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Evaluation of Cardiovascular Parameters in Elderly Hypertensive Individuals Who Practice Lian Gong or Walking

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Abstract: Introduction: *Lian Gong* (*LG)* consists of two parts: the first part deals with the prevention and treatment of pain in the cervical region, shoulders, back, lumbar region, gluteus, and legs; and the second deals with the prevention and treatment of pain in the joints of the upper and lower limbs, tenosynovitis, and functional disorders of the organs. This study aimed to evaluate the main cardiovascular parameters in elderly hypertensive patients before and after *LG* exercises or walking. ***Methods****:* The study included 98 elderly hypertensive patients aged 60-75 and they were divided into two groups: Group 1 (G_1) practiced *LG* (n=42) and Group 2 (G_2) walking (n=56). The cardiovascular parameters Blood Pressure (Systolic and Diastolic), heart rate (HT), respiratory frequency (RF), Temperature (T) and oxygen saturation (SaO_2) were analyzed in the first and fourth week of evaluation. ***Results:*** The results showed that practice *LG* showed lower BP, both before and after practicing the exercise in comparison with those who practice walking exercise. At rest, the data related to HR and FR were higher in G_1 than in G_2. After the exercises, G_2 showed higher HR and RF than G_1. As for the data concerning SaO_2, it was found that G_2 showed higher SaO_2 at rest than G_1 and these differences were statistically significant. The comparative analysis of the cardiovascular parameters before and after *LG* exercise or walking in the first week of evaluation showed that there was a statistically significant reduction in the parameters BP, HR and RF after *LG*, while SaO_2 increased significantly. In contrast, after walking there was a statistically significant reduction in BP and SaO_2, but HR and RF increased significantly. ***Conclusion:*** *LG* induced a more intense hypotensive effect than walking. Thus, it is imperative that further studies be conducted to elucidate the mechanisms involved in the regulation of BP after practicing *LG*.

Key-words: Blood Pressure. physical activities. Elderly. *Lian Gong.* cardiovascular diseases.

INTRODUCTION

Between 2000 and 2050, the proportion of the world population over 60 years of age will double from 11% to 22%. The absolute number of people aged 60 years and over is expected to increase from 605 million to 2 billion over the same period (Who, 2013).
The functional capacity of an individual biological system increases during the first years of life, reaches a peak in early adulthood and naturally declines thereafter. The rate of decline is determined, at least in part, by behaviors and exposures throughout the life course. These include what one eats, how physically active one is and exposure to health risks such as those caused by smoking, harmful consumption of alcohol, or exposure to toxic substances (Who, 2013).

Aging is associated with several changes that culminate in the significant increase of diseases of the cardiovascular system. Among these, the increase in blood pressure (BP) and alterations in the autonomic nervous system are more significant. The increase in blood pressure results from structural and functional changes in the heart and blood vessels (Cheitlin, 2003).

BP is the product of cardiac output by total peripheral resistance , which is the force exerted by blood against the walls of the arteries during the cardiac cycle and it is described in accordance with the phase of the cardiac cycle as systolic blood pressure (SBP) and diastolic blood pressure (DBP) (Wilmore and Costill, 1994).

According to Williams (2007), some health institutions such as the American College of Sports Medicine (ASCM) and American Heart Association (AHA) recommend resistance training in addition to aerobic exercises, such as walking, for individuals with cardiovascular disorders, particularly women and the elderly.

The adaptations of the cardiovascular system to exercise can be divided into acute and chronic. Acute adaptations are those caused by acute stress of exercise, i.e., due to physical training. Chronic adaptations are those that occur in response to chronic stress of physical training (Wilmore and Costill, 1994).

Chandler and Hadley (1996) the number of elderly people participating in physical activity programs is increasing. This type of behavior seems reasonable since, according to, physical activity is the key to promoting good health and a

better quality of life as regular exercises bring many health benefits and prevent cardiovascular diseases (Blain, Vuillemin and Blain, 2000).

