The influence of physical activity on balance, risk and fear of fall in the elderly

A influência da atividade física no equilíbrio, risco e medo de queda em idosos

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ABSTRACT
The purpose is to evaluate possible relationships between the level of structured physical exercise and the risk of falls in the elderly. The volunteers were elderly of both genders aged from 60 to 70 years old, sorted into 3 groups, which were: Structured Exercise Group (SEG); Sufficiently Active Group (SAG); Insufficiently Active Group (IAG). For data collecting, validated tools were used, being the International Physical Activity Questionnaire (IPAQ), Falls Efficacy Scale International (FES-I-BRASIL) and Test Up and Go (TUG) for the level of physical activity, risk of fall, and mobility, respectively. In addition, perimetry of the abdomen, waist, and hip were collected, in addition to body mass and height. To verify the normality of the data, the Kolmogorov-Smirnov test was used, and for intergroup differences, the Kruskal-Wallis and Analysis of Variance Test (ANOVA) for non-normal and normal variation, respectively. Besides height, there were no differences in anthropometric parameters and TUG. On the other hand, it was found that the SEG has less fear of falling compared to the SAG and this compared to the IAG through the FES-I-BRASIL. The data obtained that the regular practice of physical exercise and active lifestyle is related to the reduction of fear of falls.

Keywords: physical activity, physical exercise, elderly, fall risk

RESUMO
O objetivo do presente estudo foi avaliar a associação a prática de exercício físico estruturado e o risco de queda em idosos. Foram avaliados 45 idosos de ambos os sexos com faixa etária entre os 60 a 70 anos de idade, divididos em 3 grupos, sendo eles: Grupo de Exercício Estruturado (GEE); Grupo Suficientemente Ativo (GSA); Grupo Insuficientemente Ativo (GIA). Para coleta de dados foi utilizado o International Physical Activity Questionnaire (IPAQ), para determinar o nível de atividade física, Falls Efficacy Scale International (FES-I-BRASIL) para avaliar o medo de quedas e Test Up and Go (TUG) para mobilidade. Foram coletadas a perimetria de abdômen, cintura e de quadril, além de massa corporal e estatura. A fim de verificar a normalidade dos dados, foi utilizado o Teste de Kolmogorov-Smirnov e para as diferenças intergrupos os Testes de Kruskal-Wallis e Teste de Análise de Variância (ANOVA), para variação não normal e normal, respectivamente. Além da estatura, não houve diferenças nos parâmetros antropométricos e no TUG. Por outro lado, foram encontrados que o GEE apresenta menor medo de cair em relação ao GSA e este em relação ao GIA por meio do FES-I-BRASIL. Os dados sugerem que a prática regular de exercícios físicos e estilo de vida ativo tem relação com a redução do medo de quedas.

Palavras-chave: atividade física, exercício físico, idosos, risco de queda

1 INTRODUCTION

Population aging is an increasingly common global phenomenon, especially in developed countries. This event implies changes in the social, economic, and financial factors of society. According to the Elderly Statute, elderly individuals are aged 60 (sixty) years old or more.[1]

According to the Brazilian Institute of Geography and Statistics (IBGE), the elderly population in Brazil between 2012 and 2016 grew from 12.8% to 14.4%, from 25.5 million to 29.6 million people, respectively. In the same period, the number of children between 0 and 9 years old decreased by 4.7% approximately. These data demonstrate that, despite being a developing country, the Brazilian population is already aging with a profile of superior countries.[2]

From the 1970s onwards, a larger urban population was registered for the first time concerning rural ones. This event is the rural exodus, which resulted in sociocultural changes and has contributed to the increase of elderly people living in cities. According to Motta[3], this migration to the urban environment occurred due to technological advances and modernization, which impacted the daily lives of farmers, as well as the search for jobs and conditions that would enable access to a better quality of life in urban centers.

