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Functional mobility in older practitioners of Liang Gong exercise

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Abstract

Background: Falls can lead to several comorbidities and are considered a major cause of mortality in the elderly.

Objective: Herein, we evaluated functional mobility in older practitioners of Liang Gong exercise as a strategy to prevent falls.

Method: We evaluated 90 subjects (10 men and 80 women) using measures of body mass index (BMI), waist circumference (WC), abdominal circumference (AC), calf circumference (CC), 5 times sit to stand test (5TSS), and 4-meter gait speed test (4GST).

Results: Against our expectations, 68.88% of the participants presented low-performance in the 5TSS and 71.11% in the 4GST. In addition, we associated CC (considered a marker of sarcopenia) with the 5TSS using Pearson's correlation analysis but no statistical differences were found between the low-performance group and the high-performance group.

Conclusion: Our results showed that the majority of the older adults who have been practicing Liang Gong exercise for more than 6-months presented unsatisfactory results in the indices of functional mobility and we believe that a combination of resistance, functional and aerobics trainings would be more effective to improve it.

Introduction

Aging is a natural process characterized by a progressive loss of physiological functions such as hormonal and immune regulation, mobility and energetic metabolism. These physiological changes can lead to the development of obesity and sarcopenia and consequently, various chronic diseases such as cancer, diabetes, cardiovascular diseases, neurodegenerative diseases, and depression[1]. It is estimated that, by 2050, the world population aged over 60 will rise from 841 million to two billion, with approximately 434 million people been aged over 80[2,3].

According to the Physical Activity Guidelines Advisory Committee (PAGAC) the combination of physical exercises (aerobic, strength, balance, and flexibility) increases strength, gait speed and balance in daily activities of the elderly. On the other hand, the absence of physical exercise, or the poor manipulation of training variations, such as intensity and weekly frequency, may not present significant improvements in the functional and physical capacities of the elderly, thus being not able to decrease comorbidities and mortality resulting from falls[4].

Falls are one of the main causes of morbidity, mortality, and health care costs in the elderly population[5]. It is reported that 28.7% of adults with 65 years or more fell in 2014 in the United States[6]. Between 2009 and 2015, the public hospital care system from Brazil spent around US$275 million on treatments and medical assistance of people over 60 years, which represented 39% of the total costs related to admission/hospitalizations. In this period, the elderly population in Brazil increased by 27% and, consequently, the intensive care costs increased 12%. In addition, the mortality increased from 9.8% to 11.2% and the greatest cause of hospitalization in the elderly population was falls[7].

It is well known that physical activity can prevent or attenuate comorbidities and also prevent falls in the elderly population[8-12]. Despite advances in medicine aiming for a better aging process[13-16], different non-pharmacological alternatives could be a great strategy to prevent or attenuate falls, reducing morbidity, mortality, and health care costs in elderly population.

Different studies have already described the effects of non-pharmacological therapeutic oriental practices to improve health in elderly populations, such as meditation[17], Tai chi chuan[18], Yoga[19], apuncuture[20] and Liang Gong exercises[21]. Recently, Liang Gong was described as a great strategy to improve health in subjects with dizziness[21]. Liang Gong is a Chinese therapeutic technique that uses firm and smooth movements with the objective of minimizing muscle tension, correct posture, optimize motor coordination, balance, and body awareness[21]. Once the benefits of Liang Gong are still poorly characterized, we evaluated if they could improve functional mobility in elderly practitioners. To measure the functional mobility in the elderly people, we applied two easy and low-cost functional evaluation tests, known as 5 Times Sit to Stand test (5TSS) and 4-meter gait speed test (4GST), both previously described in the literature[22-29].

