

EFFECT OF THE ADULT REVITALIZATION PROGRAM ON THE OCCURRENCE OF FALLS AMONG ITS PARTICIPANTS

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ABSTRACT

Objective: To assess the effect of the first year of an Adult Revitalization program on the number of occurrences of falls, and its relationship with the evolution of muscle strength, flexibility and dynamic balance. **Method:** 94 individuals (79 women and 15 men) who participated in an Adult Revitalization program in São Carlos, State of São Paulo, Brazil, for one year were evaluated regarding their hand grip strength, flexibility, dynamic balance and occurrences of falls on five occasions: an initial evaluation followed by four others at three-month intervals. **Results:** The women and the men experienced gains in flexibility and balance over the course of the program, but there was no significant reduction in the number of falls. Only women improved their muscle strength. The individuals who reported having fallen at least once during that year (28.72% of the participants) gained strength and flexibility, but their dynamic balance did not increase. In this group, the mean number of falls decreased between the first and the third evaluation, but increased between the third and the fourth evaluation, which coincided with the period of resting from physical activities. The individuals who did not fall presented gains in balance and flexibility but not in their hand grip strength. **Conclusion:** After one year, the number of falls among the participants in the Adult Revitalization program did not decrease significantly. Among the participants who fell at least once during the study period, the improvement in the number of falls occurred inversely to the improvement in handgrip strength and dynamic balance, but did not present any relationship with the improvement in flexibility.

Key words: elderly people; falls; group physical activities; dynamic balance; flexibility; hand grip.

RESUMO

Efeito do Programa de Revitalização de Adultos Sobre a Ocorrência de Quedas dos Participantes

Objetivo: Verificar o efeito do primeiro ano do Programa de Revitalização de Adultos no número de episódios de quedas e a sua relação com a evolução da força muscular, da flexibilidade e do equilíbrio dinâmico. **Método:** 94 indivíduos (79 mulheres e 15 homens) que participaram do Programa de Revitalização de Adultos em São Carlos, SP, por um ano, foram avaliados quanto à força de preensão manual, flexibilidade, equilíbrio dinâmico e episódios de quedas em cinco momentos diferentes: uma avaliação inicial seguida por outras quatro, com intervalos de três meses entre elas. **Resultados:** Mulheres e homens experimentaram ganho de flexibilidade e de equilíbrio ao longo do programa, porém não reduziram o número de quedas significativamente. Apenas as mulheres melhoraram a força muscular. Os indivíduos que relataram ter caído pelo menos uma vez no decorrer do ano (28,72% dos participantes) ganharam força e flexibilidade, porém o equilíbrio dinâmico não melhorou. Nesse grupo, o número médio de quedas reduziu-se entre a primeira e a terceira avaliação, porém aumentou entre a terceira e a quarta avaliação, intervalo que coincidiu com o período de descanso das atividades físicas. O grupo de indivíduos que não caiu apresentou ganho no equilíbrio e na flexibilidade, mas não na força de preensão manual. **Conclusões:** Após um ano, o número de quedas dos participantes do Programa de Revitalização de Adultos não reduziu de forma significativa. Entre os participantes que caíram pelo menos uma vez ao longo do período estudado, a evolução do número de quedas se deu de maneira inversa à evolução da força e do equilíbrio dinâmico, mas não apresentou relação com a evolução da flexibilidade.

Palavras-chave: idosos; quedas; atividade física em grupo; equilíbrio dinâmico; flexibilidade; preensão manual.

INTRODUCTION

Population aging is a worldwide phenomenon that began in developed countries at the end of the twentieth century. In developing countries, the demographic transition is more recent but also more accelerated. In this context, Brazil displays one of the most severe aging processes among the most populous countries, having gone from a life expectancy at birth of 47 years in 1950 to 71.9 years in 2005¹. Projections for 2025 indicate that Brazil will be the 4th developing country with the highest number of elderly people, approximately 33 million². Therefore, disabling incidents such as falls in the elderly population are being studied to promote the creation of prevention programs.

Approximately 30% of the people aged 65 and over fall at least once a year³. Among those who fall, two-thirds suffer another fall in the following year⁴. Approximately 50% of falls cause injuries⁵ and almost one-third cause fractures. It is estimated that falls cause 90% of hip fractures in elderly individuals⁶. Hip fractures, in turn, are associated with high morbidity and mortality as well as high costs to the Public Health system. Falls are the most common cause of injury-related deaths among individuals over 75 years of age⁵. Other consequences of falls include hypoactivity, functional deterioration, social isolation, depression, reduced quality of life, institutionalization and death⁷.

