SCIENTIFIC JOURNAL OF SPORT AND PERFORMANCE

ORIGINAL ARTICLE

Effect of different types of physical exercise on blood pressure in overweight male subjects aged 50-70 in the city of Alicante

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ABSTRACT

The objective of this study was to compare different types of physical exercise on blood pressure (BP) in overweight, medicated hypertensive subjects aged between 50 and 70 years. 30 male subjects (mean ± standard deviation; age: 60.06 ± 5.22 years; height: 1.72 ± 0.06 m; body weight: 81.16 ± 9.66 kg; body mass index: 27.58 ± 1.64 kg/m²) were evaluated using different training strategies and divided into three groups. The Concurrent Training (CT) group consisted of 12 subjects, performing combined strength (40-80% of 1RM) and endurance training (40-80% of VO_{2max}). Nine subjects participated in handgrip isometric training (HT) group, performing isometric contractions using a dynamometer (4x2'/1' bilaterally). The control group (CG) consisted of nine subjects. Significant differences (p < .05) were found between the CT and HT groups after 8 weeks of intervention and in the acute effect of the sessions on systolic blood pressure (SBP). Furthermore, it was established that subjects with a body mass index (BMI) greater than 27.5 kg/m^2 and a waist-hip ratio (WHR) greater than 1 obtained more changes in their BP compared to subjects with lower BMI and WHR. Our study indicated that the implementation of CT and HT can reduce BP in hypertensive subjects.

Keywords: Sport medicine, Blood pressure, Exercise, Concurrent training, Isometric training, Body mass index.

Cite this article as:
Terol-Sanchis, M., Elvira-Aranda, C., Gomis-Gomis, M. J., Guzmán-Muñoz, E., Lledó-Rico, L., & Pérez-Turpin, J. A. (2026). Effect of different types of physical exercise on blood pressure in overweight male subjects aged 50-70 in the city of Alicante. *Scientific Journal of Sport and Performance*, *5*(1), 82-97. https://doi.org/10.55860/EJKX6529

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Submitted for publication May 19, 2025.
Accepted for publication July 07, 2025.
Published October 02, 2025.
Scientific Journal of Sport and Performance. ISSN 2794-0586.

doi: https://doi.org/10.55860/EJKX6529

INTRODUCTION

Cardiovascular diseases (CVD) are the leading cause of morbidity and mortality globally, causing significant social and healthcare costs and having a significant impact on the quality of life of those who suffer from them (Ferreira-González, 2014; Townsend et al., 2022). These include diseases of the heart and blood vessels, with high blood pressure (HBP) being the main risk factor. According to the American Heart Association (AHA), hypertension occurs when the force of blood flowing through the blood vessels is constantly elevated (American Heart Association [AHA], 2023). This serious disorder increases the risk of heart disease, encephalopathy, kidney disease, and other diseases, and is the most important modifiable risk factor for all-cause morbidity and mortality worldwide (Oparil et al., 2018). There are several risk factors for HBP, including genetics. Some studies estimate its association with hypertension at 35%-50% (Kupper et al., 2005; Hottenga et al., 2006; Oparil et al., 2018). Other risk factors include age (Osorio-Bedoya & Amariles, 2018), dietary sodium (Whelton et al., 2012; O'Donnell et al., 2015), overweight and obesity (Channanath et al., 2015; Rachmi et al., 2017; Zhao et al., 2022; Fan & Zhang, 2023), and physical inactivity (Carnethon et al., 2010; Chase et al., 2009; Forman et al., 2009). In fact, it has been observed that Physical Activity (PA) in general, and Physical Exercise (PE) in particular, improve the prevalence and control of this pathology (Lavie et al., 2019; Franklin et al., 2020; Dibben et al., 2023). Therefore, subjects lifestyle is a key factor in its control and influence (Valenzuela et al., 2021).