Methods

Study Population

The Ethical Committee of the University of Campinas approved the study protocols (CAAE: 95651918.2.0000.5404). This study is also registered in ClinicalTrials.gov (Register Number: RBR-6fgg7b) http://www.ensaiosclinicos.gov.br/rg/RBR-6fgg7b/. After providing the written informed consent, we recruited 106 elderly practitioners of Liang Gong (12 men and 94 women) from the “Centro de Melhor Idade” from Hortolândia city/ Sao Paulo. The inclusion criteria were age over 60 years by 2019, be active and to practice Liang Gong activity at least two times a week, for more than 6 months. The Liang Gong exercise was offered by “Centro da Melhor Idade” in two classes on alternate days (40 minutes per class) and extra-activities such as embroidery, aquatic weight-bearing exercises, and adapted volleyball were offered to the subjects in other days. We considered as active only those participants who practice at least 150 minutes a week of physical activity[4]. A total of 90 individuals (10 men and 80 women) successfully completed all tests. 16 subjects were excluded based on severe medical conditions that could affect significantly their mobility or because the registration of data was incomplete (See Figure 1). In Tables 1 and 2 we present baseline and sociodemographic characteristics of participants.

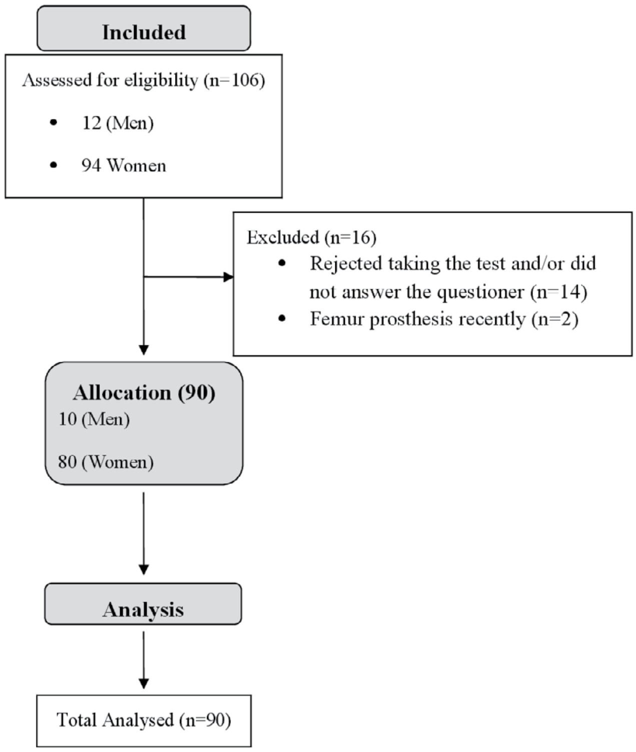

Figure 1. The flow of study subjects

Table 1. Characteristics of the subjects.

	MEN N=10	WOMEN N=80
Anthropomorphic data, mean		
Age (years)	70,3±6.72	68,39±5.53
Heigh (cm)	164,65±9.63	153,41±5.77
Weight (kg)	74,66±14.35	68,67±12.84
BMI (Body weight index)	27,4±4.17	29,16±5.20
Abd. circunference (cm)	99,51±9.59	96,08±10.37
Waist (cm)	93,91±7.92	86,92±13.12
Hips (cm)	98,8±5.59	102,76±10.63
WHR (Waist/Hips ratio)	0,95±0.05	0,84±0.10
Right calf (cm)	35,11±3.43	35,17±3.45
Left calf (cm)	34,96±3.06	35,08±3.33
Risk regarding abd. circunference, No (%)		
Normal	3 (30)	5 (6)
Increased	4 (40)	11 (14)
Substantially increased	3 (30)	64 (80)

Table 2. Sociodemographic and clinical characteristics of the participants.

