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Brief Communication

Longer Leisure Walking Time is Associated with Lower Arterial Stiffness Indexes in Older Adult Brazilian Community Dwellers: A Brief Communication

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ABSTRACT

Walking is a physical activity that reduces arterial stiffness in older adults with hypertension. However, the optimal amount of walking required to improve cardiovascular health and whether professional supervision is necessary for this population remains unclear. Therefore, this study aimed to verify the association between weekly leisure walking time without specialized professional support and arterial stiffness indexes in hypertensive older adults. The older adults were allocated to physically inactive (PI) and active (PA) groups. Baseline hemodynamic measures were obtained, and arterial stiffness was analyzed by pulse wave velocity (PWV) and augmentation index (AIx) methods. Heart rate and resting central and peripheral blood pressure were lower in the PA group. The PA had lower PWV and AIx. Association was detected between weekly leisure walking time and PWV and AIx. Longer leisure walking time without professional supervision was associated with lower arterial stiffness indicators in hypertensive older adults living in Brazilian communities.

1. INTRODUCTION

Age-related arterial stiffening is an important predictor of cardiovascular events and studies highlight that hypertension can accelerate arterial stiffness associated with aging.[1] Although arterial stiffness increases with age and hypertension, it might also be influenced by lifestyle factors, such as physical activity. Regular exercise is associated with reducing inflammation and improving endothelial function, benefiting arterial compliance, and ensuring better systemic health.[2] Older people aerobically trained have lower levels of arterial stiffness when compared to their sedentary pairs. Evidence from randomized controlled trials has demonstrated a beneficial effect of various exercise modalities on endothelial function.[3]

However, there is controversy regarding the effects of different exercise protocols on indices of arterial stiffness and wave reflection,[4] particularly when these exercises are practiced without professional guidance concerning exercise characteristics such as intensity, frequency, session duration, and overall duration of the intervention.

Walking is a physical activity of low cost and does not require a specific place of practice and most of the population can exercise. Habitual walking may play a crucial role in the prevention and management of arterial bed abnormalities, particularly among hypertensive older adults. However, the optimal "dose-response" required to achieve cardiovascular benefits in this population and the necessity of training supervision and periodization are not yet fully understood. Therefore, to clarify the chronic effects of walking under vascular health, we investigated the association between longer weekly leisure walking time without professional supervision and arterial stiffness indicators of hypertensive older.

2. METHODS

Thirty-three hypertensive older adults from a hypertension outpatient facility in a hospital complex in Minas Gerais, Brazil were enrolled in this study. According to the criteria established by the World Health Organization, the participants were allocated to physically inactive (PI, n = 18) and active (PA, n = 15) groups. This study was approved by the Institutional Review Board of the Federal University of Triângulo Mineiro in Brazil (No. 252.2089) and conducted according to the principles established in the Declaration of Helsinki. Researchers conducted an International Physical Activity Questionnaire (IPAQ - short version) to obtain the weekly walking time. The anthropometric profile and baseline pressure levels were noninvasively measured. The resting heart rate (HR) of an electrocardiogram was monitored. The arterial stiffness was analyzed by PWV and AIx methods. All analyses were performed using Jeffreys's Amazing Statistics Program (JASP, 0.18.3.0, Netherlands), and a significant level of 5% was set for all statistical tests.