There is evidence that changes to environment, discontinuation of psychotropic drug use, group Tai Chi practice and individually prescribed home exercises can prevent falls in elderly people. However, clinical trials that tested the effects of group exercise on fall reduction present conflicting results^{8,9}.

In the city of São Carlos, SP, Brazil, a group activity program developed for the elderly, called Adult Revitalization Program, has been maintained by the municipal government and Universidade Federal de São Carlos since April 2005. The program consists of three weekly 50-minute sessions, including muscle strengthening, aerobic conditioning, flexibility and coordination (balance, agility and dexterity) training. Although the effects of this kind of intervention on fall-related factors such as muscle strength¹⁰ and balance¹¹ have already been documented, there is no evidence that group physical activity can prevent falls in elderly individuals^{8,9}. Therefore, the objective of this study was to verify the effect of the first year of the Adult Revitalization Program on fall reduction and its relationship with improvements in muscle strength, flexibility and dynamic balance.

METHOD

The subjects of this study were selected among the 193 participants of the Adult Revitalization Program in São Carlos, SP. Individuals included were those who participated in the first 12 months of the program with an attendance rate above 75% at the exercise sessions. Individuals were excluded if they had missed one or more physical assessments in the beginning of or during the program. Therefore, 94 individuals (79 women with a mean age of 60.83 years \pm 8.23 and 15 men with a mean age of 63.93 years \pm 7.89) composed the sample. All participants signed the free and informed consent, and the study was conducted according to the standards of Resolution 196/96 and approved by the Committee on Ethics in Research on Humans of Universidade Federal de São Carlos (Approval n°. 104/04).

The first 12 months of the program consisted of 10 weeks of physical activities and three weeks off over the July 2005 vacation period, followed by another 21 weeks of activity and four weeks off at the end of 2005, and finally 11 weeks of activity. During this period, there were 123 physical activity sessions that included 8 to 10 minutes of stretching, 9 minutes of aerobic conditioning, 7 to 10 minutes of adapted strength, power and resistance exercises, 14 to 16 minutes of coordination, dexterity and flexibility activities and 5 to 7 minutes of breathing and relaxation exercises. Sessions were conducted by physical educators, volunteer assistants and previously trained physical therapists.

Grip strength, dynamic balance and flexibility were assessed on 5 different occasions: in April 2005 before the start of the program, in July and October 2005, in January 2006 following the four-week rest period, and finally in April 2006, when the program completed one year. In each assessment, individuals answered questions on the incidence and number of falls during the previous three months. Assessors were previously trained physical therapists, physical educators and physical therapy students.

Grip strength was measured with a hand dynamometer¹². The test was performed three times using the dominant upper extremity, with 10-second intervals. The highest value was considered for analysis. Individuals received instructions to exert strength during exhalation and avoid the Valsalva maneuver. Verbal encouragement was given throughout the test.

Dynamic balance was assessed with the maximum gait speed test¹³. Subjects were instructed to walk as quickly as possible down a pathway, 33.3 cm wide and 3.33 m

long, marked on the ground. The test was performed three times and the mean of the three measures was considered for analysis.

Flexibility was assessed using the sit-and-reach box¹⁴, which measures the flexibility of the posterior trunk and lower extremities in millimeters. Individuals were seated on the floor with the lower limbs extended and the feet touching the box. With arms extended and overlapping hands touching a marker, individuals were instructed to move the marker over the ruler on top of the box. The movement was performed three times, and the highest value was considered for analysis.

Data was analyzed using the paired Student t-test to determine the differences in means between assessments. The independent samples Student t-test was used to compare different age groups as well as to compare participants who fell and those who did not fall.

RESULTS

Women demonstrated an expressive gain in grip strength ($p=0.011$) and flexibility ($p<0.001$) after a year, which was already significant from the second assessment onwards. Dynamic balance, measured in the time (seconds) needed to walk the course, improved from the 4th assessment in the female group ($p=0.019$). The number of falls, however, did not change significantly (Table 1).