On the other hand, body composition is a widely used measurement tool for population health. It has been linked to numerous cardiovascular diseases, diabetes, cancer, and osteoporosis, among others (Kuriyan, 2018). Certain classification methods, such as those disseminated by the World Health Organization (WHO), relate an individual's weight and height (kg/m²) to determine their Body Mass Index (BMI). Thus, a BMI equal to or greater than 25 kg/m² would indicate overweight, and 30 kg/m² would indicate obesity (World Health Organization [WHO], 2024). Another widely used measurement due to its ease of application and low cost is the Waist-Hip Ratio (WHR). This is defined as a specific anthropometric measure to stipulate abdominal fat levels, obtained by dividing the waist and hip ratio in centimetres (Suárez González et al., 2013; Hernández Rodríguez et al., 2018). Some authors defined cut-off points based on the risk of disease, establishing a WHR > 1 in men and 0.85 in women (Pischon et al., 2008). These measures have been related to the appearance of hypertension in numerous studies (Chobanian et al., 2003; Welborn et al., 2003; Lemos & Gallagher, 2017; Zhao et al., 2020).

In recent decades, studies on Resistance Training (RT) for Blood Pressure (BP) control have increased, with various positive effects observed across the different methodologies and strategies applied (Cornelissen & Smart, 2013a). In this regard, guidelines on RT recommendations for subjects with hypertension have been established (Pescatello et al., 2019). These guidelines recommend performing Aerobic Exercise (AE) or strength training 2–3 times per week at a moderate/vigorous intensity. Regarding AE, its use has been recommended in both hypertensive and normotensive populations (Whelton et al., 2002; Dimeo et al., 2012; Pagonas et al., 2014; Pescatello et al., 2015; Perrier-Melo et al., 2020). On the other hand, dynamic strength training has also shown hypotensive effects on blood pressure, carried out at different training intensities, as shown in the meta-analysis by MacDonald et al. (2016). In fact, this study observed that this type of training is comparable or superior to the benefits achieved by AE. Regarding isometric strength training, which involves a contraction against a load that cannot be overcome or with a null and/or minimal change in the length of the muscle group (Carlson et al., 2014), studies have been carried out primarily through training with handgrip training and isometric lower body training (Kelley & Kelley, 2010). It has been corroborated by a multitude of studies for its effectiveness in reducing BP, both in young and older people without hypertension (Ray & Carrasco, 2000; McGowan et al., 2007; Millar et al., 2007) and in people with hypertension, including those receiving drug treatment (McGowan et al., 2007; Millar et al., 2007; Millar et al., 2013; Badrov et al., 2013). This method has been implemented clinically, more specifically in primary care (Palmeira et al., 2021). Finally, Concurrent Training (CT), defined as the combined practice of AE and strength in the same session or in separate sessions, has also been studied, being a recent and effective alternative in the treatment of hypertension (Corso et al., 2016). Some authors conclude that this training produces important effects not only on hypertension, but also on cardiorespiratory fitness, muscular fitness, and blood lipid profile in hypertensive older adults (Sardeli et al., 2021). Furthermore, this combination of strength and endurance can lead, according to studies, to greater adherence to resistance training compared to other training methodologies (Ruangthai & Phoemsapthawee, 2019). In any case, although there is no defined strategy regarding the volume and intensity of specific and interindividual training for subjects with hypertension, some recent studies maintain that greater intensity of the training, the more beneficial the effect produced on Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) (Eicher et al., 2010; Boutcher & Boutcher, 2017).

The objective of this study was to analyse and compare the effects of concurrent training and handgrip isometric training on blood pressure in overweight subjects diagnosed with hypertension, in order to determine which strategy is more effective for disease control.

