

THE INFLUENCE OF PHYSICAL ACTIVITY ON THE ARTERIAL BLOOD PRESSURE OF THE ELDERLY: A SYSTEMATIC REVIEW

Doroteja RANČIĆ¹, Tamara ILIĆ¹, Stefan STOJANOVIĆ¹

¹Faculty of sport and physical education, University of Niš

Corresponding author:

Doroteja RANČIĆ

¹Faculty of Sport and Physical Education, University of Niš

Čarnojevića 10A, 18000 Niš, Serbia

Telephone number: +381652644224

Email: doroteja.r@yahoo.com

ABSTRACT

Purpose: *The aim of this review was to determine the influence of physical activity on the arterial blood pressure of the elderly through a review of previous research.*

Methods: *The search was performed on the Web of Science, Google Scholar and PubMed databases. The first search identified 1112 articles. In the initial assessment carried out in accordance with the inclusion and exclusion criteria, 15 articles were found suitable and were included in the study, while 1097 studies were excluded. The search was limited to articles published in period of 2002–2022.*

Results: *After the applied exercise programs and evaluation at the final measurements, the mean values of systolic blood pressure, on the total sample, were 131 mmHg, while the values of diastolic blood pressure were 77 mmHg, which indicates that physical activity (regardless of whether swimming, walking, yoga, resistance training, high interval training, Tai Chi) have a positive effect on the arterial blood pressure of the elderly.*

Conclusion: *All studies, except one, showed a positive influence of physical activity on the arterial blood pressure of elderly people. In this regard, it can be concluded that physical activity, regardless of the type of activity, has a positive effect on the arterial blood pressure of the elderly, in the form of a reduction in blood pressure values.*

Keywords: *physical activity, arterial blood pressure, elderly.*

VPLIV TELESNE DEJAVNOSTI NA ARTERIJSKI KRVNI TLAK PRI STAREJŠIH OSEBAH: SISTEMATIČNI PREGLED

IZVLEČEK

Namen: Namen te analize je bil s pregledom dosedanjih raziskav ugotoviti vpliv telesne dejavnosti na arterijski krvni tlak pri starejših osebah.

Metode: Iskanje je potekalo v podatkovnih zbirkah Web of Science, Google Scholar in PubMed. Pri prvem iskanju je bilo opredeljenih 1112 člankov. Pri začetni presoji, opravljeni v skladu z merili za vključitev in izključitev, se je 15 člankov izkazalo za primerne in so bili vključeni v študijo, medtem ko je bilo 1097 študij izključenih. Iskanje je bilo omejeno na članke, objavljene v obdobju 2002–2022.

Rezultati: Po izvedenih vadbenih programih in oceni ob končnih meritvah so bile povprečne vrednosti SKT na celotnem vzorcu 131 mmHg, vrednosti DKT pa 77 mmHg, kar kaže, da imajo telesne dejavnosti (ne glede na to, ali gre za plavanje, hojo, jogo, vadbo vzdržljivosti, visoko intervalni trening, tai chi) pozitiven učinek na arterijski krvni tlak starejših oseb.

Sklep: Vse študije, razen ene, so pokazale pozitiven vpliv telesne dejavnosti na arterijski krvni tlak starejših oseb. V zvezi s tem lahko sklepamo, da ima telesna dejavnost, ne glede na vrsto dejavnosti, pozitiven učinek na arterijski krvni tlak starejših, in sicer v obliki zmanjšanja vrednosti krvnega tlaka.

Gljučne besede: telesna dejavnost, arterijski krvni tlak, starejše osebe.

INTRODUCTION

Aging is a natural process of life characterized by specific physical, psychological, and social changes (Hamidizadeh, Ahmadi & Fallahi, 2004). In addition, aging refers to irreversible degenerative changes that are generally progressive, in which the physical condition of an older individual deteriorates, along with their ability and motivation to engage in physical activity (Fiori, Smith & Antonucci, 2007). As a result, practically all organs in most elderly people experience some degree of degradation/atrophy in their morphological forms or in the tasks they perform in the body. As a result, various chronic diseases appear in older individuals, including cardiovascular diseases such as hypertension, coronary artery diseases, and skeletal diseases such as arthritis, osteoporosis, and cancer (Hamidizadeh et al., 2004).

