participants and an assessment protocol was applied, including a sociodemographic profile questionnaire (gender, age, education, marital status, occupation). In addition, pre- and post-intervention assessments were completed using the instruments described below.

Addenbrooke's Cognitive Examination-Revised (ACE-R)[10] was used for the cognitive assessment. This examination seeks to assess six cognitive domains separately: orientation; attention; memory; verbal fluency; language and visual-spatial ability. The maximum score is 100 points, and the sum of all points scored equals the total score of the individuals in the ACE. The 30 points related to the Mini Mental State Examination (MMSE) are included in this score. Cutoff points for the full battery of tests and the MMSE (ACE-R) were set at <78 points and <25 points, respectively. [11]

The aim of the digit span task is to assess the short-term storage capacity of the memory and its executive component, particularly when the digits are counted in reverse order.[12]

The Beck Anxiety inventory (BAI) was used to record symptoms of anxiety. This inventory was validated for use in Brazil by Cunha[13] and involves a list of 21 common symptoms of anxiety, with options for each, representing increasing levels of anxiety: 0-10 points, minimum symptoms or absence of anxiety; 11-19, mild; 20-30, moderate; and 31-63, severe. Anxiety is considered clinically significant for all scores above 10 points (mild to severe).[13-14]

The Beck Depression Inventory (BDI) is a symptomatic depression scale. It involves a questionnaire with 21 items, with four options ranging from 0-3 points. The sum of the points provides a total score which indicates the intensity of the depression, as follows: 0 to 9 points - minimum symptoms or absence of symptoms; 10 to 18 points - mild symptoms; 19 to 29 points – moderate symptoms; and 30 to 63 points – severe depression symptoms.[13-14]

The Functional Independence Measure (FIM)[15] seeks to assess the incapacity of patients with functional restrictions (varied sources). The FIM uses the following classifications: total dependence (total assistance) =18 points; maximum dependence (assistance up to 75% in a task) and moderate dependence (assistance up to 50% in a task) =19–60 points; minimum dependence (assistance up to 25% in a task) and supervision, stimulation or preparation =61–103; modified and complete independence =104–126 points.

Intervention: The CS workshop was planned based on data recorded from other sites that had used this type of approach, as well as other courses conducted in the area and the guidance of relevant professionals. The games were purchased after receiving financial support from the partner project "Intervention strategies for elderly individuals with mildly impaired cognition" (process FAPESP 2014/18829-4). The chronogram began in the first semester of 2015, when activities began in the Universidade Aberta da Terceira Idade (FESC, campus I). In total, 20 sessions were completed at weekly meetings of one hour, over a period of six months. In order to ensure that the participants received all the protocol interventions, their presence was controlled by a call list. During the first weeks, the theory of cognition was addressed, followed by the application of cognitive games. A circuit of two or three activities per session was established so that the individuals would exercise different cognitive domains in all of the interventions. The control group (CG) was invited to participate in workshop number 20, which focused on recreational activities and socialization, in order to ensure that this group participated in at least one activity. Figure 2 displays a chronogram of the activities performed.

Workshop	EG	CG	Activities
1	x	-	Music
2	x	-	Modeling clay, dominoes, storytelling
3	x	-	Mind academy game "Face to face", manufactured by ESTRELA Ltda. The first letter of phrases are written down and words are formed using these letters. Tetra colors game, manufactured by Simque Artefatos de Madeira Ltda.
4	x	-	Mind academy game "Focus", manufactured by ESTRELA Ltda. Tactile ability, colored sticks.
5	x	-	Mind academy game "Spot the difference", manufactured by ESTRELA Ltda. Sudoku (total of 15)
6	x	-	Word and figure association
7	x	-	Mind academy game "Face to face", manufactured by ESTRELA Ltda. Story telling.
8	x	-	Olfactory abilities; memory game
9	x	-	Dominoes; Mind academy game "Focus", manufactured by ESTRELA Ltda.
10	x	-	Colored sticks; story reproduction
11	x	-	Reading and interpretation; Mind academy game "Spot the difference", manufactured by ESTRELA Ltda.
12	x	-	Connecting points to letters
13	x	-	Mind academy game "One by one", manufactured by ESTRELA Ltda. Center attention
14	x	-	Tactile abilities; writing alternate words with numbers
15	x	-	Writing backwards; copying prescriptions
16	x	-	Supermarket (shopping) list; training with change
17	x	-	Associative memory; colored sticks; Tetra colors game; manufactured by Simque Artefatos de Madeira Ltda.
18	x	-	Sum triangle; Hanoi tower, manufactured by Wood toys Ltda.
19	x	-	Mind academy game "Spot the difference", manufactured by ESTRELA Ltda. Sudoku (total of 15)
20	x	x	Reading and interpretation; completing song lyrics; finish the workshop with songs, breakfast and fruit
Make-up classes			Make-up classes for those who were absent

EG=Experimental Group; CG=Control Group.

Figure 2. Chronogram of the activities performed. São Carlos, 2015.

Data analysis was conducted by a professional statistician, using version 20.0 of the Statistical Package for Social Science (SPSS). This analysis involved descriptive and univariate statistics for both categorical (tables of frequency) and quantitative (measures of central tendency and variability) variables. The variables measured exhibited normal distribution values, according to the Kolmogorov-Smirnov test. The results for the mean cognition variables (ACE-R and MMSE), the ACE-R domains, the digit span test, as well as depression, anxiety and functional capacity in both groups were compared and analyzed before and after the intervention using the student's t-test for independent samples. The variables of gender, marital status and occupation were compared and analyzed for independent samples using Fisher's exact test. The level of statistical significance was set at $p<0.05$.

RESULTS

In general, the majority of the participants were elderly (60 years or more), female, married, highly-educated and retired. Table 1 displays the pairing of the groups according to the clinical and sociodemographic variables of the two groups. No diferences were found between the two groups in relation to the baseline of the variables studied.

Table 1. General characteristics of the participants in the intervention and control groups. São Carlos,2015.

Variables	Group		Bilateral p-value
	Intervention (n=16)	Control (n-=15)	
Demographic variables			
Gender - Female n(%)	14 (93.3%)	15 (93.8)	0.962**
Gender – Male n(%)	01 (6.7)	01 (6.2)	
Age (mean ± sd)	71.2 ±8.5	69.1±11.6	0.570*
50 to 59 years n(%)	-	04 (25.0)	
60 to 69 years n(%)	08 (53.3)	03 (18.8)	
70 to 79 years n(%)	04 (26.7)	06 (37.5)	
80 years or more n(%)	03 (20.0)	03 (18.8)	
Marital status n(%)			
Companion	06 (40.0)	10 (62.5)	0.062**
No companion	09 (60.0)	06 (37.5)	
Education ± sd	12.8 ±3.3	12.6±4.3	0.839*
1 – 4 years of education n(%)	01 (6.7)	01 (6.2)	
5 – 8 years n(%)	02 (13.3)	-	
9 years or more n(%)	12 (80.0)	15 (93.8)	
Occupation – Active n(%)	03 (20.0)	04 (25.0)	0.124**
Occupation – Retired n(%)	12 (80.0)	12 (75.0)	0.061**
ACE-R mean ± sd	89.3 ±4.0	88.7±5.1	0.464*
MMSE mean ± sd	27.9±1.9	27.7±1.7	0.785*
BDI mean ± sd	5.3 ±3.8	5.4 ±3.6	0.946*
BAI mean ± sd	5.8 ±4.7	5.9 ±4.5	0.946*
MIF mean ± sd	124.5 ±2.4	125.1 ±1.0	0.435*

* students t-test for independent samples; ** Fishers exact test; sd = standard deviation.

When the before and after values were compared an improvement was recorded in all of the variables studied in the IG, with the exception of functional capacity, which remained the same. However, only depression (p=0.048) and anxiety symptoms (p=0.002) were significantly statistically different. In the CG, the variables also exhibited a discreet improvement, with the exception of depression and anxiety symptoms, which worsened when the before and after values were compared. No statistically significant diferences were found in the CG (Table 2).

In terms of the distribution of the ACE-R domains, an improvement was recorded in the IG in all domains, with the exception of verbal fluency, which remained the same. Interestingly, the visual and spatial domain exhibited a statistically significant difference (p=0.022) and a trend towards the total ACE-R score (p=0.082).

In the CG, there was a discreet improvement in the mean scores of the variables studied, with the exception of verbal fluency, which remained the same. However, no statistically significant diferences were found in this group.