MATERIALS AND METHODS

Participants

The study included 30 subjects diagnosed with hypertension. The sample characteristics were as follows (mean ± standard deviation): age, 60.06 ± 5.22 years; height, 1.72 ± 0.06 m; body weight, 81.16 ± 9.66 kg; body mass index (BMI), 27.58 ± 1.64 kg/m². According to WHO criteria (Bull et al., 2020), participants were classified as sedentary. SBP and DBP were categorized according to the AHA guidelines (Whelton et al., 2018; Muntner et al., 2018): level 2 hypertension (15 participants), level 1 hypertension (13 participants), and high hypertension (2 participants). Participants should not have undergone surgery in the last 12 months or suffered a musculoskeletal injury in the 6 months prior to the study. Participants were also required to be on antihypertensive therapy for hypertension. Subjects had to complete at least 12 months of the same drug for inclusion in the study. Furthermore, their BMI had to be between 25 kg/m² and 30 kg/m² according to WHO criteria (WHO, 2024), and their WHR had to be between 0.90 and 1.05. Finally, the experimental procedures were approved in accordance with the Helsinki Declaration (World Medical Association, 2013) and the Ethics Committee of the Vice-Rectorate for Research at the University of Alicante.

Procedure

The study was conducted in Alicante between 2020 and 2023. The intervention took place at Ganasalud therapeutic exercise centres under controlled indoor environmental conditions. Each group participated in the intervention for 8 weeks. Several visits were made to the centres beforehand. Participants completed a screening visit, where a comprehensive evaluation was conducted to determine their eligibility for the study. Written consent for participation was also obtained. The information collected had to meet the inclusion criteria. The study then continued with visit "*0*", where the research approach was established, anthropometric variables were assessed, the intervention material was tested, the Handgrip Training (HT) group underwent a maximum voluntary contraction test, and participants were familiarized with the method, time, and location of pre and post exercise BP measurements. Finally, subjects completed 16 treatment sessions, with each group (CT and HT) undergoing their specific training. The Control Group (CG) only took their medication for 8 weeks.

Participants in the CT group completed their intervention at Ganasalud therapeutic exercise centres, under the supervision of professionals certified in physical activity and sports sciences. The sessions were conducted under controlled environmental conditions, with a temperature of 20–25°C and a relative humidity of 60–70%. Therefore, the practice of PE was not hindered by any other subject or element unrelated to the present study. During the 16 training visits, workouts were distributed between odd and even-numbered visits. The CT group sessions were structured into alternating blocks of strength and cardiovascular work. On strength training days, participants performed three blocks of five multi-joint exercises (e.g., squat, deadlift, flat bench press), at an intensity of 40–80% of 1RM. Each block was separated by 5 minutes of cardiovascular exercise at a moderate/vigorous intensity (60–80% VO_{2max}). In addition, during visits 6 and 12, a shorter rest period was provided after each of the strength exercises that would be performed in subsequent sessions. During odd-numbered visits, subjects performed three 6-minute blocks of cardiovascular exercise separated by two 6-minute blocks of multi-joint strength exercises. Furthermore, during sessions 5, 9, and 13, one of the cardiovascular blocks included high-intensity bouts above 80% of maximum heart rate reserve. BP was recorded before and after training.

Regarding the HT group, subjects led a sedentary lifestyle. They performed a protocol using a handgrip dynamometer under controlled environmental conditions (indoors), with the same temperature and relative humidity as the CT group. This type of protocol is a manual, rapid, and inexpensive method for measuring an individual's muscle strength and has been used in numerous studies as an effective therapy for high BP (Ji et al., 2018; Almeida et al., 2021; Palmeira et al., 2021). During the 16 visits, the subjects performed a protocol of 4 x 2 minutes at 30% of their maximum voluntary contraction with one minute of rest between sets (Stiller-Moldovan et al., 2012; Badrov et al., 2013). BP was recorded pr- and post protocol (McGowan et al., 2007; Farah et al., 2017). Measurements were taken twice weekly.

Regarding the CG, BP measurements were taken twice weekly during the 8-week intervention, at the same time and with two readings (Gorostidi et al., 2018) separated by 10 minutes. The measurements were taken in their own homes.

Outcome measures

Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP)

Elevated BP occurs when SBP values exceed 130/140 mmHg and DBP values exceed 80/90 mmHg, according to the various guidelines consulted (Williams et al., 2018; Muntner et al., 2018). BP measurements followed the AHA criteria mentioned above. Blood pressure monitors (OMROM m2 basic, Shanghai, China) were used, precalibrated and each participant was identified by an identification number. The formula for calculating mean BP [(SBP-DBP/3) + DBP] taken from Acoltzin-Vidal et al. (2010) was used.