Arterial blood pressure (BP) is an important indicator of cardiovascular health, and hypertension (high blood pressure) is a major risk factor for the development of cardiovascular disease in the elderly (Chobanian et al., 2003). The risk of hypertension tends to be greater in elderly, and it is one of the diseases that can be treated. Physical activity is a well-established lifestyle factor that can lower blood pressure levels and reduce the risk of hypertension in older adults (Cornelissen & Smart, 2013; Pescatello, MacDonald, Lamberti, & Johnson, 2015). However, the relationship between physical activity levels and blood pressure in older adults is complex, and the optimal amount and intensity of physical activity required to achieve blood pressure reduction is still unclear (Pescatello et al., 2015). In addition, other factors such as age, gender, body mass index, and comorbidities such as diabetes and chronic kidney disease may influence the relationship between physical activity levels and blood pressure in the elderly. Therefore, it is important to investigate the effect of physical activity on blood pressure in the elderly while controlling for these confounding variables.

Several studies have examined the impact of physical activity levels on BP in older adults, with some showing a significant association between higher physical activity levels and lower BP (Pescatello et al., 2015), while others have reported mixed or non-significant findings (Cornelissen & Smart, 2013; Graca et al., 2022). Moreover, some studies suggest that a sedentary lifestyle increases the risk of hypertension, while increased physical activity at work or leisure is associated with lower blood pressure values (Kokkinos, Papademetriou, 2000). The effect of aerobic exercise on hypertension was mainly tested in long-term exercise programs (at least three months) with high intensity and a large number of sessions per week (5 days per week). In a study by Moraes et al. (2012), the intervention group's mean systolic and diastolic blood pressure decreased

by 3 mmHg and 1 mmHg, respectively, after three days of aerobic exercise per week for three months, but the control group's mean blood pressure showed no significant change. The short-term program had no effect on lowering systolic blood pressure, but it did lower diastolic blood pressure, according to a study by Tabara et al. (2007) comparing aerobic short-term and long-term exercise programs with mild and moderate intensities on cardiovascular indicators of older adults. Mean systolic and diastolic blood pressure decreased throughout time, from 136 mmHg to 129 mmHg, and 87 mmHg to 83 mmHg, respectively.

Based on a review of the literature, we can conclude that the previous studies are not sufficiently balanced and that there are many dilemmas about the influence of physical activity on the arterial pressure of the elderly. This study investigated the effects of multiple types of physical activity on arterial blood pressure in the elderly. Knowing the effect of physical activity on the arterial blood pressure of the elderly, this paper contributes by sublimating the evidence and showing the effect of physical activity on blood pressure. In this context, we assume that individuals who had higher level of physical activity would have preferable, that is lower SBP and DBP, BP values. Although the work is not unique, it represents evidence-based evidence of the importance of physical activity for blood pressure. Also, most systematic reviews focus on the study of one type of physical activity, while showing the importance of multiple types of physical activity gives importance in planning physical activity programs in order to regulate blood pressure, where it is possible to make the program more flexible.

Therefore, the aim of this study was to determine the influence of physical activity on the arterial blood pressure of the elderly through a review of previous research.

METHODS

This study was designed using the systematic review technique. Research data was collected considering the inclusion and exclusion criteria of the studies published, as a result of the search made by using the keywords "physical activity, arterial blood pressure, elderly" in English. The search was performed on the Web of Science, Google Scholar and PubMed databases. In accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, a systematic review of the available literature was undertaken (Moher, Liberati, Tetzlaff & Altman, 2009) (Figure 1.). The first search identified 1112 articles. In the initial assessment carried out in accordance with the inclusion and exclusion criteria, 15 articles were found to be suitable and

were included in the study, while 1097 studies were excluded. In order for a study to be included in the analysis, it had to meet the following criteria: year of publication (2002–2022), participants were elderly people (≥ 50 yrs), also the studies that were included in this review had to be based on the influence of physical activity on the arterial blood pressure of the elderly. References from all papers were reviewed in order to find more studies that dealt with topics that were of interest and related to our review paper.