Likely to these variances, there were changes in lifestyle habits, including a great reduction in the level of habitual physical activity. Studies carried out with the elderly have shown that the practice of leisure activities, as well as adherence to planned physical exercises, is capable of improving the elderly's mental health indicators, especially anxiety and depression[4,5]. Such behavior, associated with healthy lifestyle habits, such as a balanced diet, can provide greater longevity for the individual.[4]

During the aging process, there are several changes in the subject's functional capacity, which are capable of directly influencing the lifestyle, including the performance of daily living activities (DLAs). Among the changes, sarcopenia, defined as the process of the gradual decrease in muscle mass, should be highlighted.[5] This phenomenon affects not only the continuous decrease of muscle tissue but also strength and functional capacity, aspects that can reduce the quality of life in the elderly. Furthermore, according to Siqueira et al.,[6] during the aging process there is a relationship between the decrease in muscle tissue and bone composition, in addition to a reduction in balance. A study carried out with different groups of elder people showed that mobility and flexibility in physically inactive ones are lower when compared to active elderly

people, demonstrating a deficit in performing DLAs, which may contribute to an increased risk of falling.[7]

However, it should be noted that remaining in sedentary behavior for a long time, or with a low level of physical activity, may aggravate the loss of muscle strength, balance, and functional mobility, in addition to the overall functionality response. In this sense, family members must support initiatives to encourage the elderly to adopt a more physically active lifestyle, to improve their quality of life and, consequently, reduce the risk of falling.

Despite the great relevance of planned exercises in gyms, the level of habitual physical activity must also be considered, as it is also a risk factor in this population. Thus, this study aimed to analyze the impact of practicing structured physical exercises and the level of physical activity concerning body balance, associated with fear and falls in the elderly.

2 METHODOLOGY

2.1 STUDY DESIGN

This is a quantitative study. Data collection took place in gyms in a city in the state of Rondônia and the local project aimed at senior citizens.

The study was approved by the Human Research Ethics Committee of the Faculdade de Educação e Meio Ambiente (FAEMA) (appraisal number 3.429.559) and the Informed Consent Term (TCLE) was subsequently signed. The procedures carried out followed under the Declaration of Helsinki and as determined by Resolution nº 196/96 of the National Health Council of the Ministry of Health (CNS/MS). As for the time of investigation, it took place in the morning and afternoon, considering the hours of 6:00 am to 11:00 am and from 2:00 pm to 6:00 pm.

2.2 SAMPLE

The study went from the convenience sample of the gyms, reaching a total of 45 individuals for collection. The study volunteers were elderly of both genders among 60 to 70 years old. The subjects were divided into 3 groups: the first group consisted of practitioners of structured physical exercise in gyms, called Structured Exercise Group (SEG), the second group was composed of elderly people who are physically active, but who do not perform structured exercises guided by a Physical Education professional, characterized as Sufficiently Active Group (SAG) and the third were volunteers who did

not reach the minimum recommendation for physical activity, thus being the Insufficiently Active Group (IAG).

2.3 STRUCTURED EXERCISE GROUP (SEG)

This study sample was composed of elderly practitioners of physical exercise in gyms in the countryside of Rondônia, consisting of planned/structured exercises and accompanied by a Physical Education professional. The inclusion criteria were: individuals who exercise regularly at least 3 times a week, at least 3 months in the gym, and 150 minutes per week of Moderate to Vigorous Physical Activity (MVPA) through the International Physical Activity Questionnaire (IPAQ). As exclusion criteria, the following were considered: elderly people who did not have the established age range, amputees, individuals who are physically or psychologically dependent on third parties or have any other condition that affects the execution of the stages of the study.

2.4 SUFFICIENTLY ACTIVE GROUP (SAG)

The sample consisted of elderly people who meet the recommendations of MVPA of 150 minutes per week, participants of a project that develops activities aimed at elderly people in the state of Rondônia. The basis tool was the IPAQ, considering the reference of 150 minutes per week MVPA of the World Health Organization (WHO).[10-11] Exclusion criteria were adopted: present amputation, not reaching 150 minutes per week of MVPA, being an exercise practitioner physical education planned by a Physical Education professional, being physically or psychologically dependent on third parties, or having any other condition that affects the execution of the stages of the study.