Qualitative analysis of the results confirmed that the participants in the IG were excited by the activities offered in the interventions, particularly as they were grouped together with other individuals of a similar age, with similar social profiles and health conditions. They shared a space where they felt that their personal desires, subjectivities and life stories were valued. These considerations were reflected in the improvements recorded in their cognitive patterns, anxiety issues and mood. These findings are contrary to those of the CG, the participants of which remained on a wait list and did not have the opportunity to share these experiences. This was reflected in the discreet worsening recorded for their anxiety and depression symptoms.

Table 2. Descriptive and comparative analysis of the variables digit span task, mood and functional capacity according to the assessment period (before and after) for the intervention and control groups. São Carlos, 2015.

Variables mean ± standard deviation	INTERVENTION GROUP		*p* value	CONTROL GROUP		*p* value
	BEFORE	AFTER		BEFORE	AFTER	
Digit span DO†	5.8±1.0	5.4±1.3	0.290	5.1±1.5	5.6±1.3	0.323
Digit span IO†	3.8±1.0	4.3±1.2	0.313	3.6±1.2	3.7±1.1	0.878
Depression Symptoms	11.2±5.8	5.3±4.8	0.048	5.4±3.9	5.9±4.6	0.744
Anxiety symptoms	8.2±7.7	5.6±4.8	0.002	5.9±4.5	6.7±4.6	0.645
Functional capacity	125.1±1.1	125.1±0.9	1.000	124.6±2.4	125.1±0.7	0.427

†DO = direct order; IO = indirect order; *student's t-test for independent samples.

Table 3. Descriptive and comparative analysis of the ACE-R, total ACE-R and total MMSE domains according to the assessment period (before and after) for the intervention and control groups. São Carlos, 2015.

ACE-R Domains	Intervention Group			Control Group		
mean ± standard deviation	BEFORE	AFTER	*p* value*	BEFORE	AFTER	*p* value*
Guidance/care	16.7±1.5	17.5±1.1	0.111	17.1±1.1	17.4±0.9	0.481
Memory	21.7±3.8	22.1±3.3	0.497	18.4±3.0	19.7±3.1	0.231
Verbal fluency	12.6±1.2	12.6±1.7	1.000	12.4±1.5	12.4±1.7	1.000
Language	24.6±1.2	24.8±1.3	0.499	25.1±1.1	25.2±1.0	0.740
Visual and spatial	14.5±1.6	15.3±1.1	0.022	14.6±1.9	14.8±1.9	0.851
ACE-R	89.3±4.1	92.5±5.1	0.082	88±5.8	89.8±6.1	0.413
MMSE (ACE-R)	27.9±2.1	28.3±2.8	0.559	27.7±1.7	27.9±1.6	0.748

* student's t-test for paired samples.

DISCUSSION

In the present study, the two groups (IG and CG) mostly contained elderly (60 years or more), retired, married and highly-educated women. A possible explanation for the predominance of female participants in these type of groups is the different nature of the aging process among women and how they perceive these differences. Women tend to be more interested in cultural activities whereas men are more interested in political issues.[16] In addition, since the subjects were recruited from within the UATI, the profile of younger elderly (between 60 and 75 years) married, highly-educated women with a good income corroborates previous studies that described the participants of these programs.[17-20]

In the present study, CS was able to improve levels of visual and spatial function, as well as depression and anxiety symptoms. It is known that spatial perceptions can be affected by education levels. When performing visual tasks, individuals with less education require more time and commit more errors (finding less targets) than those with a higher level of education.[21] This explains the improvement in this domain in the sample studied, given that a higher level of education can be directly correlated to easier learning. Furthermore, as a consequence of their higher level of education, these people may have performed less physical work in their lives and had greater access to health services, which led to them exhibiting better physical health conditions and a satisfactory memory performance, as previously discussed in the literature.[4]

According to the World Health Organization,[22] depression is a psychiatric illness, in which the patient exhibits a deteriorating mood, reduced energy and decreased activity. Alterations to the individual's capacity to experience pleasure have also been confirmed, together with a loss of interest, low concentration levels and (usually) significant fatigue, even after exerting minimal effort. The most common symptoms are sleep disorders and a reduced appetite. Depressed individuals almost always experience reductions in self-esteem and self-confidence, as well as frequent feelings of guilt and/or worthlessness, even when depression symptoms are mild.[23]

Depression involves a series of impairments to the functioning of the individual. A study by Carneiro *et al.*[24] sought to investigate social skills, social support, quality of life and depression among elderly individuals in the University for Senior Citizens of the Universidade do Estado do Rio de Janeiro (Rio de Janeiro State University) (UnATI/UERJ). The authors analyzed both family and institutional environments and found that the elderly individuals in the institutionalize group exhibited significantly higher levels of depression than those in the family group. The authors concluded that depression symptoms are associated with worse social functioning and a lower quality of life.

It is believed that cognitive damage is characteristic of depression and depressed individuals tend to exhibit worse psychosocial functioning. When combined with old age, the fear that something awful might happen, health issues, financial problems and the fear of abandonment, it can lead to anguish, anxiety and concern for the elderly individual, which consequently worsen their depression.[25] In addition, since the individual has experienced the losses (including cognitive losses) and bodily changes associated with aging, a grieving process is commonly experienced, which may intensify the symptoms of depression and anxiety.[26] Thus, interventions that can predict cognitive impairment and minimize depressive symptoms are of great interest to the scientific community.[7]

Cognitive stimulation involves a variety of group activities and discussions that seek to achieve a general improvement in the cognitive and social functioning of the paticipants.[27] Cognitive stimulation activities and a more active and socially-engaged lifestyle can have positive effects on cognition and may prevent cognitive decline and depression.[28]

A significant decrease was recorded in the symptoms of anxiety exhibited by the participants in the IG after the intervention used in the present study. One of the hypotheses proposed for this

result was their participation in the cognitive stimulation group sessions, where they felt valued and were stimulated to modify their lifestyle, expand their knowledge and feel equal (or even better) than other people of the same age.[4]

Valentjin *et al.*[6] compared strategies of cognitive stimulation for groups and individuals. The authors found that the individuals exhibited no improvements in specific tests, although their anxiety levels did decrease. Conversely, group memory training was beneficial in terms of the specific tests and anxiety levels, since the participants had the opportunity to share their experiences (positive and negative) in relation to memory. The individuals who participated in groups also witnessed more examples and were more motivated than those who trained on their own. The value of group cognitive stimulation activities for healthy elderly individuals was also reported in a recently-published systematic review and meta-analyis.[29]

Although the present study did not achieve statistically significant improvements for the cognitive domains of attention, memory, verbal fluency, language and executive functions, there was a discreet improvement in these domains when comparing the values recorded before and after the intervention. The participants of the present study were active, healthy individuals, who recorded high scores for cognitive performance in the pre-test, which may have affected these results.

A study by Youn *et al.*[30] also demonstrated the effectiveness of cognitive training in a healthy sample, with positive results for the memory of elderly individuals. Carvalho, Neri and Yassuda[31] reported improvements in episodic memory and more use of the strategies learned in the experimental group. Another study demonstrated an improved cognitive performance in a healthy sample, in terms of their performance in tests of attention, memory, verbal memory, oral language, written language and constructional apraxia, when comparing the results of the experimental and control groups.[4] The results of a literature review demonstrated the promising and significant effects of CS on healthy elderly individuals, particularly in relation to memory, attention, executive function and the speed of processing.[32]

Another study[33] sought to ascertain and compare the performance of adults and elderly individuals (n=79) in tests of attention, memory, mood and metamemory before and after 20 sessions of multidisciplinary cognitive stimulation in a large hospital in the city of São Paulo. The authors reported improvements in the performance of the participants in the attention and memory tests ($p<0.001$), as well as a reduction in symptoms of depression ($p=0.014$) and anxiety ($p<0.001$).

Therefore, literature contains divergent findings. In most studies, the participants in cognitive stimulation workshops exhibited significant improvements in these domains. However, many of these studies used different assessment techniques and were conducted in different regions, with specific peculiarities for each sample studied. Thus, it is difficult to adequately compare these results with other studies in this area.