In the female group, four women were 40 to 49 years old, 38 were 50 to 59, 23 were 60 to 69, 13 were 70 to 79, and one was 80 to 89. At the end of the program, muscle strength improved only in the group of women aged 70 to 79 ($p=0.019$). Balance increased only in the group of women aged 50 to 59 ($p=0.011$), and flexibility increased in the groups aged 50 to 59 ($p<0.001$), 60 to 69 ($p=0.003$) and 70 to 79 ($p=0.033$). Women aged 40 to 49 did not report falls in any of the assessments. No group demonstrated significant differences in the number of falls between the five assessments.

To analyze differences between age groups, women were divided into two groups: one with maximum age of

59 years ($n=42$) and another with women aged 60 and over ($n=37$). In all five assessments, younger women showed greater strength compared to older women (p value varied between 0.000 and 0.001). There were no significant differences between groups for falls or flexibility.

At the end of the program, the men did not show any significant increase in strength, but demonstrated increased flexibility ($p<0.001$) and improved balance ($p=0.042$). Similarly to the female group, no significant differences were observed in the number of falls (Table 2).

Six men were 50 to 59 years old, six were 60 to 69 and three were 70 to 79. After a year of physical activity, only the group of men aged 70 to 79 displayed increased balance ($p=0.024$). Those aged 50 to 59 and 70 to 79 demonstrated significant increases in flexibility ($p=0.008$ and $p=0.010$, respectively).

When men under 60 ($n=6$) were compared to men over 60 ($n=9$), the younger group presented greater strength (p value varied between 0.006 and 0.028) and balance (p value varied between 0.003 and 0.015) in all assessments. Flexibility did not differ significantly between groups. The men under 60 did not suffer any falls during the year, and of those over 60, two reported one fall each, in the first assessment only.

In the first assessment, 11 people (11.58% of the sample) reported at least one fall during the previous three months. A year later, in the last assessment, six people (6.38%) reported they had fallen during the previous three months. The number of participants that fell during the year was 27 (28.7%), with a mean age of 61.62 (± 8.46) years, and those who did not fall numbered 67 (71.27%), with a mean age of 61.21 (± 8.20) years. There were no significant differences in the mean age of the two groups ($p=0.413$).

The greatest decrease in the number of falls among individuals who fell occurred between the first and second assessments ($p=0.029$). However, between the third and fourth assessments, the mean number of falls increased again (Table 3). Grip strength demonstrated a similar pattern of change in this group, with a decrease between the third and fourth assessments.

Table 1. Evolution of the grip strength, dynamic balance, flexibility and fall variables in the female subjects.

Women (n= 79)				
Evaluation	Strength (kgf)	Balance (s)	Flexibility (mm)	Falls
1 st	29.03	2.18	257.35	0.13
2 nd	29.87 *	2.30 *	274.27 *	0.05
3 rd	30.41 *	2.22	282.05 *	0.06
4 th	29.96 *	2.13 §	280.33 *	0.11
5 th	30.05 *	2.11 §	284.15 *	0.08

* Significant increase (paired Student t-test: $p<0.05$) in relation to the 1st evaluation.

§ Significant decrease (paired Student t-test: $p<0.05$) in relation to the 1st evaluation.

Table 2. Evolution of the grip strength, dynamic balance, flexibility and fall variables in the male subjects.

Men (n= 15)				
Evaluation	Strength (kgf)	Balance (s)	Flexibility (mm)	Falls
1 st	46.27	2.08	175.60	0.13
2 nd	47.67	2.22	200.87 *	0.00
3 rd	45.27	2.15	208.07 *	0.00
4 th	46.67	2.37	208.80 *	0.00
5 th	47.73	1.96 [§]	211.67 *	0.00

* Significant increase (paired Student t-test: $p < 0.05$) in relation to the 1st evaluation.

§ Significant decrease (paired Student t-test: $p < 0.05$) in relation to the 1st evaluation.

Table 3. Evolution of the grip strength, dynamic balance and flexibility variables in the groups of fallers and non-fallers.

Evaluation	Falls	Fallers (n= 27)			Non-fallers (n= 67)		
		Strength (kgf)	Balance (s)	Flexibility (mm)	Strength (kgf)	Balance (s)	Flexibility (mm)
1 st	0.444	29.85	2.26	258.41	32.55	2.12	238.63
2 nd	0.148 §	31.33 *	2.36	283.33 *	33.27	2.26 *	254.18 *
3 rd	0.185 §	31.22 *	2.29	288.14 *	33.40 *	2.17	263.03 *
4 th	0.333	30.77	2.22	289.52 *	33.37	2.14	260.61 *
5 th	0.222	32.07 *	2.19	290.63 *	33.19	2.05 §	265.31 *

* Significant increase (two-sample Student t-test: $p < 0.05$) in relation to the 1st evaluation.