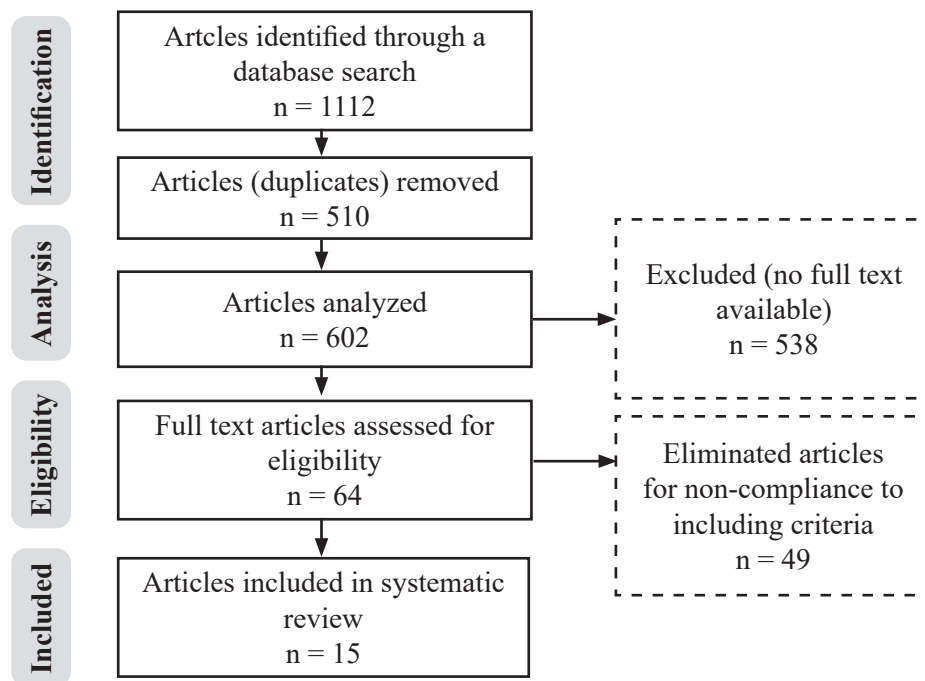


Figure 1. PRISMA flow chart of article selection process

RESULTS

In this part, 15 original scientific studies are presented on the topic of the influence of physical activity on the arterial blood pressure of the elderly in Table 1.

Table 1. Systematic review of the studies

Authors	Participants	Experimental program	Mean SBP (Before intervention)	Mean DBP (After intervention)	Results
Tabara et al. (2007)	n = 139 2 groups Age 67±6	Mild to moderate aerobic exercise for 30 minutes 2/week for 6 months	136 mmHg 75 mmHg	129 mmHg 70 mmHg	Both SBP and DBP were significantly reduced
Kawasaki et al. (2011)	n = 35 2 groups Age 57–73	6-month exercise program (swimming) 2/week	136 mmHg 81 mmHg	132 mmHg 77 mmHg	The exercise program significantly improved SBP and DBP, as did lipid and glucose metabolism
Pitsavos et al. (2011)	n = 42 2 groups Age 53 ± 7	Aerobic exercise program for 16 weeks, 3/week, with 60 to 80 max. heart rate	131 mmHg 83 mmHg	119 mmHg 76 mmHg	This study showed a positive effect of regular exercise on SBP and DBP
Habib et al. (2014)	n = 92 2 groups Age 65–75	4-week period of walking, 3/week, each time for 20–30 minutes	149 mmHg 94 mmHg	144 mmHg 85 mmHg	The findings showed that walking is effective in reducing blood pressure in the elderly
Miura et al. (2015)	n = 200 2 groups Age 60–88	12-week program (90 minutes 2/week), 6–8 resistance exercises, circuit training and chair exercises for the lower body	150 mmHg 84 mmHg	145 mmHg 80 mmHg	Both groups had reductions in SBP and DBP (group doing circuit training and group doing lower body chair exercises)
Patil et al.(2015)	n = 60 2 groups Age ≥60	Yoga training and brisk walking with stretching exercises 1 hour in the morning 6/week for 12 weeks	146 mmHg 74 mmHg	133 mmHg 73 mmHg	Yoga was more effective than brisk walking in reducing SBP and DBP