Spirduso (1995) states that health and physical activity together are likely to contribute to reducing mortality in this population, improving their lifestyle and consequently leading to improved physical, mental and emotional conditions, as the participation in regular physical activity programs prevents aging and brings many benefits to aging people.

According to Pescatelo (2004), physical exercises are planned, structured, and repetitive activities with the ultimate or intermediate goal of increasing or maintaining health and fitness. Walking is one of the physical activities that reduce post-exercise BP levels in comparison with the pre-exercise levels.

Walking is a cyclic activity in which one stride follows another in a continuous pattern. Described that a walking stride as being from touchdown of one foot to the next touchdown of the same foot, or from toe-off to toe-off and it does not require any equipments, which is also true for *Lian Gong* (Bartlett, 2007).

LG is a technique that combines Chinese medicine therapy and physical culture, which for the Chinese means: the harmonious strengthening of the body, enabling absolute functioning and use of the muscles, tendons, and bones. *Lian Gong* is described as preventive therapeutic gymnastics that began to be disseminated in 1975 and a large number of individuals have been attracted to it probably due to the simple movements of the exercises (Ming and Shen, 2012).

According to Ming, *Lian Gong* consists of two parts: the first part deals with the prevention and treatment of pain in the cervical region, shoulders, back, lumbar region, gluteus, and legs; and the second deals with the prevention and treatment of pain in the joints of the upper and lower limbs, tenosynovitis, and functional disorders of the organs. The author further states that according to the National Council and Council of Corporal Practices of Shanghai, *Lian Gong* is considered as one of the techniques that best represents the ancient Chinese culture in the area of physical activities inside and outside of China (Ming and Shen, 2012).

Within this context, regular physical activity, provided it is planned, brings health benefits to the elderly by promoting healthy aging as well as increasing or maintaining health and fitness. From a cardiovascular and orthopedic point of view, walking is considered one of the safest exercises for elderly hypertensive subjects and individuals are more committed to exercise for the prevention of health problems and promotion of health (Ming and Shen, 2012).

Additionally, neither walking nor *Lian Gong* require any equipments. *Lian Gong* exercises are an alternative body exercise of Oriental origin that uses simple exercises with the purpose of achieving therapeutic outcomes by improving blood circulation, physiology of the joints, and by strengthening muscles. Thus, the present study evaluated and compared the main cardiovascular parameters in elderly hypertensive patients before and after *Lian Gong* and walking since they are more vulnerable to chronic diseases, particularly cardiovascular diseases (Ming and Shen, 2012).

METHODS

Design and participants:

Physical activity programs such as walking and *Lian Gong* were chosen because they are popular among the elderly in some areas in the city of Sao Paulo and among residents in Sao José do Rio Preto who participate in a program called "HIPERDIA", which is designed for individuals with diabetes and or hypertension.

The study included 98 elderly hypertensive patients aged 60-75 years who had been practicing *Lian Gong* and walking for at least 03 years, twice a week, with duration of approximately 30 minutes.

The elderly were randomly divided into two groups: Group 1 (G_1) practiced *Lian Gong* (n=42) and Group 2 (G_2) walking (n=56). Elderly people who were morbidly obese, sedentary, diabetics, smokers, alcoholics, drug users, and those who had a diagnosis of cardiovascular complications were not included in the study. All participants had a medical indication for practicing the above-mentioned physical activities.

Cardiovascular parameters were measured in the first and fourth week of evaluation, always at two different time intervals: 15 minutes before the physical activity (at rest) and 15 minutes after the activity always in the morning. BP and HR were measured with the aid of a digital device (OMRON HEM 742 INT®); respiratory frequency (RF) was determined with a digital stopwatch; body temperature (T) was obtained with a digital clinical thermometer (G-TECH® TH-186); oxygen saturation (SaO_2) was measured using a pulse oximeter with a light emitting diode (LED) light source (pulse oximeter, model CMS50DL®). Furthermore, abdominal circumference (AC) and body mass index (BMI) were determined and the BMI reference values used are specific for the elderly population (Lipschitz, 1994).