In general, the improvement in cognitive function recorded in the present study can be explained by cognitive plasticity, which refers to increased learning (note the diferences in the pre- and post-test scores), as indicated by the improved performance after receiving instructions and practicing the task. Cognitive functions are sensitive to manipulation strategies and can benefit from the effects of cognitive stimulation.[34]

Another possible explanation for these results could be the fact that the engagement in these training sessions led to the activation of the cognitive function as a whole, due to the constant practice of exercises and the stimulation of the development of activities in the home that involved memory, attention and executive functions. Another hypothesis is that the simple fact of being in a stimulating and collective environment improved the participants´ cognition in several domains. This hypothesis was previously suggested by Marioni *et al.*,[8] who confirmed the correlation between participation in social, physical and intellectual activities and increased (or stable) cognitive capacity.

Continuous learning is essential in order to remain healthy in old age. Gerontologists have provided several arguments in favor of the promotion of an integrated social life for the elderly. These include the new information learned at cognitive stimulation workshops, which is important in relation to the promotion of health, the prevention of disabilities and the maintenance of cognitive capacity and quality of life.[8,35] These conditions are associated with the concept of successful aging. The educational opportunities involved in workshops are important antecedents of evolutionary gains in old age, since they seem to intensify social contact, while promoting the exchange of experiences/knowledge and personal improvements.

CONCLUSION

The results of the present study suggest that group CS interventions have a beneficial effect on visual and spatial functions, while also improving symptoms of depression and anxiety. The limitations of the present study include the fact that it was not randomized and it was impossible to control the variables related to the living conditions of the subjects, as well as their participation in other activities in the UATI. It is important to stress that this study was conducted using a relatively homogenous sample, with a high level of education and a satisfactory socioeconomic situation, which may not reflect the reality of many elderly individuals.

Brazilian studies of cognitive stimulation in adults and the elderly remain incipient, particularly those that focus on cognitive abilities. Therefore, other studies are suggested to explore the influence of these impact variables on the improvement of cognitive functions.

It is hoped that the results of the present study promote cognitive stimulation practices, thereby improving social inclusion and creating a sense of mutual cooperation between those involved, particular the elderly population. It is also hoped that these practices are disseminated in health and education services.

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The Effects of Pilates on the Elderly: An Integrative Review

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Abstract

Introduction: Pilates is considered a form of exercise that aims to improve flexibility, resistance, strength, balance and coordination. As a result, many elderly people have tried the method seeking to improve or maintain their health. *Objective:* The present study aimed to review the effects of Pilates on the elderly. *Methods:* An integrative review was carried out that studied elderly persons undergoing an intervention based on the Pilates method, combined or not with other techniques. The guiding question considered existing studies in literature that evaluated the effects of Pilates on the elderly. Searches of the MEDLINE (PubMed), Scopus and Physiotherapy Evidence Database (PEDro) electronic databases were conducted in May 2014. *Results:* Of a total of 445 studies found, 17 articles were included. Several variables were analyzed, with balance and the risk of falling described most frequently. *Conclusions:* The most studied variables were balance and the risk of falling and there was consensus among the studies regarding the improvement that Pilates caused in these variables. There was also agreement about increased flexibility, but controversy continues to surround the other effects reported in literature, or the data is isolated and therefore inconclusive. Among the studies found, most were experimental, and there were only two randomized controlled trials. The performance of more clinical trials featuring high quality methodological approaches addressing the theme is recommended, so that systematic reviews with meta-analysis may be performed, ensuring greater reliability of the results suggested in this study.

Keywords: Pilates, elderly, exercise, integrative review.

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INTRODUCTION

Life expectancy has undergone a global increase in recent years, resulting in the growth of the elderly population.[1,2] Aging brings biological alterations[3] and generates changes in psychological and social aspects, which compromise independence and quality of life.[4]

Exercise programs that involve strength and balance training are considered to be responsible for maintaining the functional capacity[5] of the elderly, as well as being a preventive intervention to reduce the risk of falls in this population.[6,7]

One of the physical activities recommended for this group is the Pilates method, consisting of a system of physical exercises created by Joseph Pilates which involve body movements based on six principles: breathing, control, concentration, precision, fluidity and centralization, so integrating body and mind[8]. The exercises are designed to promote improvement in posture, strength, endurance, flexibility and balance.[9,10]

Many elderly persons have tried the Pilates method in search of health and the maintenance of physical fitness and disease prevention, as well as adjuvant therapy. Literature contains a number of studies that seek to clarify the benefits of the Pilates method for this population. However, there is still no study that synthesizes these effects among the elderly population.

In seeking to systematize information about the effects of the Pilates method on this population, the aim of the present study was to perform an integrative review on the effects of the Pilates method on the elderly.

METHOD

The integrative literature review method was used, aiming to gather and summarize the scientific knowledge produced on the subject being studied. This allowed the search, evaluation and synthesis of available scientific evidence to facilitate the development of conclusions on the theme.[11] Six stages were followed for the preparation of this study: establishing the research question and the objectives of the study; definition of the inclusion and exclusion criteria of the publications; literature search; analysis and categorization of studies; and presentation and discussion of results.[11]

The research question was: What are the effects of the Pilates method on elderly persons? The search was performed in May 2014 using the following electronic databases: MEDLINE (PubMed), Scopus and the Physiotherapy Evidence Database (PEDro). The year of publication was between 2004 and 2014, and the descriptor was a single term: Pilates. The search strategy used was to insert this term in the database and search. The inclusion criteria were: articles published in indexed journals of a population aged greater than or equal to 60 years undergoing intervention with the Pilates method, with or without other techniques. The exclusion criteria were: incomplete articles and articles in a language other than English, Portuguese and Spanish. The abstracts were read and evaluated by two independent evaluators and papers that met the established criteria were selected for the study and read in their entirety. An instrument for collecting information in order to answer the research question of this review was developed, composed of the following items: title, author, method, journal, year of publication, study objective and main results. The data was presented in tabular form. After reading the articles selected, an analysis and organization of the following themes was performed: Flexibility; Functional aspects; Risk of falls and balance; Body composition and cardiometabolic parameters; Body posture. Analysis, categorization and synthesis of the themes was carried out with the aim of achieving the best description and classification of the results.[11]

RESULTS

The search revealed 445 studies, of which 17 were considered eligible for data analysis (figure 1).

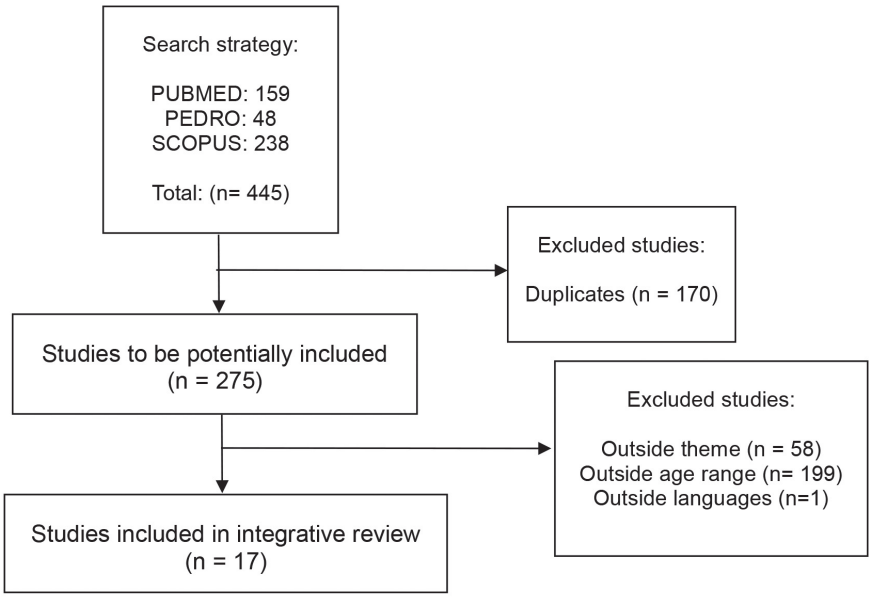

Figure 1. Review flowchart, 2014.

The variables of balance and risk of falls were the most researched, and all the studies found positive results.[5,12-19] This was also the case for variables such as fat percentage,[5,20,21] muscle strength,[22] gait[16,17] and quality of life.[18] Other variables studied that presented positive results, albeit with only one study for each variable, were: motor coordination,[3] personal autonomy,[18] spinal mobility,[3] reaction time,[15] functional performance,[12] systolic blood pressure[21] and pain.[16] Studies featuring the variables flexibility,[15,16,20,22] strength[3,12,15] and posture[23] presented controversial or inconclusive results or there was low adherence among hospitalized elderly persons in Pilates exercises[24] (table 1).