2.5 INSUFFICIENTLY ACTIVE GROUP (IAG)

This group was composed of elderly aged from 60 to 70 years old who, through the IPAQ, do not meet the weekly MVPA recommendations of the WHO[10-11] of 150 minutes of MVPA, characterized as insufficiently active. The collection was carried out within the aforementioned project, exclusively with the elderly who do not participate in the center's physical activities. The exclusion criteria were: elderly people who reach 150 minutes of MVPA a week, participating in physical exercises planned by a Physical Education professional, amputees, elderly people who are physically or psychologically dependent on others; have any other condition that affects participation in the study.

2.6 QUESTIONNAIRES

The questionnaires were applied in a closed room, individually, respecting the volunteer's integrity, as well as the collection of anthropometric data. The researcher was properly trained to apply each questionnaire, avoiding the embarrassment of the volunteer, as well as the induction of responses.

2.6.1 International Physical Activity Questionnaire (IPAQ)

To measure the level of habitual physical activity of the volunteers, a tool validated for the Brazilian population, called the International Physical Activity Questionnaire (IPAQ - short version) was used. The questionnaire consists of 4 topics that result in 8 questions about physical activity and sedentary behavior.[12]

2.6.2 Falls Efficacy Scale International (Fes-I)

The Falls Efficacy Scale International (FES-I-BRASIL) is a questionnaire adapted and validated for the Brazilian elderly population. This instrument consists of 16 questions related to the possibility of falling in everyday life. Each question is numbered from one to four, indicating in their sum that the closer to 16, the lower the fear of falling and the closer to 64, the greater the fear of falling.[13]

2.6.3 Timed Up and Go (TUG)

The Timed Up and Go (TUG) is a test, which consists of an activity in which the subject gets up from a chair, walks 3 meters as fast as possible, outlines an object and returns to starting position. This test is widely used, especially for elderly people. To measure performance, the time taken by the individual to perform the task was measured, based on the time of 12 seconds, thus suggesting functional changes in the elderly that exceed this time to complete the route.[14] It is remarkable that this instrument also has the potential to assess the dynamic balance in this elderly population.[15]

2.7 ANTHROPOMETRIC DATA

Anthropometric data collections were carried out in a closed room individually. The Techiline Digita lModel scale was used: Tec-Silver, for body mass and an anthropometric Sanny Medical measuring tape, Starrett Sn-4010, 2m for height and perimeter of the abdomen, waist and hips.

These data are also intended to assess possible cardiovascular risks, since the Body Mass Index (BMI) and the Waist-Hip Ratio (WHR) can be considered cardiovascular risk factors.[16,17]

The specific BMI classification for the elderly was used, as follows: BMI ≤ 22 underweight; BMI >22 and <27 adequate weight; BMI ≥ 27 overweight. In addition, the analysis of calf perimetry was performed, which indicates possible reductions in muscle mass.[18]

The approaches to the volunteers were carried out after they arrived at the place, initially presenting the present study and thus suggesting their participation on it. Anthropometric data, as well as the test, were performed before the volunteers practiced any type of physical activity, or even the test, in order to avoid changes in the final result.

2.8 STATISTICAL ANALYSIS

Descriptive statistics were used to illustrate baseline characteristics, mean, standard deviation and median. To verify the normality of the data, the Kolmogorov-Smirnov test was used. For intergroup comparison, when the data did not show normal variation, the Kruskal-Wallis Test and Analysis of Variance Test (ANOVA) were used for normal variation. For all statistical analyses, SPSS Statistics version 20 software was used. Significance $p \leq 0.05$ was assumed.

3 RESULTS AND DISCUSSION

It was observed that the 45 elderly participants in the survey were 51% female, the other basic data are provided in Table 1.

Table 1. Basic Data for Insufficiently Active, Sufficiently Active, and Structured Exercise Groups.