§ Significant decrease (two-sample Student t-test: $p < 0.05$) in relation to the 1st evaluation.

Participants who fell and those who did not fall demonstrated increased flexibility from the second assessment and maintained it until the last assessment. Dynamic balance did not change significantly during the year for individuals who fell. Individuals who did not fall demonstrated increased balance (decreased course time) only in the last assessment ($p = 0.005$). In the first assessment, there was no difference between the mean strength, balance or flexibility between the two groups. However, in the last assessment, the group of participants who reported falls demonstrated a weaker dynamic balance performance ($p = 0.044$) than the group of individuals who did not fall.

Figure 1 illustrates the pattern of change in the grip strength, dynamic balance and flexibility variables compared to the pattern of change in the number of falls of the individuals who fell at least once during the study. Clearly the behavior of the strength variable is inversely related to the number of falls. Increases in strength are associated to reductions in the number of falls, while decreases in strength are associated with an increased number of falls. Between the first and fourth assessments, the relationship between changes in dynamic balance and falls was paradoxical. During the intervals when dynamic balance improved (decreased course time), there was an increase in the number of falls and vice-versa. Only between the fourth and fifth assessments did the

reduction in the number of falls follow the improvements in dynamic balance. Gains in flexibility were inversely related to the number of falls only in the first and last intervals.

DISCUSSION

The incidence of falls in the studied sample (28.72%) was similar to the one reported by Campbell³ of 30% a year. In a meta-analysis, Ueno et al.¹⁵ identified the female gender as one of the factors most related to falls. Although it was not possible to identify differences between genders due to different numbers of participants in the female and male groups, women seem to have a greater risk of falling, as they reported falls in all assessments while men reported falls only in the first assessment.

Women and men under 60 performed better in grip strength and dynamic balance tests compared to older participants. Aging causes a progressive decline in strength, flexibility¹⁶, and balance¹⁷, therefore performance differences among participants were already expected. However, no differences were observed between the flexibility means of younger and older participants.

Contrary to expectations, there was no reduction in the mean number of falls between the first and last assessments. Nevertheless, participants who reported falls experienced a