Table 1. Description of results of studies included in review, 2014-2015.

Study	Results found
Smith and Smith, 2005[3]	Strengthening of transversus abdominis, multifidus and pelvic floor muscles. Improves balance, mobility of the spine and stability.
Ruiz-Montero, *et al.*, 2014[5]	Pilates Group: reduction of fat percentage and fat mass. Increased lean body mass. No changes in body weight and body mass index (BMI). Strong correlation between fat mass and waist and hip ratio. Control group: no change.
Hyun, Hwangbo and Lee, 2014[7]	Increased static and dynamic balance of both groups (Pilates and floor activities), with the Pilates group achieving a greater reduction in oscillation.
Granacher *et al.*, 2013[12]	Improved balance and functional performance and reduced risk of falls.
Bird, Hill and Fell, 2012[13]	Pilates Group: Improved static and dynamic balance. There was no improvement in lower limb strength. Control group: no change.
Bird and Fell, 2013[14]	Acute effects (five weeks): increased balance and lower limb strength. Long-term effects (12 months): maintenance of static and dynamic balance. Lower limb strength was maintained only in individuals who continued practicing Pilates. There was an improvement in the risk of falls.
Irez *et al.*, 2011[15]	Pilates Group: Improvement in dynamic balance, flexibility, strength, reaction time, and tendency to fall. Control group: no change.
Stivala and Hartley, 2013[16]	Increased balance, strength, range of motion and gait speed. There was a reduction in pain and functional mobility, although there remained a risk of falls.
Newell, Shead and Sloane, 2012[17]	Improvements in gait speed and step cycle and length. There was a reduced risk of falls.
Rodrigues *et al.*, 2010[18]	Pilates Group: Improved personal autonomy, static balance and quality of life. Control group: no change.
Kaesler, *et al.*, 2007[19]	Improved static and dynamic balance.
Fourie *et al.*, 2013a[20]	Pilates Group: improved shoulder flexion and hip flexibility, with no change in shoulder and knee extension. Control group: Improved shoulder extension.
Fourie *et al.*, 2013c[21]	Pilates Group: Decreased systolic blood pressure, diastolic blood pressure unchanged. Total cholesterol and triglycerides unchanged. Both groups: increased glucose. Control group: no further changes.
Plachy; Kovách; Bognár, 2012[22]	Pilates group and Pilates group associated with water exercises showed improvement in physical strength, and flexibility and range of motion of the shoulder, hip, lumbar spine, thoracolumbar and torso. Control group: no changes.
Kuo, Tully and Galea, 2009[23]	Immediate effect (after 15 weeks): decreased thoracic angle and increased lumbar extension angle. Long-term effects (after 20 weeks): maintained alignments prior to intervention.
Mallery *et al.*, 2010[24]	Pilates group compared to passive mobilization group had lower participation and adherence.
Fourie *et al.*, 2013b[25]	Pilates Group: reduced fat mass and fat percentage and greater lean mass, no changes in body mass and BMI. Control group: no change.

In terms of the type of study, the majority used experimental models,[5,7,13,15,18,20-22,24,25] with only two randomized clinical trials.[13,24] The other studies were of different types, with one literature review[3], one systematic review[12], one pilot study[19], one longitudinal study,[23] one case study[16,] one observational study[17] and an observational prospective cohort study.[14]

DISCUSSION

Balance and the risk of falls were the most reported variables in literature.[7,12-19] This fact can be justified by the balance deficit inherent to aging, which represents a major disabling factor among this population, interfering with functionality and quality of life. The topics described below were stipulated in order to facilitate understanding of the results with respect to all the variables described in the studies analyzed.

Flexibility

Flexibility is directly linked to the independence of elderly persons, as it is an extremely important component in movement.[20] All the studies contained in this review that evaluated this variable were in agreement regarding the improvement of flexibility after a Pilates intervention. Fourie *et al.*[20] evaluated 50 sedentary elderly women divided into two groups, one which underwent Pilates exercises three times a week and a group that went without exercise for eight weeks. The authors identified improvement in the flexibility of the shoulder and hip flexors, although there was no difference in the extensors of the same joints. The decrease in body fat percentage, which possibly generates a mechanical barrier to movement, was described as one of the factors that contributed to this result. However, the control group presented improved shoulder extension.

Plachy, Kovach e Bognár[22] investigated 42 elderly persons, randomly divided into three groups. The first group performed Pilates three times a week, the second underwent Pilates once a week, combined with water exercise twice a week, while the third did not perform physical exercise during the study period of six months. The groups who performed Pilates presented improved flexibility in comparison with the control group. The second group had significant improvement in shoulder, hip, lumbar spine, thoracolumbar and trunk flexibility. The control group remained unchanged. Corroborating these results, Irez *et al.,*[15] who evaluated 60 elderly persons over 12 weeks, divided into an intervention group which performed pilates three times a week and a control group, identified improvements in flexibility.

Functional aspects

Aging brings a decline in muscle mass and subsequently strength. Training involving muscle resistance and strength exercises is very important for the elderly when preventing the loss of muscle and bone mass due to aging.[13] The term functional aspects is extremely broad and includes many variables, such as strength, range of motion, mobility and stamina. Few studies assessed these valences. A study by Plachy, Kovach and Bognár,[22] addressed range of motion and physical resistance. The results showed an improvement in these aspects in both groups that performed an exercise routine, but elderly individuals who practiced only the Pilates Method also demonstrated an improvement in muscle control. The authors state that this improvement may be related to the strengthening of the center of the body, which brings stability and safety when performing movements.

In order to improve functional aspects related to loss of strength and muscle mass, Mallery *et al.*[24] conducted a study with 39 hospitalized patients, which included an evaluation of participation in and adherence to the training. Patients were divided into a control group, which performed passive movements with the aid of a physiotherapist, and an experimental group, who performed the Pilates exercises. Adhesion was higher in the passive movements group. According to the authors, this difference can be explained by the greater intensity of the Pilates method and also by the intervention period, which was more than three times longer in the Pilates group.

Regarding lower limb strength, Bird, Hill and Fell[13] evaluated this aspect and found no difference between groups that practiced and did not practice the method. A year later, however, the same authors found increased strength in another study[14] with a similar design, corroborating the results of Riz *et al.*,[15] who achieved the same findings with a more expressive sample and a longer follow-up.

There were two systematic reviews with functional aspects among their objectives. In the review by Smith and Smith,[3] the authors found evidence of the strengthening of the transversus abdominis, multifidus and pelvic floor muscles, improving body stability and mobility of the spine. Granacher, Gollhfer and Hortobágyi[12] meanwhile, investigated the possible correlation between functional aspects and falls, with the results suggesting that increased body center strength is related to a reduced risk of falls.

Risk of falls and Balance

The risk of falls can be assessed in different ways, with static balance, dynamic balance and strength of the lower limbs the most commonly used parameters in the selected studies. Granacher, Gollhfer and Hortobágyi,[12] in the systematic review described above, concluded that strengthening the center of the body through intervention with Pilates can contribute to the efficiency of the extremities of the body, improving balance among the elderly. In the study of Bird, Hill and Fell,[13] 27 elderly persons were divided into two groups, one that performed Pilates twice a week for five weeks and a group without physical activity during this period. The results showed little improvement in static and dynamic balance in Pilates group, with no increase in lower limb strength. The study of Bird and Fell,[14] however, which was also developed over five weeks and evaluated 30 elderly persons, identified an improvement in lower limb strength, as well as increased balance and a decrease in the risk of falls. This study also performed a follow-up evaluation after 12 months of intervention and found that the elderly persons retained better static and dynamic balance values and a reduced risk of falls, regardless of whether they continued the practice of Pilates or not. However, elderly persons who continued Pilates exercises obtained further increases in static and dynamic balance and still maintained the strength gains. The study by Kaesler *et al.*[19] corroborated these results. This study evaluated seven people for eight weeks, twice per week. The authors concluded that Pilates training can improve static and dynamic balance, reducing the risk of falls.

A case study by Stivala and Hartley[16] evaluated the use of the Pilates method in the rehabilitation of an elderly women aged 84 years after hip surgery due to a fall. The results showed that the patient achieved improvements in balance, range of motion and gait speed, but still had a high risk of falls.