Authors	Participants	Experimental program	Mean SBP (Before intervention)	Mean DBP (After intervention)	Results
Ardakani et al. (2018)	n = 24 2 groups Age 67.37	8 weeks of resistance training, 3/week with 40–65% intensity + one max. repetition	143 mmHg 72 mmHg	138mmHg 70mmHg	Resistance training for 8 weeks reduced SBP to a greater extent than DBP
Wong et al. (2018)	n = 100 2 groups Age~74	Swimming 3–4/week for a period of 20 weeks	147 mmHg 92 mmHg	143mmHg 86 mmHg	Swimming led to a decrease in blood pressure while increasing strength and aerobic capacity in women
Amooali et al. (2019)	n = 40 2 groups Age 50–70	Aerobic exercises performed 3 times a week for 12 weeks	145 mmHg 86 mmHg	140 mmHg 81 mmHg	Aerobic exercise for 12 weeks was effective in reducing SBP and DBP
Ruangthai & Phoemsapthawee (2019)	n = 54 3 groups Age 67±5.8	Supervised exercise training (1-hour sessions, 3 times a week for 12 weeks), (strength and endurance training + combined)	146 mmHg 84 mmHg	141 mmHg 76 mmHg	Both types of training, as well as the combination of the two, led to a decrease in SBP and DBP
Herrod et al. (2020)	n = 48 4 groups Age 71.0	HIIT on a cycle ergometer; isometric handgrip training (IHG); unilateral, upper limb remote ischemic preconditioning (RIPC) or non intervention control	HIIT 142 mmHg 85 mmHg IHG 139 mmHg 83 mmHg	HIIT 131 mmHg 82 mmHg IHG 131 mmHg 75 mmHg	6 weeks of fully supervised HIIT or IHG can reduce the resting SBP of older adults by an average of 9 mmHg

Authors	Participants	Experimental program	Mean SBP (Before intervention)	Mean DBP (After intervention)	Results
Choi et al. (2020)	n = 27 2 groups Age 72–77	Elastic band exercises (EBE) for 60 min, 3/week for 3 months. The exercises consisted of incremental resistance and aerobic exercises.	126 mmHg 78 mmHg	121 mmHg 75 mmHg	Resting SBP and DBP were significantly reduced by ~5.0 mmHg after the 12-week EBE program
Iellamo et al. (2021)	n = 36 3 groups Age ≥ 60	Aerobic continuous exercise (ACE), HIIT, and combined (aerobic and resistance) exercise (CE)	ACE 121 mmHg 81 mmHg CE 121 mmHg 82 mmHg	ACE 115 mmHg 78 mmHg CE 114 mmHg 78 mmHg	SBP lowering significant in the ACE and CE groups but not in the HIIE group. In all groups, DBP decreased to a similar level, although not significantly.
Wen & Su (2021)	n = 66 2 groups Age 50–75	60 minutes of simplified Tai Chi (STC) 3/week for 6 weeks or 60 min of Wu-style Tai Chi (WTC) 3/week for 6 weeks	STC 134 mmHg 80 mmHg WTC 136 mmHg 80 mmHg	STC 124 mmHg 77 mmHg WTC 123 mmHg 76 mmHg	Results showed that compared with simplified Tai Chi, Wu-style Tai Chi had a better effect on BP in the elderly –5.80 (mmHg)
Graça et al. (2022)	n = 32 2 groups Age 55–72	Resistance training followed by HIIT or vice versa (8 weeks)	119 mmHg 80 mmHg	114 mmHg 74 mmHg	Blood pressure did not change significantly following the intervention for either group

Legend: Mean BP – arterial blood pressure before the exercise program (mean values); Mean BP – arterial blood pressure after the exercise program (mean values); n – number of participants; SBP – systolic blood pressure; DBP – diastolic blood pressure.