	MEN	WOMEN
	N=10	N=80
Declared ethnicity, No (%)		
White	6 (60)	42 (53)
Pards	4 (40)	32 (40)
Black	0 (0)	6 (7)
Education, No (%)		
Illiterate	2 (20)	12 (15)
0-4 years (Fundamental I)	4 (40)	33 (41)
5-9 years (Fundamental II)	3 (30)	23 (29)
> 9 years (High School)	1 (10)	9 (11)
> 12 years (Graduated)	0 (0)	1 (1)
> 16 years (Pos-graduated)	0 (0)	2 (3)
Marietal Status, No (%)		
Married	8 (80)	28 (35)
Single	1 (10)	12 (15)
Divorced	0 (0)	5 (6)
Widow(er)	1 (10)	33 (41)
No answer	0 (0)	2 (3)
Health condition, No (%)		
Fall in the last 12 months	2 (20)	22 (28)
Difficulty climbing stairs	3 (30)	17 (21)
Hypertension	7 (70)	41 (51)
Diabetes	1 (10)	24 (30)
Arthritis	2 (20)	9 (11)
Arthrosis	5 (50)	26 (33)
Osteoporosis	1 (10)	10 (13)
Osteopenia	0 (0)	2 (2)
Other diseases	-	3[a], 2[b],1[c],1[d],1[e], 1[f] (11)
a: Thyroid dysfunction		
b: Labyrinthitis		
c: Cardiac Arrhythmia		
d: Dyslipidaemia		
e: Asthma		
f: Fibromyalgia		

Anthropometrics data

The subjects were classified into underweight, normal weight, overweight, or obese according to the *body mass index (BMI).* The BMI was calculated using the mathematical formula kg/m^2 with the cut-off point provided by the World Health Organization (WHO) (BMI > 30 kg/m^2)[30]. Body weight (kilograms) was verified using a commercial digital scale (100g) and height (in meters) using a measuring tape (precision of 01mm).

The *waist circumference* (WC) was measured and classified according to [31], with the subject in the anatomical position and feet slightly apart. The evaluator stood in front of the participant and measured WC with a tape measure at the smallest perimeter of the abdomen. Three measurements were performed and the mean was used for the analysis.

Abdominal circumference (cm) (AC) was collected and classified according to[31], with the participant in the anatomical position, feet slightly apart. The evaluator performed the measurement at the height of the navel with a measuring tape. Three measurements were performed and the mean was used for the analysis.

Calf circumference (cm) (CC) was measured with the subjects in an anatomical position with the feet slightly apart, distributing body weight evenly between the lower limbs. The evaluator faced the participant, and performed the measurement with the measuring tape at the point of greatest circumference of the right or left calf. The classification was made according to the literature[32,33]. Three measurements were performed and the mean was used for the analysis.

Tests

5 Times Sit to Stand test (5TSS): This test was performed using a chair with a backrest and no arms, and a seat height of 43 cm. Timer, paper and pen were used to record the time (in seconds). The chair was positioned against the wall for greater stability. After being given explanations about how to perform the test, the participants were allowed to have a time of familiarization. The test began with the subject in a standing position. At the evaluator's command "attention, now", the participant performed five movements of sitting and standing up, fully touching the buttocks on the seat of the chair and performing a complete extension of the knees at the end of the movement. The chronometer was stopped when the subject had completed the movement five times, finishing in the initial position. Two measurements were recorded and the best time was adopted as the final result. The final results were classified as low-performance according to age cut-offs as follows; 61 to 69 (>11.4 seconds), 70 to 79 (>12.6 seconds), and 80 to 89 (>14.8 seconds). Below this time, the subject was classified as high-performance, according to the literature[22-24].

4-meter gait speed test (4GST): This test was performed on the volleyball court, with a non-slip floor to avoid accidents. The initial and final points were measured with metric tape and signalized with coloured masking tape. In order to prevent deceleration of participants before four meters, the floor was signalized at 4 meters and 4.5 meters and the participants were instructed to walk along the distance to the second lane (4.5 meters) in normal rhythm[25] but the chronometer was stopped when the subject reached the 4 meters lane. After explaining the details of the test we gave time to participants to familiarize themselves with the test. All participants started in the rest position and standing. The evaluator started the chronometer after the command "attention, now" and finished when the participant crossed the line of 4 meters with both feet. Two measurements were performed and the best time was taken as the final result. The speed was calculated according to the time (in seconds) divided by 4 (meters). The final results were classified as low-performance (≥0.8 meter/second) and high-performance (≤0.8 meter/second) according to the literature[25].

Sociodemographic analyses

Sociodemographic analyses, including ethnicity, educational level, marital status and health conditions were obtained using a questionnaire at the screening interview.