Flexibility, reaction time, dynamic balance, strength of lower limbs and propensity to fall were studied by Irez *et al.*[15] The authors analyzed 60 elderly persons, divided into an intervention group that performed Pilates three times a week for 12 weeks and a control group. There was improvement in all the parameters and a reduced risk of falls.

Newell, Shead and Sloane[17] analyzed gait parameters, balance and risk of falls in nine elderly women who practiced Pilates once a week for eight weeks, concomitantly with walking on a treadmill. The results showed improvement in gait speed and cycle and step length, with a subsequent reduction in risk of falls. However, these results should be analyzed with caution, as the intervention did not only involve Pilates.

When comparing the effects of Pilates and an unstable platform in 40 elderly persons, Hyum, Hwangbo and Lee[7] concluded that both types of training brought benefits in balance, but the Pilates group achieved a greater decrease in oscillation. Rodrigues *et al,*[18] meanwhile, assessed the effects of Pilates on static equilibrium, personal autonomy and quality of life. The authors concluded that there was an improvement in static balance and level of personal autonomy in the Pilates group. Corroborating these results, Kaesler *et al.*[19] also found improvements in static and dynamic balance

and a reduced risk of falls among elderly persons who practiced Pilates.

Body composition and cardiometabolic parameters

Fourie *et al.*[25] evaluated 50 elderly persons divided into a Pilates group, which practiced three times a week for eight weeks, and a control group. The results were a decrease in the percentage of fat and fat mass and an increase in lean mass in those practicing Pilates. There were no changes in body weight and body mass index. The control group showed no changes. Other variables were evaluated by Fourie *et al.*,[21] such as blood pressure, fasting glucose, cholesterol and triglycerides. The Pilates group presented a reduction in systolic blood pressure, but no change in diastolic blood pressure. There were no changes in cholesterol and triglycerides. Both groups had increased glucose. This fact may be explained by the fact that the post-intervention assessments were carried out in winter, which is associated with a nutritional increase. However, the authors suggest that Pilates is not a substitute for forms of aerobic exercise when the goal is solely to improve cardiometabolic risk parameters.

The study by Ruiz-Montero *et al.*[5] involved 303 elderly persons divided into an intervention group which performed Pilates combined with music-based aerobics exercises, twice a week for 24 weeks, and a control group that did not perform physical activity. The intervention group presented reduced fat mass and fat percentage and an increase in lean mass, but there were no changes in body weight or body mass index. Again the results need to be analyzed with caution, as Pilates was combined with another type of physical exercise.

Body posture

Only one item assessed body posture among the elderly. Kuo, Tully and Galea[23] evaluated 34 elderly persons who performed Pilates for ten weeks. Postural analysis was performed by measuring the angles of the spine on the sagittal plane at three moments: before the experiment, fifteen weeks after the start of the intervention and after twenty weeks. After fifteen weeks, there was a decrease in the thoracic angle and an increase in the lumbar extension angle, while after 20 weeks there was no change from baseline.

Limitations of the present study included the fact that the methodological quality of the articles was not evaluated; the diversity of the research designs and intervention protocols, making proper comparison between the studies difficult; and the fact that the exclusion criteria rejected studies for which complete versions were not found, thus generating a significant publication bias.

CONCLUSION

We can infer that the positive effects of the Pilates method, namely improved balance and a reduced risk of falls, were agreed upon by the studies. While there was also a consensus among researchers regarding improved flexibility, there was controversy regarding the other effects reported in literature, with isolated, and thus inconclusive, data presented.

It is suggested that clinical trials are conducted, ensuring greater reliability of the effects of Pilates, allowing the concatenation of the results through future systematic reviews with meta-analysis.

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Factors associated with the resilience of family caregivers of persons with dementia: a systematic review

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Abstract

Background: Resilience is the ability of individuals or groups to overcome adversity without displaying physical or mental disorders, or even learning to deal with unfavorable conditions more efficiently. There have been many studies on resilience, which try to identify the conditions under which people in situations of deprivation or adversity overcome such challenges. *Objective:* The present article aimed to identify factors associated the with development of resilience in family caregivers of people with dementia and the possible outcomes of resilience for the caregiver and receiver of care. *Method:* The study consisted of a systematic literature review carried out in accordance with the PRISMA methodology with searches in the Lilacs, PsycInfo, PubMed, SciELO, SCOPUS and Web of Science databases, using pre-established descriptors. *Results:* After synthesis of the extracted data and the considerations of this review, it was possible to identify possible factors associated with the development of resilience in family caregivers of persons with dementia: depression, anxiety, burden, drug use, the relationship with the person receiving care and health conditions are associated with the resilience of family caregivers. *Conclusion:* We found in literature that the development of resilience by family caregivers of people with Alzheimer's is influenced by factors related to the patient and the caregiver himself or herself.

Keywords: Psychological resilience. Caregivers. Family. Dementia. Alzheimer's disease.

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INTRODUCTION

Dealing with emotions, controlling impulses, being optimistic and expressing empathy are attitudes of overcoming difficulties that have been analyzed by the scientific community in an attempt to determine why certain people are more likely to overcome a problem than others.

When these abilities are analyzed from different points of view, a wide range of conclusions can be drawn: biologists claim that humans have the genetic potential to become more resilient; psychologists claim that the family is responsible for the development of the ability to overcome problems; sociologists believe that cultural and traditional influences give humans this ability to resist; and theologians understand that trials and challenges are essential for human beings to evolve and grow stronger.[1] Despite these differences, there is a general consensus that certain people can overcome problems and return to their normal lives, or indeed improve them, when faced with tragedies and problems, whereas others suffer a great deal more.

Some authors believe that resilience is a personality characteristic that moderates the negative effects of stress and promotes the ability to adapt.[2] Others see it as a process in which the family reorganizes itself after a period of crisis, with the family unit being all-important, since a systemic focus and functional unity strengthen the individual and the unit to which they belong.[3-7] Others believe that resilience is a personal ability or characteristic.[8-10] A number of studies have suggested that environmental conditions favor the development of resilience.[11] Therefore, this could be a strategy or an ability that enables humans to impose themselves when faced with adversities in their lives, allowing them to overcome the problem and adapt, thereby recovering, or even transforming their lives.[7, 12-14]

Human beings are able to adapt to a wide range of situations. However, taking care of a family member who has a chronic illness, especially a degenerative illness such as Alzheimer's disease, can affect the resistance levels of an individual. According to the American Psychiatric Association,[15] dementia represents evidence of significant cognitive decline, which impairs the memory and at least one other cognitive function (attention, executive functions, learning). This can lead to the loss of intellectual capacity, which affects the social and professional functioning of an individual.

According to Alzheimer's Disease International,[16] the most common form of dementia is Alzheimer's disease (AD), which corresponds to between 50% and 60% of all cases and represents one of the main causes of incapacity in adult life, followed by vascular dementia (VD), which represents between 15% and 20%.

The overburdening of caregivers who work with individuals suffering from dementia occurs as a result of a series of physical, psychological, emotional, social and financial problems, as such caregivers generally take responsibility for the care network required by the patient. However, caregivers are often not aware of how to adequately deal with the elderly, which can lead to a state of chronic stress, with occasional social isolation, thereby further increasing the risks of the caregiver suffering from physical and mental pathologies (depression, anxiety and burnout).[17]

While resilience is the response to the totality of the context under experimentation, coping is the response to a moment and provides a solution to a certain situation. The sum of these two coping scenarios does not always guarantee the resistance of the individual. A fundamental characteristic of coping strategies is the fact that they are conscious and intentional, in that the stressor is perceived and analyzed consciously. Constant cognitive and behavioral alterations are required in order to manage specific, internal and/or external demands,[17] which leads to coping being seen as a tactic, rather than a personality trait of the individual, with a focus on the person's actions at a certain moment in time.

The aim of this systematic review was to identify possible factors that are associated with the development of resilience in family caregivers who care for individuals with dementia, as well as the effect of this resilience on outcomes for the caregiver and the patient.

METHOD

This systematic literature review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) methodology proposed by Moher *et al*.[18] This method was created to help researchers and authors to improve the communication, results and methodological rigor of their systematic reviews and meta-analysis. It can also be used for critical assessments of previously published systematic reviews.

Search strategy

This review was conducted in January and February of 2014 in the following databases: LILACS; PsycINFO; PubMed.; Scielo; SCOPUS and Web of Science.