Handgrip (Handgrip dynamometer)

Grip strength is a measurement that has been used for the prevention and diagnosis of a multitude of diseases and pathologies, including hypertension (Lima-Junior et al., 2019; Kunutsor et al., 2021; Tarantino et al., 2021; Benton et al., 2022; Pucci et al., 2022). Electronic handgrip dynamometers (CAMRY EH101, Zhongshan Camry Electronic Co. Ltd., China) were used in this study.

Body composition testing (BMI and WHR)

BMI is the value obtained by dividing weight by height in meters squared (kg/m²). According to the inclusion criteria, subjects had to be between 25 and 30 kg/m² (WHO, 2024). The WHR is an anthropometric measurement derived from dividing the hips by the waist in centimetres (Hernández Rodríguez et al., 2018). The coefficient used in this article for the WHR is ±1.

Age
In older adults, high BP disproportionately affects the rest of the population and, therefore, becomes a major established risk factor for cardiovascular diseases (Osorio-Bedoya & Amariles, 2018; Shukuri et al., 2019).

Statistical analysis
SPSS 25.0 software (SPSS Inc., Chicago, IL, USA) was used for data processing. The Shapiro-Wilk test was used to test for normality due to the characteristics of the sample. Paired Student t-tests were also used to determine the degree of difference between means, and robust ANOVA using Brown-Forsythe tests was used, developing a Tukey post hoc comparison to determine the most significant differences between the different groups. Finally, to provide consistency and validity to the data, the effect size was calculated based on Cohen's (1988) criteria. The significance level was set at $p < .05$.

RESULTS

Effect of physical exercise on blood pressure
Data on changes in SBP and DBP after the intervention are described below (see Table 1). In the groups that completed a training program, there were significant differences between pre and post intervention SBP, and the effect size, following Cohen's (1988) criterion, was medium-high ($p < .05$; $d_{ec} = 0.62$; $d_{ht} = 1.00$). However, there were no significant differences in DBP. Furthermore, when examining the acute effect of the sessions (see Figure 1), all the strategies applied reduced BP. On average, the CT group had greater benefits on BP than the HT and CG groups. SBP was able to reduce by -8.25 mmHg after the end of the sessions in the CT group, while in the HT group, there was an average reduction of -3.93 mmHg. Regarding DBP, no significant differences were observed ($p > .05$).