Statistical Analysis

Statistical analyses were performed using GraphPad Prism version. 8.2.1. A two-tailed Pearson's correlation was used for the correlation analyses, and the Mann Whitney test, when necessary. Differences were considered when P-value < .05. Data were expressed as mean ± standard error of the mean (SEM).

Results

Initially, we recruited 106 physically active elder subjects for this study (12 men and 94 women); however, 16 subjects were excluded, resulting in a final of 90 participants (10 men and 80 women). Figure 1 presents the flowchart of the participants. Table 1 presents the characteristics of the participants and table 2, the sociodemographic and clinical characteristics.

Herein we measured the levels of functional mobility[22-29] of 90 physically active elderly subjects in an indirect manner using the 5TSS and 4GST. We classified the test results into low-performance and high-performance, according to the literature[22-25]. Our results showed that 68.88% of the participants presented low-performance in the 5SST and 71.11% low-performance in the 4GST (Figure 2A and B).

According to the European Working Group on Sarcopenia in Older People (EWGSOP), the reduction in physical performance is a marker used to indirectly measure sarcopenia[34]. Previously studies suggest that calf circumference (above 31cm) indicates preserved muscle mass and could be a marker associated with sarcopenia[32,33]. Since most of our participants presented reduced physical performance (Figure 2A and B), we postulated that our group of participants could be sarcopenic; therefore, we measured calf circumference. The mean calf circumference was 35.17±3.45 for the right calf and 35.08±3.33 for the left calf (Table 1). These results indicate that the group studied is not sarcopenic, according to the literature[32,33]. Using correlation analysis, we associated the calf circumference with the 5TSS but our results demonstrated no correlations between calf circumference and the 5TSS in either group (low and high-performance groups) (Figure 3A-D). Thus, we concluded that calf circumference measurement does not represent an adequate strategy to evaluate physical performance, since our group presented a circumference above that recommended (> 31cm) but the majority of participants showed low performance in the tests.

Discussion

It is estimated that the world population aged over 60 years will increase over the next decades[2,3]. Consequently, the number of aging-related diseases will increase[6,7,35]. Reduction in functional mobility in the lower and upper limbs in the older population is one of the main reported causes of decreased self-confidence in balance and consequently a major factor of falls[35]. Currently, it is proposed that falls are the main cause of morbidities, mortality, and health care costs in elderly people[6,7,35]. Thus, strategies to prevent or attenuate falls are important for health care system. The current study aimed to evaluate

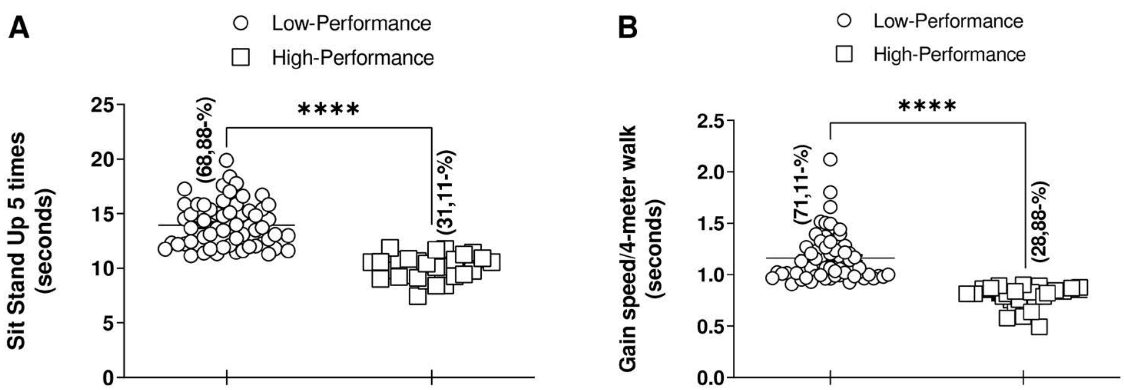

Figure 2. Analysis of 5 times sit to stand test or the 4-meter gait speed test. **(A)** Analyses of 5 times sit to stand test (n=62 low-performance and n=28 high-performance); **(B)** Analyses of 4-meter gait speed test (n=64 low-performance group and n=26 high-performance group); The percentage (%) analyses were calculated from the multiplication of the total subjects in the low-performance group or high-performance group by 100 and then divided by the total number of participants. ****p < 0.0001. Mann Whitney test, (*p < 0.05).