3. RESULTS

The mean (± standard deviation) age of the participants was 68.2 ± 6.1 years, and the majority, 19 (57.6%) were female. Table 1 presents anthropometric characteristics, resting hemodynamics parameters, and weekly walking time. The median (interquartile range [IQR: 25th and 75th percentile]) weekly walking time was higher in the PA group (280 [IQR: 210.0 to 356.0] minutes) compared to the PI (35 [IQR: 25.0 to 80.0] minutes; $p < 0.001$). The PA showed lower levels of systolic (131.5 ± 8.2 *vs.* 121.4 ± 8.4 mmHg; p = 0.001), diastolic (80.0 [IQR: 78.0 to 87.0] *vs.* 77.5 [IQR: 72.1 to 79.0] mmHg; p = 0.022), and mean (99.0 ± 7.4 *vs.* 90.4 ± 8.9 mmHg; p = 0.005) blood pressure (BP), as well as brachial pulse pressure (48.7 ± 2.6 *vs.* 46.4 ± 2.1 mmHg; p = 0.011). Likewise, the PA group had lower values of SBP (115.0 [IQR: 103.5 to 128.0] mmHg), DBP (78.2 ± 7.3 mmHg) and central MBP (90.3 ± 8.3 mmHg) when compared to PI group: SBP (122.5 [IQR: 120.0 to 130.0] mmHg; p = 0.043), DBP (83.6 ± 6.9 mmHg; p = 0.036), and MBP (97.5 ± 6.3 mmHg; p = 0.007), respectively. The PA group had lower resting HR (67.3 ± 4.2 bpm) compared to PI group (74.8 ± 4.1 bpm; $p < 0.001$).

Table 1. Anthropometric and hemodynamic characteristics of the entire sample of hypertensive older adults (n = 33) enrolled in the study, categorized by physical activity status (PI and PA)

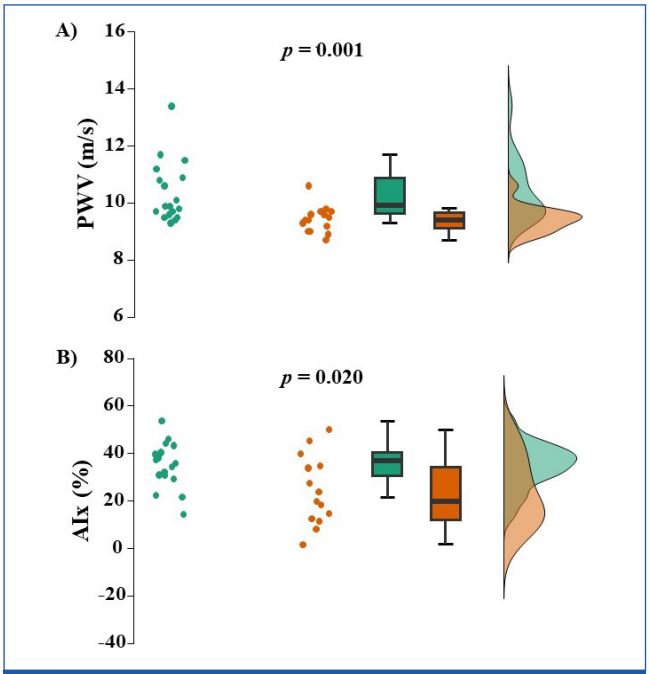
Variables	Δ [95%CI]	p value	Effect size	Classification
Age (years)	2.0 [-2.0 to 6.0]	0.231	0.25 [-0.15 to 0.57][b]	Small
Body mass (kg)	1.8 [-7.6 to 11.2]	0.700	0.13 [-055 to 0.82][a]	Small
BMI (kg/m^2)	-1.6 [-4.9 to 1.6]	0.316	-0.35 [-1.04 to 0.35][a]	Medium
Weekly walking (min)	211.7 [173.0 to 290.0]	< 0.001	1.0 [1.0 to 1.0][b]	Large
Brachial SBP (mmHg)	-10.1 [-15.8 to -4.2]	0.001	-1.20 [-1.94 to -0.44][a]	Large
Brachial DBP (mmHg)	-4.0 [-12.0 to -1.0]	0.022	-0.47 [-0.72 to -0.11][b]	Medium
Brachial MBP (mmHg)	-8.6 [-14.4 to -2.8]	0.005	-1.03 [-1.75 to -0.29][a]	Large
Brachial PP (mmHg)	-2.3 [-3.9 to -0.5]	0.011	-0.92 [-1.63 to -0.19][a]	Large
Central SBP (mmHg)	-11.0 [-19.0 to -27.1]	0.043	-0.42 [-0.69 to -0.04][b]	Medium
Central DBP (mmHg)	-5.4 [-10.5 to -0.4]	0.036	-0.75 [-1.45 to -0.03][a]	Large
Central MBP (mmHg)	-7.2 [-12.4 to -2.1]	0.007	-0.98 [-1.70 to -0.24][a]	Large
Central PP (mmHg)	-5.5 [-13.5 to 2.5]	0.169	-0.48 [-1.18 to -0.22][a]	Large
Heart rate (bpm)	-7.5 [-10.5 to -4.6]	< 0.001	-1.76 [-2.56 to -0.94][a]	Large
Cardiac output (L/min)	0.4 [-27.1 to 0.8]	0.064	0.38 [0.00023 to 0.67][b]	Medium