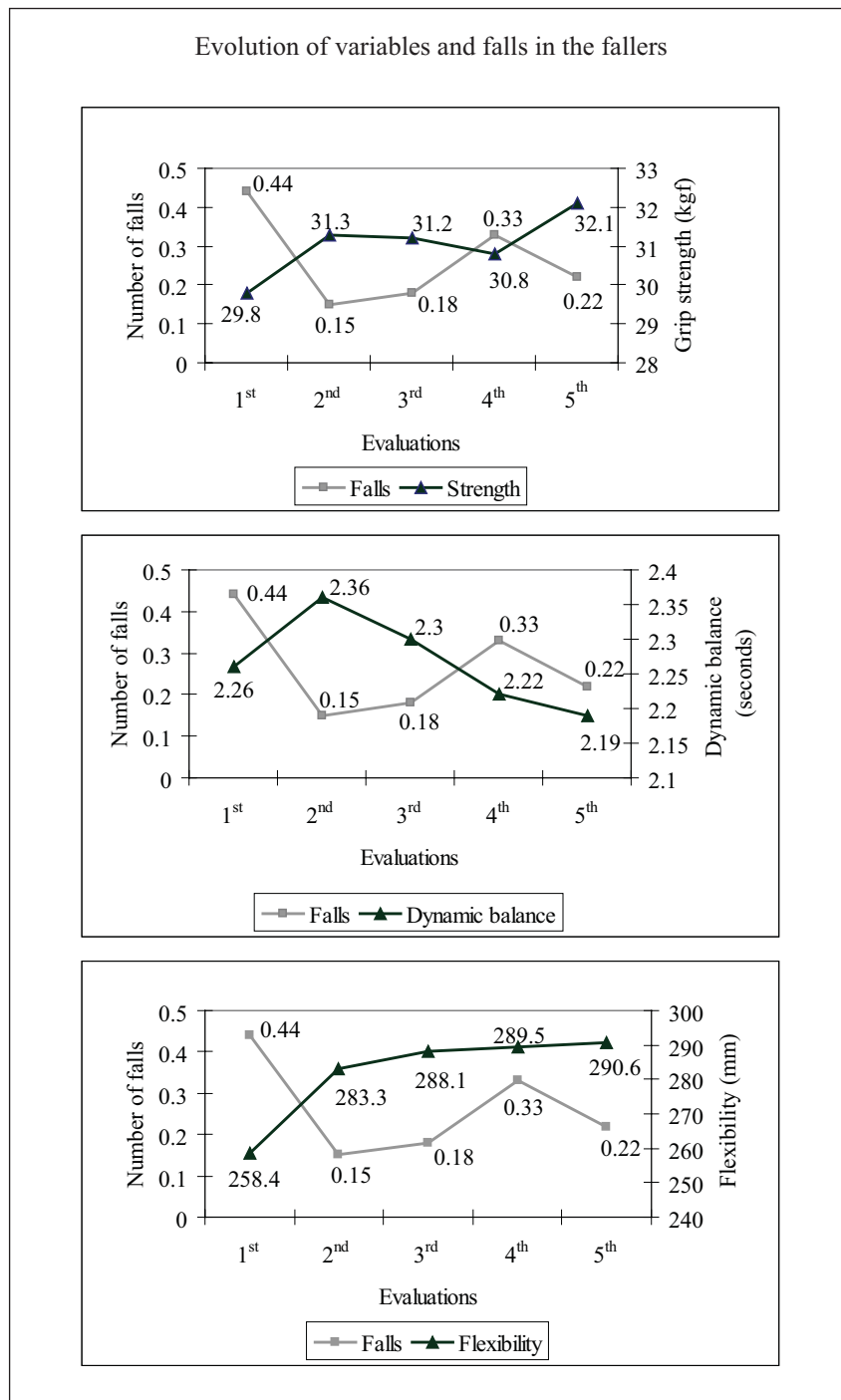


Figure 1. Evolution of the grip strength, dynamic balance and flexibility variables, and evolution of the number of falls in the fallers (n= 27).

reduction of this mean in the second and third assessments. It is possible that the four-week rest period before the fourth assessment may have influenced results, as it might have contributed to a decrease in strength or to alterations of other variables not assessed in this study. The activities of the program resumed immediately following the fourth assessment, thus in the fifth assessment the mean number of falls decreased again.

At the end of the program, participants demonstrated increased grip strength and flexibility. Some studies have also used grip strength tests to assess body strength and identified its correlation with the number of falls^{15,18}. Flexibility, however, is not frequently associated with the risk of falling¹⁹. In fact, two studies used flexibility training as a control condition in order to investigate the efficacy of other interventions aimed at preventing falls^{11,20}. Some studies, nevertheless, associate

a reduction in ankle range of movement to increased risk of falls²¹ and suggest that flexibility training be part of exercise programs aimed at reducing falls²².

Only participants who did not fall demonstrated increased dynamic balance and, in the last assessment, took significantly less time to complete the balance test compared to participants who reported falls. Additionally, in the group of participants who fell, the pattern of balance tests and the number of falls was paradoxical until the fourth assessment. Balance deficits are among the main determinants of falls²³⁻²⁵, and there is evidence that interventions that include only balance training can provide effective prevention²⁶.

A systematic review published in 2003 indicated the effectiveness of group physical activity for fall prevention is yet unknown⁹. This conclusion was based on a meta-analysis of nine clinical trials, involving 1378 participants. On the other hand, the analysis of three clinical trials including 566 participants indicated that the prescription of individual exercises is beneficial. In the same year, a clinical trial with 551 elderly individuals was published. In this trial, 280 of the individuals performed group physical activity, 90 did stretching and relaxation exercises, and 181 did not perform any activity. After one year, the group that performed group physical activity demonstrated a significant reduction in the number of falls, while there was no change in the risk of falls in the other two groups²⁰. Although the efficacy of group activity programs in fall prevention remains uncertain, other benefits of this kind of intervention justify implementation of such activities in elderly communities. These benefits include improved capacity to perform activities of daily life and decreased propensity for depression²⁷.

It is important to remember that several factors affect the individual predisposition to falls, such as cognitive deficiency, chronic health conditions²⁸, functional disabilities and vision or hearing impairments²⁹. One limitation of the present study is the fact that these factors were not assessed.

Based on the data obtained in this study, it is possible to conclude that, after a year, the number of falls reported by participants of the Adult Revitalization Program was not significantly reduced. Among the participants who fell at least once during the studied period, the pattern of change in the number of falls was inversely related to the pattern of change in strength and dynamic balance, but showed no relationship to the pattern of change in flexibility.

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