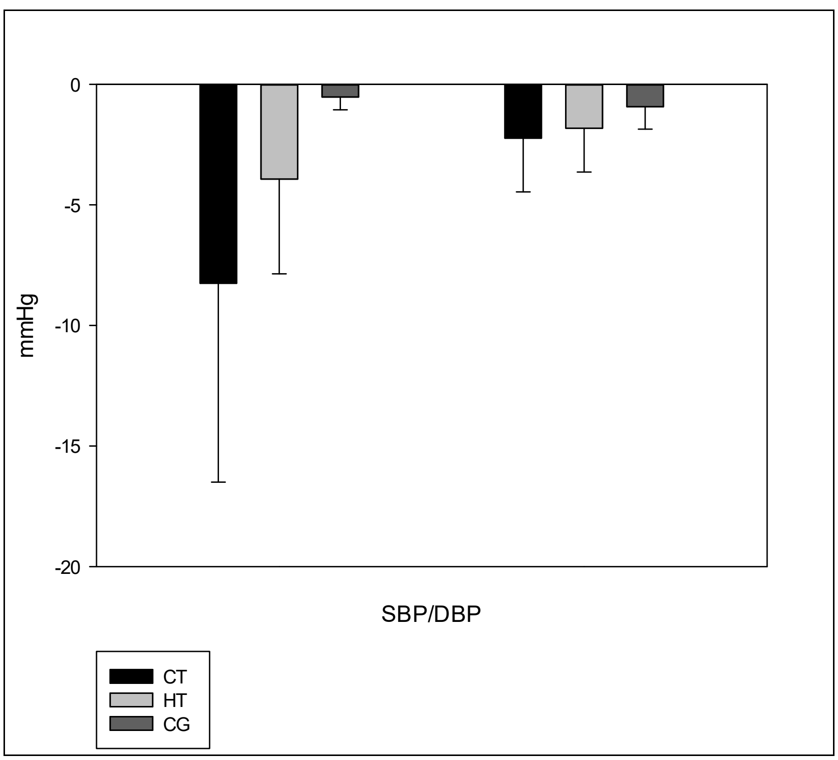

Figure 1. Changes in BP across all sessions.

Table 1. BP behaviour after the intervention and across sessions.

Group (SBP)	Baseline ± SD (mmHg)	Post ± SD (mmHg)	*p*-value	d
CT	145.6 ± 18.2	134.4 ± 13.1	.022	0.62
HT	142.1 ± 9.2	136.6 ± 6.2	.019	1.00
CG	141.4 ± 7.9	139.9 ± 8.3	.137	0.14
Group (DBP)	**Pre ± DS**	**Post ± DS**	***p*-value**	**d**
CT	83.4 ± 9.7	78.5 ± 4.7	.072	0.19
HT	86.2 ± 4.1	81.9 ± 2.8	.093	0.07
CG	85.1 ± 3.8	84.3 ± 4.4	.171	0.11

Note. SD: standard deviation; Significance level: (p < .05) paired Student's t test; d: effect size (Cohen, 1988).

Comparison between groups

Below is the comparison between groups regarding the difference between the start and end of the intervention (see Table 2). Significant differences were observed between groups in both SBP and DBP (*p* < .05). Post hoc (Tukey) analysis revealed significant differences in SBP across all groups, while in DBP only the differences were observed between the CT and CG groups and the HT and CG groups, but not between the CT and HT groups.

Table 2. Difference in BP (baseline-final) between groups.

Anova				Between groups (post hoc)		
Between groups		F	Sig.	group	group	Sig.
SBP_start-end	Between groups	39.391	.000	CT	HT	.000
					CG	.000
				HT	CG	.000
DBP_start-end	Between groups	4.293	.010	CT	HT	.221
					CG	.010
				HT	CG	.010

Note. F: Variance between groups; Sig.: Significance (p < .05). Statistics: Robust ANOVA; Post hoc analysis (Tukey).

Relationship between body mass index and waist hip ratio with blood pressure reduction

Next, a division is made between subjects with higher and lower BMI and WHR who do or do not engage in PE. A range is established for subjects with a BMI ≥ 25 and < 27.5 (PE group 1) and subjects with a BMI ≥ 27.5 and < 30 (PE group 2). Likewise, those with a WHR ± 1 are divided into two groups. In addition, the CG is analysed using the same proposed groups (CG1 and CG2). A greater decrease in BP is obtained in those subjects with higher BMI and WHR values. Significant differences are recorded in SBP (*p* < .05) and in those groups that participate in a PE program. There are no significant differences in CG, regardless of BMI and WHR (see Tables 3 and 4).

Table 3. Effect of the intervention on BMI.

Start-end intervention (BMI)						
	SBP_baseline	SBP_post	Sig.	DBP_baseline	DBP_post	Sig.
PE1	142.82 ± 13.4	137.1 ± 10.8	.052	84.97 ± 6.6	84.23 ± 3.8	.124
PE2	144.16 ± 14.1	135.92 ± 13.6	.023	85.42 ± 6.4	83.88 ± 4.2	.095
Start-end intervention (BMI)						
CG1	138.82 ± 7.5	137.92 ± 6.4	.236	84.12 ± 3.6	83.17 ± 4.1	.319
CG2	142.14 ± 8.1	143.10 ± 7.1	.101	84.76 ± 3.9	83.56 ± 3.8	.098

Note. SD: standard deviation; Significance value: (p < .05) paired Student's t test.