The search descriptors were obtained from the MeSH and DeCS. The following operations were carried out in the databases: "*psychological resilience* AND *dementia*"; "*psychological resilience* AND *family* AND *dementia*"; "*psychological resilience* AND *Alzheimer's disease*"; "*psychological resilience* AND *caregivers*" and "*psychological resilience* AND *Alzheimer's disease* AND *caregivers*".

Identification and screening

The following Inclusion criteria were used to screen the articles: publications in English, Spanish or Portuguese; in peer-reviewed journals; without publication date limits; with a full version of the text available. Review articles were excluded.

The article selection was performed independently and the two investigators (CSSM and AGB) were blinded. They first assessed the titles and abstracts compiled in the databases. After the articles had been selected, a meeting was held to form a consensus and dispel doubts and disagreements between the data collected by the investigators, as per the PRISMA protocol.

Eligibility selection criteria

The following study types were considered eligible: (1) cross-sectional and longitudinal studies of family caregivers who look after people with a diagnosis of some form of dementia; (2) studies that associated resilience with other variables or theories related to caregivers, such as coping and overburden; (3) studies of adults (+18); and (4) studies that sought to understand the resilience of caregivers both objectively and subjectively.

RESULTS

Figure 1 displays the synthesis of the methods used and the findings. In total, 384 articles were identified. Of these, only 13 studies were selected for this review.

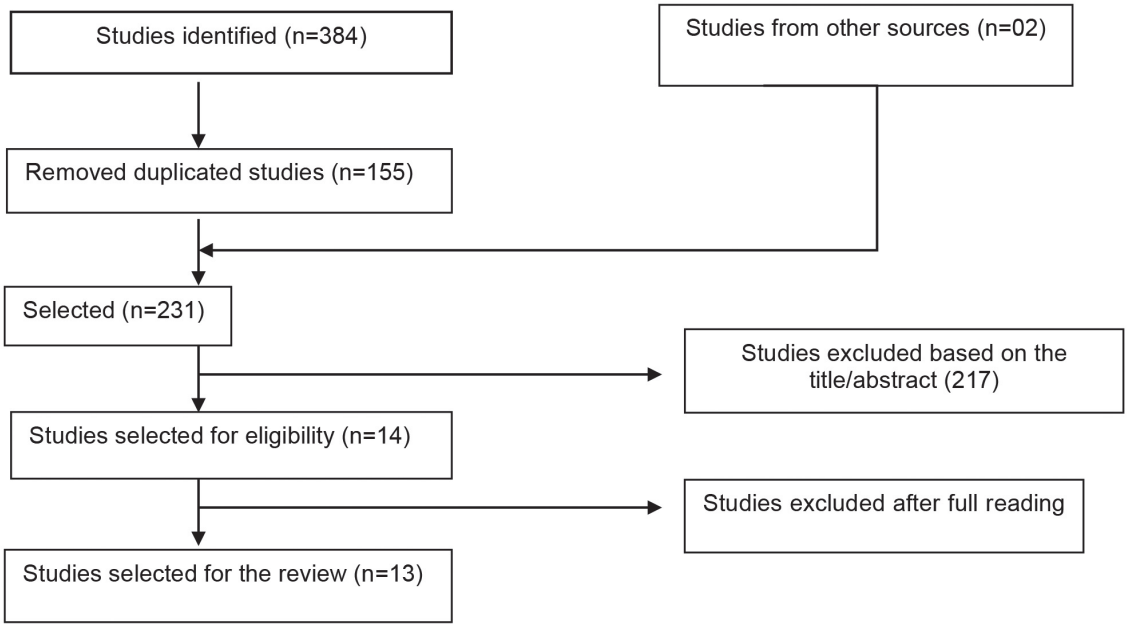

Figure 1. Selection and identification process of the articles. São Carlos, São Paulo, 2015.

Of the studies used in this review, six (46%) were published between 2001 and 2009, three (23%) were published between 2010 and 2011 and four (31%) were published between 2012 and 2013. Most of the studies (46%) were published in the USA, while 31% were published in Brazil, with 8% published in each of Canada, Spain and Portugal. (TOTAL OF 101%).

Concerning the methodology used in these studies, 12 applied a quantitative approach and one used a qualitative approach, while seven (54%) were longitudinal and six (46%) were cross-sectional. Two studies (15%) were experimental. Table 1 displays the synthesis of the studies selected.

Table 1. Synthesis of studies selected for the review. São Carlos, São Paulo, 2015.

Author/Year	**Location**	Design	n	Age	Main findings
Loureiro (2009)	Porto, Portugal	Quantitative/ cross-sectional	32	61*	Coping associated with overburden. Spouses exhibit less negative symptoms.
Lopes, Massinelli (2013)	Sao Paulo, Brazil	Qualitative/ cross-sectional	10	57*	Social and family resources contribute to an increase in resilience.
Lampert (2009)	Porto Alegre, Brazil	Quantitative/ longitudinal	20	55-78	Lower levels of resilience associated with symptoms of depression and stress.
Scott (2010)	Knoxville, USA	Quantitative/ cross-sectional	111	63*	Lower levels of resilience associated with overburden.
Garces et al (2012)	Cruz Alta, Brazil	Quantitative/ cross-sectional	06	40-69	Resilience associated with older caregivers.

continues on next page

Continuation of Table 1

Clay et al (2008)	Birmingham, USA	Quantitative/ longitudinal	166	60*	Resilience in terms of satisfaction with life/ social support and less depressive symptoms among black people.
Lavrestsky, Siddarth, Irwin (2010)	Los Angeles, USA	Quantitative/ longitudinal	40	43-91	A 10mg/day dose of escitalopram improves resilience.
Roth et al (2001)	Birmingham, USA	Quantitative/ longitudinal	197	59,7*	The effects of resilience on symptoms of depression and life satisfaction were higher among black people.
Haley et al (2008)	Tampa, USA	Quantitative/ longitudinal	254	71,1*	Psychological support improves resilience.
Gaioli, Furegato, Santos (2012)	Ribeirao Preto, Brazil	Quantitative/ cross-sectional	101	+18**	Better socioeconomic conditions, lifestyle habits, health conditions and child/parent relationships favor resilience.
Gaugler, Kane, Newcomer (2007)	Rochester, Urbana, Memphis, Portland, Cincinnati, Parkersburgs, Minneapolis and Miami, USA	Quantitative/ longitudinal	1979	63,32*	High resilience associated with less overburden, a lower frequency of institutionalization and death among people in care.
Fernández-Lansac et al (2012).	Madrid, Salamanca and Zamora, Spanish	Quantitative/ cross-sectional	53	63,18*	Resilience associated with the best physical/ emotional state, better healthy habits, less overburden and neuroticism, and greater extroversion, self-efficacy, self-esteem and coping skills.
O'Rourke et al (2010)	Vancouver, Canada	Quantitative/ longitudinal	105	69,59*	Resilience as a perceived control and the challenge-stability ratio as a predictor of depressive symptoms.

*mean age **non-specified limit.

In the studies included in this review, resilience was most commonly associated with depression symptoms in the caregiver (38%), followed by the overburden of the caregiver (31%) and drug use (23%). Degree of kinship with the elderly individual, black ethnicity/skin color, health conditions, lifestyle habits and life satisfaction seem to affect the resilience of caregivers, appearing in 15% of the studies. Anxiety, self-efficacy, self-esteem, tiredness, discouragement, coping skills, burnout, emotional condition, physical condition, stress, extroversion, age, neuroticism, social/ family resources, satisfaction with social support, socioeconomic conditions, psychological support and medical treatment were all mentioned with similar frequency (8%).