Notes: [a]For the Student t-test, effect size was given by Hedges' g. [b]For the Mann-Whitney test, effect size was given by the rank biserial correlation (r_B). Abbreviations: CI, confidence interval; DBP, diastolic blood pressure; MBP, mean blood pressure; PA, physically active; PI, physically inactive; PP, pulse pressure; SBP, systolic blood pressure.

The PWV was significantly lower in PA (9.4 [IQR: 9.0 to 9.6] m/s) than PI group (9.9 [IQR: 9.6 to 10.9] m/s; p = 0.001) (Figure 1A). Similar results were observed for AIx in the PA group (19.8 [IQR: 11.8 to 34.5] %) compared to the PI (36.7 [IQR, 30.7 to 40.5] %; p = 0.020) (Figure 1B).

An association was detected between weekly walking volume and PWV (p = 0.020, r^2 = 0.164, r^2 adjusted = 0.137; Supplementary Figure 2A) and AIx (p = 0.020, r^2 = 0.163, r^2 adjusted = 0.136; Supplementary Figure 2B).

Figure 1. Cardiovascular parameters of arterial stiffness in PI and PA hypertensive older adults. A) PWV, and B) TVR. Values are displayed as median and interquartile range (25%, 75%).



Abbreviations: AIx, augmentation index; PA, physically active; PI, physically inactive; PWV, pulse wave velocity; TVR, total vascular resistance.

4. DISCUSSION

This study demonstrated the dose-response relationship between leisure walking without professional support and arterial stiffness in Brazilian hypertensive older adults. Specifically, walking more than 300 minutes weekly was associated with lower arterial stiffness indices. Our results align with recent evidence from the World Health Organization on the benefits of physical activity for various health indicators.[5] These benefits are observed with a minimum of 150 minutes per week of moderate-intensity aerobic activity, and additional benefits are achieved with higher volumes of such activity. Thus, the customary practice of this physical activity proves to be safe, and effective for controlled hypertensive individuals. To the best of our knowledge, such findings are among the few in the literature that show the effect of weekly leisure walking time (without considering the frequency, intensity of the walk, and accompaniment of professional trainers) on arterial compliance of hypertensive older adults. It is important to highlight that both groups of hypertensive older adults in this study practiced walking by medical recommendation with equal practice time (around 10 years), regardless of the weekly volume.

A previous study showed that at every 1000 steps/day increment there is a 0.18 m/s reduction in PWV. This increment is estimated to produce a 3% decrease in vascular events and mortality. This increase in the number of steps of daily walking is also responsible for the PWV reduction observed with supervised exercise programs,[6] thus a steps/day increment of this magnitude (as well as the higher walking time found in our study) would theoretically equal the PWV reduction of such a structured program and consequently to reduce the risk of additional cardiovascular events.[7]

The PWV is considered the gold standard for arterial stiffness analysis. However, AIx is also considered an important marker of arterial stiffness. We found lower rates of AIx in hypertensive older adults with higher walking activity per week, which corresponds to lower arterial stiffening in these individuals. Studies have shown a significant improvement in AIx in response to aerobic exercise intervention. Furthermore, both the relative and absolute intensity of physical exercise were positively associated with improvements in Aix.[8]

It was also evidenced a higher resting bradycardia in favor of the PA group. Higher resting bradycardia represents good cardiovascular health. Studies indicate that well-aerobically individuals conditioned have lower resting HR, suggesting higher parasympathetic activity or lower sympathetic activity.[9] Several physiological mechanisms can explain the interrelation between better arterial stiffness indicators and longer leisure walking time. However, further studies on the practice of a specific type of physical activity, such as walking, and arterial stiffness are necessary, because the walking modality can reach a greater number of practitioners compared to other types of physical activities.