Table 4. Effect of the intervention on the ICC.

Start-end intervention (WHR)						
	SBP_baseline	SBP_post	Sig.	DBP_baseline	DBP_post	Sig.
PE1	140.85 ± 11.6	137.45 ± 10.9	.061	84.59 ± 5.9	84.28 ± 6.1	.579
PE2	141.15 ± 12.9	135.94 ± 13.3	.018	85.25 ± 6.3	84.31 ± 4.9	.183
Start-end intervention (WHR)						
CG1	142.83 ± 6.9	141.96 ± 7.2	.342	85.22 ± 3.7	84.94 ± 4.4	.665
CG2	144.1 ± 8.1	142.87 ± 6.6	.188	86.16 ± 3.6	85.08 ± 3.4	.201

Note. SD: standard deviation; Significance value: (p < .05) paired Student's t test.

DISCUSSION

The objective of this study was to analyse and compare the effects of CT and HT training on blood pressure in overweight subjects diagnosed with hypertension. Our study observed greater BP reductions in subjects who completed a PE program compared to the CG. SBP reductions were -11.2 mmHg in the CT group, -5.5 mmHg in the HT group, and only -1.5 mmHg in the CG. In the PE groups, a BP-lowering effect three to five times greater than in the non-PE group was observed. This is the case in the analysed literature, where the effectiveness of PE in subjects with hypertension has been verified (Pescatello et al., 2019; Reia et al., 2020; Saco-Ledo et al., 2020) and the variability in the effects of the intervention. Similar results were observed in the study carried out by Carpes et al. (2022), in which 24 hours after exercise, resistance and strength training reduced BP by 37% and 26% respectively, and HT by 22%. Therefore, PE can have a greater or lesser effect on BP depending on the type of training carried out (Cornelissen & Smart, 2013; Boutcher & Boutcher, 2017; Lopes et al., 2020; Marçal et al., 2021; Zhao et al., 2022).

Our study analysed the effects of PE after 8 weeks of study and the changes induced during the sessions (acute effect). Studies such as that of Alpsoy (2020) observed the effects of PE up to 24 hours after practice, performing PE 2/3 times per week, which is known as post-exercise hypotension. This reduction can reach between -10 and -12 mmHg in different PE interventions such as aerobic, strength, combined, or isometric exercise (Dassanayake et al., 2020). When analysing the effects of PE on BP in subsequent weeks, de Oliveira et al. (2020) in their intervention on CT in hypertensive subjects over 8 weeks, showed a significant reduction in BP. This study looked at changes 72 hours pre and post intervention to determine the effect of PE. Furthermore, the effects of isometric exercise have also been demonstrated in a systematic review carried out by Farah et al. (2017) using handgrip. In this study, the authors observed different changes in BP in a single session and by carrying out this methodology repeatedly over time.

In the present study, the CT for subjects with hypertension showed significant and greater reductions than the other groups. A meta-analysis carried out by Corso et al. (2016), in which they applied this training methodology, showed SBP reduction values of -3 mmHg, being, in hypertensive subjects, greater (5-6 mmHg) than in prehypertensive subjects (3-4 mmHg). These data imply a similarity with what was presented in this work. That happens in another more recent meta-analysis composed of 14 studies. The authors observed the effectiveness of the CT in hypertensive, prehypertensive, and normotensive subjects (De Mello & Ostolin, 2020). However, some authors did not find significant differences in BP reduction when comparing the CT group with groups that performed only aerobic training (Sillanpää et al., 2009; Sousa et al., 2013; Tseng et al., 2013). Regarding the organization of the session, in the CT group, the aerobic component was included between the different strength training blocks. Santiago et al. (2013) organized the primarily aerobic component at the beginning of the session and, subsequently, the strength training, observing reductions in SBP of -7.4 mmHg, -12.14 mmHg and -15.14 mmHg after 30, 45 and 60 minutes post exercise respectively.