This study was conducted in accordance with the Guidelines for Good Clinical Practice and the Declaration of Helsinki after approval by the Ethics Committee on Human Experimentation from School of Medicine of São José do Rio Preto (number 200.315). Informed consent was obtained from all volunteers.

Statistical analyses:

Statistical analyses were performed using the Minitab 15® (MINITAB, 2007). We used the chi-square test to compare categorical variables between the groups. The Student's t-test was used to compare numerical variables between two groups. A p value of ($p<0.05$) was used to indicate the statistical significance. Data were expressed as mean ±standard deviation (SD).

RESULTS

This study was based on the data collected that are related to the cardiovascular parameters of the elderly who practice *Lian Gong* (G_1) or walking exercises (G_2). The

cardiovascular parameters evaluated were systolic and diastolic blood pressure (SBP and DBP), heart rate (HR), respiratory frequency (RF), temperature (T) and O_2 saturation (SaO_2). These were characterized, analyzed and compared between the two groups of elderly individuals before and after practicing the physical activities at two time intervals: one in the first week and the other in the fourth week of evaluation.

Table1. Characteristics of study population.

Parameters	**G_1**	**G_2**
N	42 (42.9%)	56 (57.1%)
Female	26 (61.9%)	32 (57.1%)
Male	16 (38.1%)	24 (42.9%)
Age (60-75 years)	68.35 (5.0**%**)	67.25 (5.3**%**)
BMI (Kg/m^2)	25.90 (2.7**%**)	26.24 (2.3**%**)
Abdominal circumference (cm)	91.1 (8.3**%**)	96.6 (6.4**%**) ***

Mean ± standard deviation (SD)
Body mass index (BMI); Abdominal circumference (AC)
*** *P* values for *t*-tests. (p<0.001)

According to the data presented in (Table 1), the mean age of the 98 elderly hypertensive individuals evaluated was 67.5 years. With regard to gender, there were 26 women and 16 men in G_1 (n=42), while there were 32 women and 24 men in G_2 (n=56). According to the data obtained, the elderly in G_2 showed higher AC than those in G_1 and this difference was statistically significant (p<0.001).

Table 2. Cardiovascular parameters before and after the physical activities in the two evaluations.

First week					**Fourth week**	
Parameters		**Groups**	**Means (±SD)**	**Significance**	**Means (±SD)[2]**	**Significance**
SBP (mm Hg)	**Before**	*LG* G_1	147.2 ±11.3	**0.002**	140.9 ±10.7	**0.002**
		Walking G_2	152.2 ±13.0		148.1 ±12.1	
	After	*LG* G_1	126.5 (11.0)	**<0.001**	124.1 (12.8)	**<0.001**
		Walking G_2	141.05 (12.71)		137.96 (11.18)	
DBP (mm Hg)	**Before**	*LG* G_1	83.07 (9.79)	**<0.001**	79.64 (12.07)	**<0.001**
		Walking G_2	92.16 (9.16)		91.23 (7.45)	
	After	*LG* G_1	70.45 (7.30)	**<0.001**	69.38 (8.92)	**<0.001**
		Walking G_2	82.02 (13.38)		84.16 (9.64)	
HR (Beats/min)	**Before**	*LG* G_1	79.62 (13.86)	**0.008**	79.05 (12.58)	**0.001**
		Walking G_2	74.30 (11.59)		74.39 (10.26)	
	After	*LG* G_1	72.17 (12.02)	**0.008**	72.19 (10.77)	**0.001**
		Walking G_2	79.80 (11.37)		81.05 (10.21)	
RF (Breaths/min)	**Before**	*LG* G_1	16.95 (1.66)	**<0.001**	16.28 (1.25)	**0.001**
		Walking G_2	15.64 (0.79)		15.75 (0.69)	
	After	*LG* G_1	15.88 (1.33)	**<0.001**	15.76 (1.41)	**<0.001**
		Walking G_2	17.92 (1.22)		18.00 (1.20)	
T (^{0}C)	**Before**	*LG* G_1	36.18 (0.40)	0.124	36.07 (0.18)	0.078
		Walking G_2	36.07 (0.13)		36.05 (0.10)	
	After	*LG* G_1	36.09 (0.18)	**<0.001**	36.03 (0.13)	**<0.001**
		Walking G_2	36.54 (0.15)		36,48 (0.13)	
Sat O_2 (%)	**Before**	*LG* G_1	95.43 (1.04)	**<0.001**	95.73 (1.17)	**<0.001**
		Walking G_2	97.96 (0.87)		98.17 (0.78)	
	After	*LG* G_1	98.21 (0.68)	**<0.001**	98.47 (0.63)	**<0.001**
		Walking G_2	95.62 (1.18)		95.78 (1.00)	