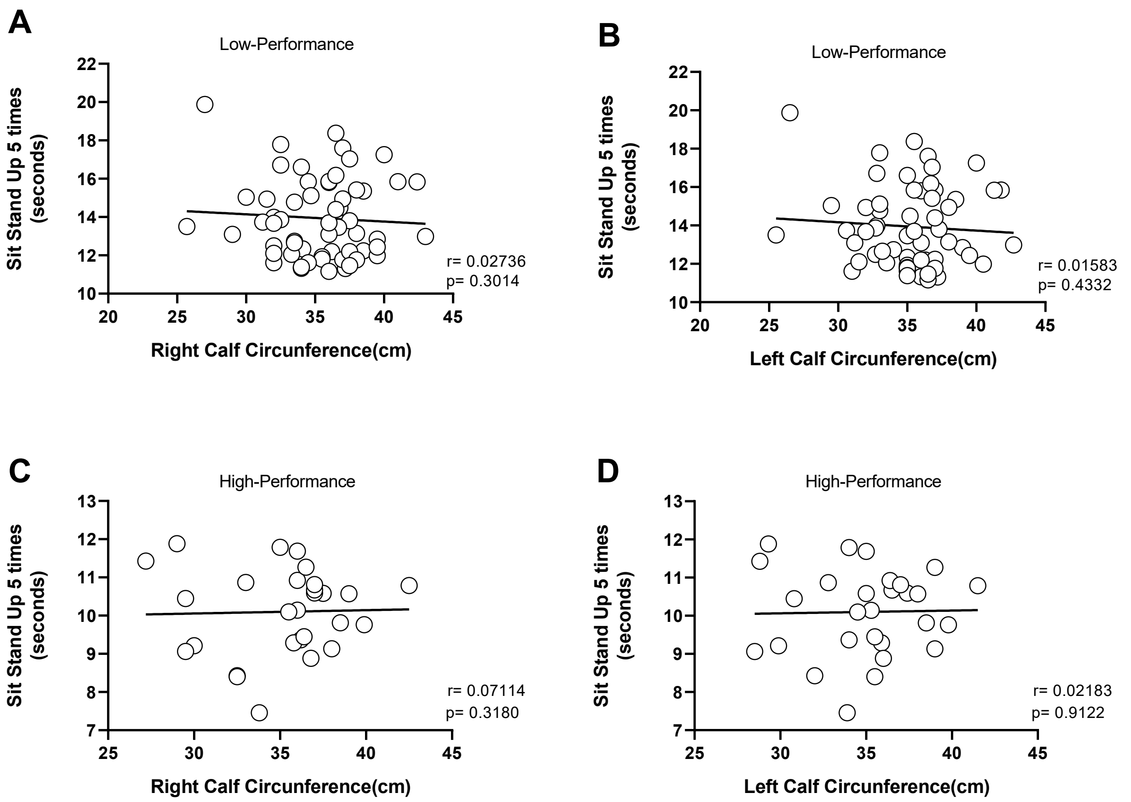

Figure 3. Pearson's correlation analysis between 5 times sit to stand test with calf circumference. **(A and B)** Right or left calf circumference of low-performance group (n=62); **(C and D)** Right or left calf circumference of high-performance group (n=28). two-tailed Pearson's correlation was used for the correlation analyses (*p < 0.05).

the functional mobility in older practitioners of Liang Gong exercise.

Physical activity can help to improve health. In this line, therapeutic oriental medicine has been proven to be efficient in improving the quality of life of older populations[17-21]. However, we observed that, according to functional mobility tests, the elderly participants of Liang Gong exercises presented poor mobility. The results showed that 68.88% of the participants presented low-performance in the 5TSS and 71.11% in the 4GST, both markers of functional mobility[22-25]. Liang Gong is a Chinese therapeutic technique and although the movements cover the whole body[21], this activity does not have characteristics of resistance training and functional movements. In addition, it is important to highlight that the volume and intensity of the Liang Gong exercises could not have been enough to increase the functional mobility. Our participants have been practicing Liang Gong two times a week on alternate days (40 minutes per class). Thus, we cannot discard the possibility that with an increase in the volume and intensity of this type of exercise we would have achieved better results. Therefore, studies with clinical trials are necessary to better understand the effects of the volume and intensity of the Liang Gong session in elderly population.