	IAG (15)	**SAG** (15)	**SEG** (15)
Age (years)	65,6 (± 3,3)	64,5 (± 2,6)	65,5 (± 3,3)
Body weight (Kg)	70,9 (± 15,9)	74,1 (± 6,9)	79,8 (± 15,7)
Height (m)	1,57[c] (± 0,5)	1,68[b] (± 0,1)	1,74[a] (± 0,6)
BMI (Kg/m^2)	28,6 (± 6,4)	25,9 (± 3,1)	26,5 (± 4,7)

Different letters on the same line are significantly different at 5% probability; IAG: Insufficiently Active Group; SAG: Sufficiently Active Group; SEG: Structured Exercise Group; BMI: Body Mass Index; m: meters; kg: kilogram; Kg/m2: kilogram per square meter.
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Regarding BMI, there was no significant difference among the groups. Concerning the analysis criteria for this variable, it is only valid for comparison between the IAG and SAG groups. For the SEG group, the analysis is inadequate, given the possibility that this group has greater muscle mass for being a bodybuilder. In this logic, excluding the SEG, it is possible to affirm that the increased BMI is related to metabolic complications, with no alarming data in any of the groups, even though the IAG group is, on average, in an overweight condition.[19] Table 2 shows the perimetry and WHR of the different groups.

Table 2. Perimetry (abdominal and calf) and Waist-Hip Ratio (WHR).

	IAG (n=15)	**SAG** (n=15)	**SEG** (n=15)
A.P (cm)	103 (± 15,54)	82 (± 9,1)	87 (± 29,1)
C.P (cm)	35 (± 3,5)	33 (± 1,8)	35 (± 2,5)
WHR	0,9 (± 0,07)	0,93 (± 0,04)	0,87 (± 0,14)

Total number of volunteers; IAG: Sedentary Group; SAG: Sufficiently Active; GHG: Structured Exercise Practitioners; A.P: Abdominal Perimetry; C.P: Calf Perimetry; whr: Waist-Hip Ratio; cm: centimeter.
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Regarding anthropometric analyses, no significant differences were demonstrated within any of the analyzed parameters. However, despite the results not showing significant difference, the SEG group and the SAG group had lower individual prevalence (60%) of reaching the risk reference criteria for abdominal perimetry, according to the cutoff values determined by the International Diabetes Federation (IDF).[20] On the other hand, in the IAG, according to the same reference criteria, 93.3% of the individuals reached the risk criteria, indicating a greater probability of this group presenting some metabolic complication, compared to the SEG and SAG.

Concerning the WHR, the groups did not show significant differences, although it is possible to emphasize that there were differences in the prevalence of risk when using the risk classification criteria of >0.9 for men and >0.85 for women, proposed by the World Health Organization (WHO).[21] Based on this reference, it was observed that 66% of the individuals in the IAG were above the values considered as the normal reference in the WHR. Using the same pattern, 86.6% of the GSA group presented risk values; on the other hand, in the SEG, only 40% of the members were at risk in relation to the WHR. In agreement with our findings, Castro et al.,[22] with 70 elderly people (67±5 years old),

compared the effects of practicing different structured exercises such as weight training, dance, and meditation; concluding that planned exercises are more effective for taking into account the limitations of the elderly, as well as individualities, increasing the quality of life of its practitioners. These findings focus on the importance of performing physical exercise guided by a Physical Education professional, as well as the importance of a multidisciplinary analysis, which is also related to the nutritional guidance of this public.

Regarding the calf perimetry (CP), there was no significant difference. However, when considering the reference values (>31 cm) for an impactful decrease in muscle mass, it is observed that 20% of IAG members presented risk classification; in the case of SAG and SEG, none of the members reached the reference values. These findings strengthen that regular physical activity can maintain muscle mass, attenuating the aging process.[23] Our findings are associated with the literature, suggesting that sedentary behavior can accelerate sarcopenia; on the other hand, regular physical activity, especially weight training, but also aerobic exercises, tend to delay these limitations, contributing to the conservation of functional capacity.[24]

Table 3 shows the variables: level of physical activity, fear of falling, and agility test in the different groups.