DISCUSSION

Two complementary longitudinal studies found psychological differences between different

ethnic groups of caregivers. Roth *et al.*[19] spent two years monitoring 197 family caregivers of people with dementia and 218 non-caregivers, assessing depression, physical health and satisfaction. The authors sought to identify differences between white and black caregivers. The results suggested that white caregivers exhibited higher levels of depression over time, when compared with black caregivers. African-American caregivers exhibited a higher level of life satisfaction and were found to be more resilient against symptoms of depression, although they were vulnerable to increases in physical symptoms over time. Both groups of caregivers reported an increase in physical symptoms over time. However, resilience was both a positive association and a moderating factor, attenuating the symptoms of depression among black caregivers.[19] Similar results were reported by Clay *et al.*,[20] who spent five years monitoring a sample of 166 American caregivers (mean age of 60 years) who cared for individuals that had been classified with dementia. The aim of the study was to analyze their satisfaction with social support and depression symptoms, thereby confirming the resilience found among white and black caregivers. Concerning age, black caregivers were younger than white caregivers, with women more commonly performing this role. As in the above mentioned study, black caregivers exhibited higher levels of life satisfaction than white caregivers, as well as fewer symptoms of depression. The resilience of black caregivers was positively associated with their high levels of satisfaction with social support and life in general, as well as their low levels of depressive symptoms, when compared with white caregivers. The results suggest that low levels of social support have an effect on resilience and are a possible precursor for psychological poverty. Dias *et al.*[21] studied concepts, methodological approaches and determining models related to the resilience of caregivers who work with individuals suffering from dementia. The authors found that high levels of resilience were correlated with low levels of depression and better physical health and concluded that social support was a moderating factor, since depending on a variety of types of support seems to relieve the physical and mental overburden caused by stress.

A number of experimental studies have used interventions to assess the factors that influence the resilience of caregivers. Haley *et al.*[22] spent two years monitoring a randomized sample of 254 caregivers (mean age of 71.1 years) of deceased individuals who had suffered from dementia. The aim of the study was to analyze the joint effects of mourning and care intervention on the depressive symptoms of caregivers. Psychological support was offered to a group of caregivers in the form of an intervention. The caregivers who received the intervention were significantly more resilient and less likely to develop depressive symptoms before and after mourning, which suggests resilience to depression. Conversely, the control caregivers were more likely to exhibit chronic depressive symptoms before and after mourning. The authors suggested that caregivers who possess knowledge, abilities and support (interventions) may find valuable resources in the detachment of assistance, as well as facing challenges such as dealing with the death of a loved one.[22] It is possible to infer that resilience and the support received (social, family or psychological, when required) serve as a protection factor, enabling caregivers to face the adversities of life more effectively. Lavrestsky et al. conducted a 12-month experimental study with 40 caregivers (aged 43 to 91 years) of people with AD. Of these 40 participants, 25 were children of patients, while 15 were spouses of patients. In total, 65% of the sample were women. The participants received 10 mg/day of escitalopram or a placebo (two groups) and the following outcomes were analyzed: the intensity of depression; overburden; resilience; anguish; quality of life; level of cognitive abnormality in the individual with dementia and their behavioral disorders at the beginning of (and throughout) the treatment. The use of escitalopram triggered the remission of severe symptoms of depression, while also improving anxiety, resilience, overburden and quality of life. The use of anti-depressants improved the resistance of the caregiver.[23] A Brazilian study conducted by Manzini[24] sought to assess the factors associated with the resilience of family caregivers of elderly individuals with Alzheimer's. The authors conducted multiple linear regression analysis and found that several factors negatively

affected the level of resilience. These included the mean self-perception of mental health among the caregivers, being from the middle and upper economic classes and symptoms that suggested depression.[24] Alzheimer's disease leads to a great demand for attention from the caregiver, which inevitably damages their own health, leading to depression and other disorders. Clinical support is often required to find a cure for these disorders or to maintain the physical and/or mental health of the caregiver. Gaioli *et al.*[25] reported that resilience is correlated with several variables. In a sample containing 101 Brazilian citizens aged between 18 and 45 years, all of whom cared for elderly individuals with Alzheimer's, the authors sought to describe the socio-demographic and health variables of the caregivers and to analyze associations with resilience. Of the caregivers in this sample, 83.1% were female, 57.4% had studied for up to eight years, and 80.1% were older than 46 years of age, with 36.6% of these older than 60 years. Socio-demographic conditions, lifestyle habits and health conditions affected the resilience of the caregiver. Despite the difficulties involved in caring for an elderly person with Alzheimer's, the caregivers were able to perform their duties more effectively when they had some knowledge of the disease and received help from others. Significant associations were found between resilience and the following variables: the degree of kinship (caregivers who were children of the patient were considered more resilient than spouses, siblings, sisters-in-law and others); medical treatment (43.1% of the caregivers who were receiving some form of medical treatment exhibited poor resilience); drug use (60.0% of the caregivers who used drugs exhibited a medium to high level of resilience); tiredness (76.0% of the caregivers who exhibited tiredness had a low to moderate level of resilience); exhaustion and discouragement (47.8% of the caregivers that did not exhibit exhaustion and discouragement had a high level of resilience). Physical health was significantly associated with the experience of the caregiver, since 81.1% of the elderly in care suffered from severe cognitive issues. The authors suggested that in a family context, elderly individuals may benefit from the presence of a more resilient caregier.[25]

In Spain, Fernández-Lansac *et al.*[26] assessed a sample of 53 caregivers who worked with patients with dementia. In total, 66% of these caregivers were female, while the mean age was 63.1 years. Concerning the degree of kinship, 54.7% were spouses and 37.7% were children of the elderly patients. The aim of this study was to assess resilience and establish variables associated with stress factors (the level of cognitive impairment of the elderly individual), the overburden of the caregiver, personality characteristics, resources and the consequences of the care on the physical and emotional health of the caregiver. The caregivers achieved moderate scores for resilience, which was significantly associated with worse physical and emotional conditions in the caregiver, while higher scores were associated with less anxiety, less depression, lower drug consumption and the absence of psychological interventions. Higher resilience scores were also significantly correlated with levels of overburden, low levels of neuroticism, high levels of extroversion, self-efficacy, self-esteem and self-care, less use of coping strategies that focused on emotions and less changes in healthy habits. The authors concluded that resilience is associated with better physical and emotional conditions and the capacity to deal with adverse situations.[26]

In Canada, O'Rourke *et al.*[27] used a longitudinal study to analyze resilience (assessed through perceived control, life commitment and the challenge versus stability ratio) as a predictor of depressive symptoms among married caregivers over the course of a year (mean age of 69 years). In total, 58 of the caregivers were wives of individuals with (probable) Alzheimer's, while 47 of the caregivers were husbands of patients. The study also sought to correlate these resilience factors with socio-demographic variables and variables related to dementia. The analysis confirmed that resilience, direction and the magnitude of the change in resilience over time were distinct predictors of depressive symptoms. Perceived control and challenges predicted lower levels of depressive symptoms over the course of a year, while an increase in the challenge predicted less depressive symptoms. Conversely, life commitment

was not a significant predictor of depression among caregivers.[27] A study that sought to describe the correlations between functionality, depressive symptomatology and cognition among groups of resilient and non-resilient elderly individuals found that resilience was negatively correlated with depressive symptomatology, thereby demonstrating that elderly individuals with high resilience exhibit less depressive symptomatology.[28] Depression, stress, overburden and psychological characteristics, as well as social, economic and family resources, have been significantly associated with resilience. A Brazilian study by Lampert[29] sought to investigate how social support networks and resilience affect the psychological, neuroendocrine and immunological abnormalities involved in the chronic stress of caregivers who work with dementia patients. The age of the caregivers (n=20) ranged from 55 to 78 years. Resilience was inversely associated with depression and stress, but was not correlated with neuroendocrine and immunological responses. Chronic stress was correlated with an emotional overburden among caregivers. In this study, low levels of cortisol may have been associated with the psychological exhaustion of the caregivers, although emotional overburden did not increase the level of cortisol. Resilience and social support attenuated certain effects of chronic stress related to the emotional overburden of caregivers.[29] A descriptive study of family caregivers of elderly individuals with chronic illnesses reported moderate scores for overburden among the sample. The authors concluded that caregivers who believed that the care they provided was a great responsibility exhibited the greatest overburden.[30] Gratão *et al.*[31] sought to describe the overburden and emotional discomfort of caregivers working with elderly patients and found that older caregivers are more susceptible to overburden, although younger caregivers may suffer from isolation and greater social restrictions. Other issues related to overburden included taking on tasks beyond the scope of those performed in the home, resulting in an accumulation of roles and an overburden in their social, physical, emotional and spiritual lives.