DISSCUSION

Hypertension is a serious public health challenge worldwide, being quantitatively the major risk factor for premature cardiovascular disease (Angeli, Reboldi & Verdecchia, 2013). If the underlying problem is not prevented or treated, many patients with hypertension die from hypertension-related diseases. Therefore, the aim of this review was to determine the influence of physical activity on the arterial blood pressure of the elderly, regardless of gender, through a review of previous research.

In the selected studies, there was usually one group that had to fulfill the conditions (the elderly population) in order to participate in the study. The number of participants varied from study to study, the smallest number of participants was included in our study (Ardakani, Qassemian, Koushki, Shakour & Mehrez, 2018) had a sample of only 24 elderly people, and the largest number (Miura, Takahashi, Maki, & Sugino, 2015) as many as 200 elderly people. The total number of participants in the present study amounted to 995 elderly people between the ages of 50 and 88.

Data from all the studies presented show that the mean values of systolic blood pressure (SBP) before exercise, in the total sample, were 138 mmHg, while the mean values of diastolic blood pressure (DBP) before exercise were 82 mmHg. After the exercise programs and evaluation at the final measurements, the mean values of SBP, on the total sample, were 131 mmHg, while the values of DBP were 77 mmHg, which indicates that physical activities (regardless of whether swimming, walking, yoga, resistance training, high interval training or Tai Chi) have a positive effect on the arterial blood pressure of the elderly.

When it comes to physical activity, people who exercised more frequently and for a longer period of time had better improvements in the mean values of arterial blood pressure compared to people who did not exercise, i.e. sedentary individuals from control groups in the presented studies (Habib, Fariba, Farideh, Navideh & Saeed, 2014; Kawasaki, Sullivan, Ozoe, Higaki & Kawasaki, 2011; Wong et al., 2019; Ardakani et al., 2018; Pitsavos et al., 2011; Patil, Aithala & Das, 2015; Amooali, Daryanoosh, Baigi & Mohamadi, 2019). It is clear that all forms of physical activity have a positive effect on arterial blood pressure, with significant improvements observed after the swimming program (Kawasaki et al., 2011; Wong et al., 2019), walking / brisk walking program (Amooali et al., 2019; Pitsavos et al., 2011; Patil et al., 2015; Habib et al., 2014; Tabara et al., 2007; Iellamo et al., 2021), and resistance training (Ruangthai & Phoemsapthawee 2019; Miura et al., 2015; Ardakani et al., 2018; Choi, Hurr &

Kim, 2020), with the same positive effects being observed in the study by Wen & Su (2021) that implemented simplified Tai Chi and Wu-style Tai Chi and Patil et al. (2015) who implemented yoga sessions (Patil et al., 2015). Only one study did not find significant changes in SBP or DBP after intervention (Graça et al., 2022), in which they implemented resistance training and high-intensity interval training for 8 weeks. A total of 14 out of 15 studies shown in the table showed positive results of physical activity on arterial blood pressure and in this connection we can conclude that physical activity, in general, has a positive effect on the arterial blood pressure of the elderly.

CONCLUSION

Physical activity (regardless of whether swimming, walking, yoga, resistance training, high interval training or Tai Chi) has a positive effect on the arterial blood pressure of the elderly.

With the exception of one study, all the other studies reviewed demonstrated a beneficial impact of physical activity on the arterial blood pressure of elderly individuals. In light of this, it can be concluded that physical activity, regardless of type of activity, yields favorable results by lowering blood pressure values in the elderly population.

Limitations of the study

This study has potential limitations. The study's stringent inclusion and exclusion criteria may have limited the amount of literature gathered. Additionally, the heterogeneity of studies included in this systematic review indisposed us of performing meta-analysis. Also, there are numerous internal and external factors, such as gender, age, level of metabolic health, stress etc., that can affect BP values, but the analyzed studies did not take into account all these variables.

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Conflict of interest

The authors declare that there is no conflict of interest.

Future research

For future research, it is recommended to use a larger number of studies included in systematic review. Also, it is desirable to include studies based on only one type of physical activity.

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