Table 3: Level of Moderate to Vigorous Physical Activity, Fear of Falling, and Timed Up and Go Test.

	IAG (15)	**SAG** (15)	**SEG** (15)
MVPA (minutes/week)	54,3 (± 41,9)[a]	247,2 (± 52,09)[b]	393,8 (± 184,6)[c]
FES-I-BRASIL (score)	37,9 (± 6,3)[c]	30,5 (± 4,9)[b]	21,9 (± 4,3)[a]
TUG (s)	12,05 (± 2,6)	10,9 (± 1,1)	10,2 (± 1,6)

Different letters on the same line are significantly different at 5% probability N: The total number of volunteers; IAG: Sedentary Group; SAG: Sufficiently Active; SEG: Structured Exercise Practitioners; MVPA= Vigorous Moderate Physical Activity; TUG = Timed Up and Go; FES-I-BRASIL = Falls Efficacy Scale International; s: seconds.
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The level of MVPA showed a significant difference among the 3 groups, in ascending order: IAG, SAG, and SEG. It is noteworthy that such evidence was already expected, including the sample selection criteria whether or not to reach the weekly criteria. Thus, it can be said that the sample lives up to the methodological design of the present study. Furthermore, it is possible to remark that there is a significant difference between the SEG and the SAG, displaying that in addition to the benefits of planned activity and greater variability of types of training, everyone performed weight training,

the planned physical exercise also contributed to a level of activity increased global physics and possibly better quality of life.[25]

The FES-I-Brasil tool scores showed significant differences within the 3 groups, in ascending order: SEG, SAG, and IAG. This was the main result of this work, given that our findings demonstrate that the increased level of physical activity is associated with a lower fear of falling, especially in individuals who practice planned physical exercise, in this case, weight training. The findings by Abdala et al.,[26] with structured physical exercises indicate that systematic physical exercise is an important strategy to minimize the fear of falling in the elderly population, supporting our study. Regarding habitual physical activity, the work by Harada et al.[27], also with the elderly, showed that there is an important association between increased fear of falling and a low level of daily physical activity, meeting our conclusions. It is suggested that, in addition to the relationship with quality of life, the greater the fear of falling, the greater the real risk of falling, as this feeling can cause attention bias to threatening stimuli, causing changes in gait.[28] It is coherent to associate that reduced muscle strength and poor physical fitness, especially in lower limbs, lead to an increased risk of falling, aspects that can be decreased by physical activity/physical exercise.[29]

The literature has a significant number of studies that separately presented the impact of interventions with physical exercise on fear of falling in the elderly, as well as the level of habitual physical activity.[30] However, it is worth noting that the literature lacks studies with the segmentation of risk and fear of falling concerning habitual physical activity and planned physical exercise, which is the purpose of this study.

Regarding the TUG test, there were no significant differences between groups. A study by Ruzene and Navega[31] showed that elderly women who practice regular physical exercise, regardless of the modality (cardiorespiratory, resistance, or both), showed better mobility also measured by the TUG. It is well established that the maintenance of lean mass occurs through planned physical exercises, especially resistance, and that this is positively associated with mobility.[29] However, a study by Rojo[32], when analyzing the mobility of physically active and inactive elderly, did not find significant differences between groups, although a trend in this improvement was pointed out, corroborating our work ($p=0.052$).

4 CONCLUSION

Given the results found, it was found that the fear of falling was reduced in elderly people who had a higher level of physical activity. Furthermore, the practice of structured physical exercise can further minimize this risk.

It has been shown that the practice of physical activity is essential for the health of the elderly, especially structured exercises, as they have the potential to maintain lean mass, thus providing greater functional capacity and a tendency to improve the individual's dynamic balance. The elderly who attend the gym presented, in percentage terms, lower WHR values concerning the other groups, according to the WHO classification.

These findings support the hypothesis of the present work; demonstrating that the systematization of activities performed through planning and monitoring by a Physical Education professional enhances the results of physical activity, thus providing greater longevity and quality of life for the elderly.

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