Since the natural aging process leads to the atrophy of type II fibers, indispensable for strength[36], the resistance training should be included in activity programs for older populations, in order to prevent reduction in muscle strength[35,37,38]. It was already demonstrated that well elaborated and well prescribed resistance training programs improve muscle strength and physical performance in older populations, even in those individuals diagnosed with sarcopenia[9,39,40].

The most common method of practicing resistance training is using equipment; however, for some elder people, the use of equipment may be difficulty for several reasons, including disability and poor strength. Therefore, training with body weight can be a good strategy in those cases, improving strength, increasing muscle mass and reducing body fat[41,42]. Corroborating these findings, a recent study showed that resistance training without equipment improved muscle strength and functional fitness in healthy older subjects. The authors noticed that eccentric resistance training was more effective than concentric training for improving lower limb strength, mobility, and postural stability in older adults[43]. However, other types of training programs are important to maintain health in older people[17-21,39]. In our opinion, Liang Gong exercises could be more effective if combined with resistance training sessions; once recent findings suggest that the optimum training should contain multicomponent exercises, including both aerobic and resistance exercises[39,44].

As mentioned in the methodology session, the "Centro de Melhor Idade" offered extra-activities to the participants of Liang Gong exercises, such as aquatic weight-bearing exercises. If well oriented and practiced with quality, this extra activity could improve muscle strength. Balsamo *et al.*[45], reported that both resistance training and aquatic weight-bearing exercises can prevent loss of bone mineral density in postmenopausal women over fifty years of age when compared to the respective control group. In our study, most of the participants practiced aquatic weight-bearing exercises, but, unfortunately, as a recreational activity, without periodization and overload, and, consequently, without intention to gain muscle strength. Thus, we hypothesized that the association of Liang Gong exercises with aquatic weight-bearing using periodization protocols could be an alternative to improve muscle strength in older populations.

Another relevant finding in our study is regarding the evaluation of sarcopenia. Some studies characterize sarcopenia when the calf circumference is less than 31cm[32,33] and a correlation between sarcopenia and reduction in physical performance was already reported[12,34]. Thus, we were curious to compare these two parameters, once the average of calf circumference in our study group was 35 cm (see table 1). Interestingly, our results do not agree with the literature. When we performed the 5TSS and 4GST, most of the subjects presented low-performance (see figure 2A and B) within the established time, based on age[22-25]. This led us to conclude that calf circumference is not the better way to evaluate sarcopenia related to physical performance. Despite being one of several markers of sarcopenia, its evaluation in an isolated manner seems to be inconclusive. Similar results were previously observed in a large group of community-dwelling elderly females[46]. Taken together, we did not see strong positive effects of the Liang Gong exercises in the functional mobility of elderly people, but we believe that if associated with others activities in a multicomponent program of exercises, including aerobic and anaerobic training, the practice of Liang Gong may improve the quality of life of this population.

Conclusion

Our results showed that the majority of the older Liang Gong exercise practitioners who have been performing this activity for more than 6-months presented unsatisfactory results regarding functional mobility. To reach better functional mobility, the literature recommends the combination of resistance, functional and aerobics trainings. Multicomponent exercises seem to improve the daily functional movements such as walking, sitting and standing and consequently, being able to increase the independence of the individual and to decrease the risk of falls.

Study limitations

In our study, we presented the effects of Liang Gong on physical function in an indirect manner and we failed to perform pre- and post-test comparison. We were not able to control extra activities that were performed by the individuals. Additionally, we had proportionally more accession of women than men in the study, which reflects the greatest concern with health between women, but may have led to a sex difference in physical performance between the genders.

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Declaration of Conflicting Interests

No potential conflicts of interest are declared by the authors of this study.

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