LG=Lian Gong; G=Group; SBP=Systolic Blood Pressure; DBP=Diastolic Blood Pressure; mmHg=millimeter of mercury; HR=Heart Rate; RF=Frequency Respiratory; T (^{0} C)=Temperature (degrees Celsius); $SatO_2$=Oxygen Saturation.

(Table 2) shows the cardiovascular parameters of the sample groups of the elderly for the two evaluations. With respect to SBP, it can be noted that G_1 showed lower SBP values both before and after practicing *Lian Gong* when compared with G_2, and these differences were statistically significant. The same was found when BPD was compared, which means that those who practiced *Lian Gong* showed lower DBP, both before and after practicing the physical activity, when

compared with the elderly who practiced the walking exercise.

The data related to HR and RF obtained in G_1 at rest were higher than those in G_2; however, after the physical activities, the HR and RF in G_2 were higher than in G_1, and these differences were statistically significant. As for the data obtained concerning O_2 saturation, it was found that G_2 showed higher O_2 saturation at rest when compared with G_1 and these differences were statistically significant. In contrast, O_2 saturation decreased in G_2 after walking and increased in G_1 after *Lian Gong*.

No statistically significant difference was found for the parameter body temperature in either groups before practicing the physical activities in the first and fourth week ($p=0.124$ and $p=0.078$, respectively). However, G_2 showed higher body temperature than G_1 after the physical activities. The data obtained in the first evaluation were very similar to those observed in the fourth week.

It should be noted that the Student's t-test was applied to determine the level of significance and compare the results obtained in the first and fourth week. The data obtained showed no statistically significant difference in the parameters assessed before and after the physical activities when the first and fourth week of evaluation were compared. However, G_1 showed a statistically significant reduction ($p<0.05$) in SBP at rest when compared with the fourth week of evaluation (data not shown).

According to the results obtained, a significant reduction in the parameters SBP, DBP, HR and FR was found in G_1 after practicing *Lian Gong*, while O_2 saturation increased significantly ($p<0.001$). In contrast, body temperature was not significantly altered after *Lian Gong*. It was found that SBP, DBP and O_2 saturation decreased significantly in G_2, but the body temperature did not change after walking. However, HR and RF increased significantly after the physical activities ($p<0.0001$ and $p<0.001$, respectively).

Note that when the first and fourth week of evaluation were compared, the data obtained for G_2 were very similar to those observed in the first week, with the exception that body temperature increased significantly ($p<0.0001$) after walking (data not shown).

DISCUSSION

According to the American College of Sports Medicine (1998) low levels of cardiorespiratory fitness are associated with the risk of premature death, particularly from cardiovascular disease. For this reason, physical fitness is related to health. National and international organizations (Brazilian Society of Exercise Medicine and Sports, and the American College of Sports Medicine) recommend resistance training combined with aerobic exercises and stretching at least twice a week to promote health and improve fitness in elderly persons (Camara, Bastos and Volpe, 2012; American College of Sports Medicine and Chodzko-Zajko, et al., 2009).