This study has some limitations. The walking habit was measured by a questionnaire. Measures like accelerometers and pedometers can provide more objective and reliable data. Conversely, the IPAQ questionnaire is a validated and widely used tool.[10] Our study is a cross-sectional experimental design, and therefore temporal ambiguity cannot be ruled out, randomized controlled trials would allow evidence about causality; however, it was not the purpose of our study. Diet is another limiting factor. We did not conduct specific recalls for their dietary pattern. However, at the time of the interview, we asked participants about their food habits (food

quality, number, and meal amount), and we found that, substantively, the responses between older adults about food habits were not too different. Another considerable limitation of our study is that walking intensity was not assessed.

5. CONCLUSION

Our finding indicates that longer leisure walking time, independent of professional supervision, was associated with lower arterial stiffness indicators in hypertensive older adults Brazilian Community Dwellers. In addition, the results contribute to and reinforce to understanding that a simple practice of physical activity (walking) may be a contributing factor to reducing arterial stiffening in hypertensive older adults.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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REFERENCES

1. Castelli R, Gidaro A, Casu G, et al. Aging of the arterial system. *Int J Mol Sci.* 2023;**24**(8):6910. doi:10.3390/ijms24086910
2. Gao J, Pan X, Li G, Chatterjee E, Xiao J. Physical exercise protects against endothelial dysfunction in cardiovascular and metabolic diseases. *J Cardiovasc Transl Res.* 2022;**15**(3):604–620. doi:10.1007/s12265-021-10171-3
3. Fuertes-Kenneally L, Manresa-Rocamora A, Blasco-Peris C, et al. Effects and optimal dose of exercise on endothelial function in patients with heart failure: A systematic review and Meta-Analysis. *Sports Med Open.* 2023;**9**(1):8. doi:10.1186/s40798-023-00553-z
4. Kresnajati S, Lin YY, Mündel T, Bernard JR, Lin HF, Liao YH. Changes in arterial stiffness in response to various types of exercise modalities: A narrative review on physiological and endothelial senescence perspectives. *Cells.* 2022;**11**(22):3544. doi:10.3390/cells11223544
5. Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 202 guidelines on physical activity and sedentary behaviour. *Br J Sports Med.* 2020;**54**(24):1451–1462. doi:10.1136/bjsports-2020-102955
6. Ashor AW, Lara J, Siervo M, Celis-Morales C, Mathers JC. Effects of exercise modalities on arterial stiffness and wave reflection: A systematic review and meta-analysis of randomized controlled trials. *PLoS One.* 2014;**9**(10):e110034. doi:10.1371/journal.pone.0110034
7. Kobayashi R, Asaki K, Hashiguchi T, Negoro H. Effect of aerobic exercise training frequency on arterial stiffness in middle-aged and elderly females. *J Phys Ther Sci.* 2022;**34**(5):347–352. doi:10.1589/jpts.34.347
8. Seals DR. Habitual exercise and the age-associated decline in large artery compliance. *Exerc Sport Sci Rev.* 2003;**31**(2):68–72. doi:10.1097/00003677-200304000-00003
9. Zhang D, Shen X, Qi X. Resting heart rate and all-cause and cardiovascular mortality in the general population: A meta-analysis. *CMAJ.* 2016;**188**(3):E53–E63. doi:10.1503/cmaj.150535
10. Cleland C, Ferguson S, Ellis G, Hunter RF. Validity of the international physical activity questionnaire (IPAQ) for assessing moderate-to-vigorous physical activity and sedentary behaviour of older adults in the United Kingdom. *BMC Med Res Methodol.* 2018;**18**(1):176. doi:10.1186/s12874-018-0642-3