Garces *et al.*[32] interviewed six caregivers aged between 40 and 69 years in order to assess the resistance of caregivers who work with elderly individuals suffering from Alzheimer's disease and correlate it with other psychological variables. Of the six caregivers, five were female, three were married, four were the child of the patient and two were the spouse of the patient. The results suggested that, although most of the caregivers exhibited the probability of developing psychiatric disorders, they also exhibited a high disposition to resilience, thereby confirming that they were capable of facing the adversities involved in dealing with Alzheimer's disease. It was also notable that there was a significant association between resilience and age, in that the oldest caregivers exhibited the greatest levels of resilience.[32]

In Portugal, Loureiro[33] set out to assess physical, emotional and social overburden and correlate these with other variables among 32 informal caregivers who worked with elderly individuals suffering from dementia. The characteristics of the sample were: 71.9% were female; 46.9% were elderly; 87.5% were married; 37.5% had completed a primary education; 43.8% were the spouse of the elderly patient; 37.5% were a child of the elderly patient; 12.5% were the son/daughter-in law of the elderly patient; 6.2% were other relatives; 21% had been caring for the patient for more than five years and 71.8% of the elderly patients were female. The results demonstrated that emotional overburden was the most affected dimension among caregivers of both genders. However, women have a greater perception of overburden, given that they spend more time caring for others, their health is affected to a greater extent and they cite greater social restrictions than men. Psychological coping mechanisms were found to be predictors of overburden. No correlations were found between overburden and the stage of dementia or the length of time caring for the patient. Spouses of the elderly patients reported less negative sentiments about caring for the patient than children and other relatives. Therefore, the results confirmed that informal caregivers exhibited considerable levels of physical, emotional and social overburden.[33]

According to Manzini, the task of caring for a family member with Alzheimer's demands almost exclusive dedication on behalf of caregivers, who often do not have time to look after themselves. They do not perform any physical activities or exercise and end up leaving aside their affairs at the expense of the care they provide. Caregivers may feel overburdened and exhausted as a result of the intensity of the care required by elderly individuals with AD.[24] Similar results were reported by Scott[34] in a study conducted in North America. The authors interviewed 111 caregivers of individuals with AD to determine the moderating effect of resilience on the correlation between stress and predictors of overburden. The results showed that resilience is not a moderating factor between stress and overburden. However, there was an inverse correlation between the scores for resilience and overburden: greater resilience levels led to lower levels of overburden for the caregiver. The authors concluded that these findings show the importance of caregivers of individuals with Alzheimer's and the implementation of support/interventions that increase their resilience.[34] Reppold et al.[35] highlighted the fact that being resilient in a given situation does not guarantee or predict that the individual will be resilient the next time something similar happens, nor does it confirm that they will be resilient in other situations. The authors also stressed that changes to a social support network could have more of an impact on the capacity to successfully face risky situations than individual variables, such as anxiety, depression and stress, among others.

Concerning the high resilience found among caregivers, two previous studies provided similar results. Gaugler *et al.*[36] analyzed the data of 1979 caregivers, of whom the majority (77.8%) were female (mean age of 63.3 years) spouses who cared for their elderly partner (with dementia) for more than four years. Logistical regression analysis confirmed that high resilience (less overburden in the context of high care demands) in the initial measurement was associated with a lower prevalence of institutionalization, the loss of monitoring and a lower rate of mortality for the people in care.[36] It can be inferred, hypothetically, that greater levels of resilience in the caregiver are correlated to better adaptation skills when faced with these adversities, an improved capacity to face problems, and an improvement in their performance in the eyes of the patient, all of which benefit both the patient and the caregiver. Lopes & Massinelli[37] used a qualitative methodology to determine the profile of 10 informal caregivers of elderly individuals with AD and their level of resilience. Nine of the caregivers (mean age of 57 years) were female, while seven had completed both high school and a third level course. Six received help when caring for the patient and all of the caregivers exhibited high levels of resilience. The findings also confirmed the negligence of the caregivers in relation to taking care of themselves. All of the caregivers claimed not to be interested in institutionalizing the elderly individual with dementia. The presence of professional support, such as convenience centers, helped to increase the resilience and coping skills of the caregiver, when faced with adverse situations. The fact that the caregiver was married also increased resilience, since sharing their care-related tasks and other responsibilities with their partner decreased the occurrence of overburden. Positive psychological adaptation when faced with these unfavorable situations, allied to financial, social and family support, lightens the emotional and physical burden on the caregiver, making them more capable of facing challenges, less vulnerable to health problems and more prepared to offer the best quality assistance to the elderly individual.[37]

Understanding the resilience of caregivers of elderly individuals with dementia and its associated factors favors the implementation of health services and the search for solutions that can contribute to improvements in emotional disorders such as anxiety, stress and depression.

Based on the data extracted from this review, a fluxogram was created to explain the factors associated with resilience and its respective outcomes.

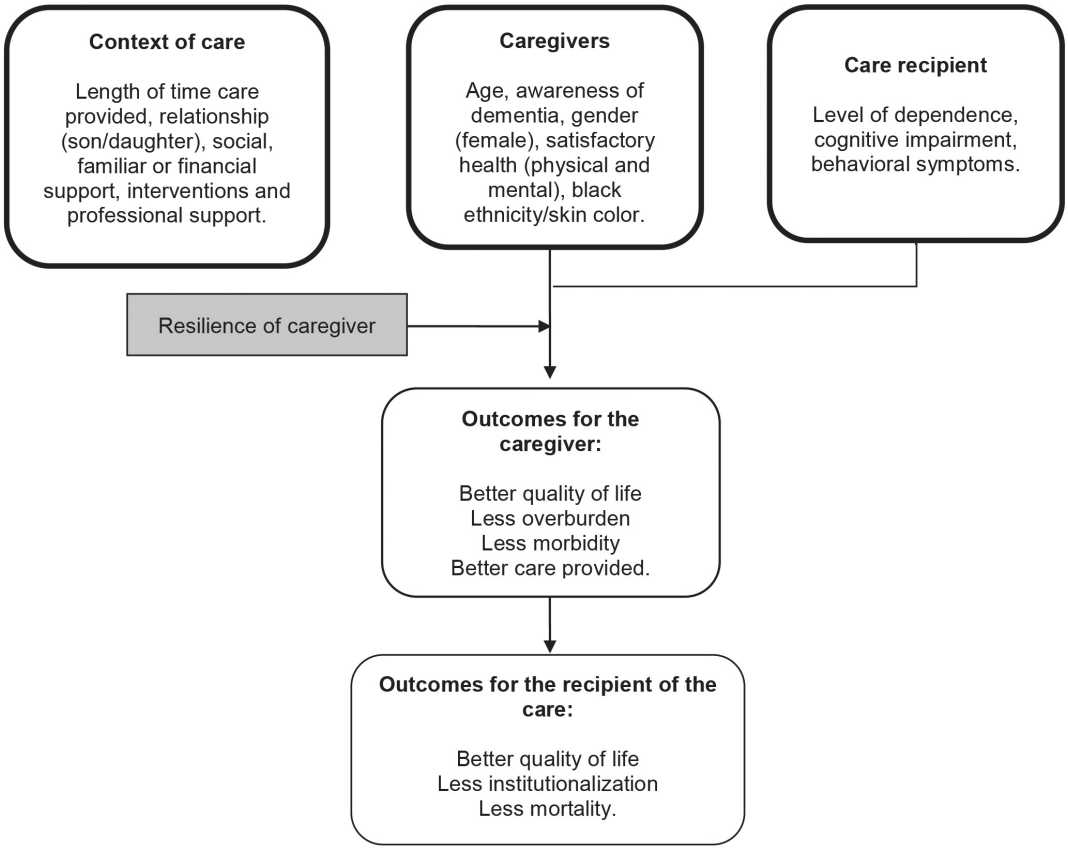

Figure 2. Fluxogram of the main factors associated with the development of resilience in the caregiver and its outcomes. São Carlos, São Paulo, 2015.

CONCLUSION

Based on the studies analyzed, depression, anxiety, stress, overburden and drug use are extremely common in the daily lives of family caregivers of people with dementia.

A number of variables seem to affect the increase in the resilience of caregivers, including: the degree of kinship to the patient; black ethnicity/skin color; a satisfactory quality of life; healthy lifestyle habits; optimism and life satisfaction. Resilience was also promoted by family, social and financial support, as well as assistance with or division of responsibilities, better physical and emotional conditions (of the caregiver) and awareness of the illness. These factors ease the physical and emotional overburden of the caregiver, while strengthening the possibility of dealing with adversity and challenges, which is consequently reflected in the quality of the assistance received by the patient.

As proposed, the present study identified factors associated with the development of resilience in caregivers with previously established characteristics, while also creating a fluxogram containing the main factors associated with the development of resilience and the attenuating effects (direct and indirect) of this development on the outcomes of caregivers and patients.

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