Thus, the present study evaluated and compared the main cardiovascular parameters in elderly hypertensive patients before and after *Lian Gong* and walking. Initially the characterization of the population who participated in this study was carried out and it was found that AC measurement was significantly smaller in those who practiced *Lian Gong* than in those who practiced walking exercises. These findings can be explained because *Lian Gong* is an exercise that focuses on the whole body by means of simple and objectives exercises with the purpose of achieving therapeutic outcomes by improving blood circulation, physiology of the joints, as well as strengthening muscles (Ming and Shen, 2012). Through the movement of the upper and lower limbs, which is a characteristic of this physical activity, one can observe an emphasis on the development of motor skills and flexibility, while walking favors the development of the aerobic capacity (Nunes and Santos, 2009).

The results presented in this study show those who practice *Lian Gong* had lower BP (SBP and DBP), both before and after the physical activity, when compared with those who practiced walking exercises. As for the data related to the HR and FR in G_1 these were higher at rest than those in G_2. However, after the physical activities, G_2 showed higher HR and RF when compared with G_1. These results are in agreement with our expectations since walking is an essentially aerobic activity. The practice of *Lian Gong* exercises involves synchronized movements, marked by the rhythm of music and associated with slow breathing. According to (Bernardi, Porta and Sleight, 2006), who evaluated the cardiovascular, cerebrovascular, and respiratory changes induced by different types of music, slow or meditative music produces a relaxing effect, which induces a decrease in heart rate, blood pressure and ventilation.

A study conducted with hypertensive patients, which used a device to guide the patients to breathe slowly and regularly as they listened to music, found that slow musical rhythms induce a change in the breathing patterns and reduce blood pressure. Schein et al. (2001) reported that participants in their study reported that physical exercise associated with music improved respiration and reduced insomnia and stress.

With regard to SaO_2, G_2 showed higher SaO_2 at rest when compared with G_1. After the physical activities it was found that SaO_2 was higher in G_1 than in G_2, which may be because *Lian Gong* is an activity that uses a breathing technique that consists of inhaling and exhaling slowly and deeply, which favors the relaxation process and improves tissue oxygenation. This is not a characteristic of walking although RF increases after the exercise, but there is also an increase in oxygen consumption due to increased energy demand required by the activity.

In this study it was found that the parameters BP (SBP and DBP), HR and RF decreased significantly after *Lian Gong*, while O_2 saturation increased significantly. In contrast, a statistically significant reduction in BP (SBP and DBP) and SaO_2 occurred after walking, whereas HR and RF increased significantly. Post-exercise hypotension (PEH) is a phenomenon of a prolonged decrease in resting blood

pressure in the minutes and hours following acute exercise (MacDonald, 2002).

PEH seems to occur in individuals of different gender and ages, in normotensive and hypertensive patients, irrespective of the intensity, duration , exercise mode , and the amount of active muscle mass. However, the results of some studies suggest that the magnitude and duration of PEH may depend on the intensity and duration of the exercise (MacDonald, MacDougall and Hogben, 2000a; MacDonald, MacDougall and Hogben, 1999b; Forjaz, et al., 1998a; Forjaz, et al., 1998b and Wallace, 2003).

Forjaz et al. (2004) showed the acute hypotensive effect of acute exercise on BP in hypertensive individuals. Studies in recent years suggest that the key signaling pathways are activated to maintain a post-exercise vasodilator effect and the greater this effect, the better adaptation to training (Halliwill, et al., 2013). It is therefore essential that further studies be conducted to elucidate the mechanisms involved in the regulation of BP after practicing physical activities, such as the *Lian Gong*. It is noteworthy that this study is unpublished and the literature related to the topic is scarce.

When evaluating the cardiovascular parameters of elderly hypertensive individuals, it may be concluded that *Lian Gong* induced a more intense hypotensive effect than walking. Furthermore, a statistically significant reduction in the parameters BP (SBP and DBP), HR and RF was found after *Lian Gong* was practiced, while O_2 saturation increased significantly. In contrast, a statistically significant reduction in BP (SBP and DBP) and SaO_2 occurred after walking, whereas HR and RF increased significantly. Thus, it is important that further studies be conducted to elucidate the mechanisms involved in the regulation of BP and other cardiovascular parameters after *Lian Gong* exercise.

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