Other studies, such as that conducted by Mazzoccante et al. (2016), showed the effects of CT by structuring the sessions in the opposite way. These authors did not observe changes in DBP in any of the groups, but they did observe significant differences in SBP in one of them. The strategy proposed in our research regarding the intensity of the CT is based on the proposal by De Mello & Ostolin (2020), following the American College of Sports Medicine (ACSM) guidelines. The intensity ranges of the aerobic base were between 40-80% of the heart rate reserve and the strength work between 40-80% of a 1 Repetition Maximum (1RM) approximately. For their part, Corso et al. (2016) suggest an intensity close to 55% of VO_{2max}. regarding aerobic training, and a development of dynamic strength at 60% of 1 RM.

Regarding the HT group, significant decreases in hypertension were observed, especially in SBP. In absolute terms, the results obtained show reductions in BP of between 3 and 5 mmHg in SBP and approximately 2 and 3 mmHg in DBP. The application of these training protocols for hypertension has been widely studied in the scientific literature. Due to their ease of application and low cost, they could be a recommended tool for subjects with hypertension. Previous studies have shown that, using an isometric strength protocol using a handheld dynamometer at 30% of the subjects maximum voluntary contraction and distributed over four two-minute sets, decreases in SBP of -4 mmHg and -3 mmHg in DBP are observed (Farah et al., 2017). Other authors applied the same protocol for 10 weeks to hypertensive subjects, carrying out a pre and post exercise control intervention line, recording reductions in SBP of -6 mmHg and -5 mmHg in DBP (Badrov et al., 2013). On the other hand, Stergiou et al. (2019) in subjects with hypertension, and after taking a BP measurement one hour after isometric exercise applying the same protocol, showed reductions in SBP of -11 mmHg and -6 mmHg in DBP. These protocols have even been extended to primary care. Palmeira et al. (2021) carried out, for 12 weeks, an isometric exercise intervention with a handheld dynamometer in 63 hypertensive patients of heterogeneous ages in the public health service. The authors observed a significant reduction in SBP and DBP compared to the CG (-8 mmHg and -4 mmHg, respectively).

When analysing the data from our study, subjects with a BMI ≥ 27.5 kg/m² had a higher baseline BP (SBP: 143.94 mmHg; DBP: 85.62 mmHg) than subjects with a BMI < 27.5 kg/m² (SBP: 140.8 mmHg; DBP: 82.93 mmHg). For decades, some studies have linked being overweight with a higher risk factor for hypertension in all ages and populations (Field et al., 2005; Jackson et al., 2014; Juonala et al., 2015; Wang et al., 2023). According to the WHO (2024) classification, it is estimated that up to 80% of the hypertensive population is overweight or obese (Chobanian et al., 2003), and for every 5% increase in weight, the risk of hypertension increases by 20–30% (Drøyvold et al., 2005; deMarco et al., 2014). Thus, studies in age ranges similar to those of the present study (40–69 years) in almost 9,000 adults confirm that there is a causal relationship between the development of high BP and BMI (Lee et al., 2018). Furthermore, not only BMI is related, but also waist circumference and WHR (Dalton et al., 2003). Chaudhary et al. (2018) showed a stronger positive correlation between waist circumference and WHR than BMI in 175 participants, in relation to high BP. For their part, Zhao et al. (2020), after 6 years in a longitudinal cohort intervention published in the British Journal of Nutrition (BJN), maintain that a high abdominal circumference increases the risk of HTN. Furthermore, larger epidemiological studies such as the one carried out by Jayedi et al. (2018) on more than 2 million participants, affirm that a lower weight is the best tool for primary prevention of hypertension.

When relating the effect of PE on BP and body composition in our research participants, it is observed that subjects with a higher BMI and WHR and who perform PE (PE1 and PE2) obtain greater BP changes than those who do not perform PE (CG1 and CG2). After the development of the intervention, significant differences are shown in the groups with higher BMI and WHR in SBP. Those participants who perform PE with a higher BMI and WHR show a reducing effect twice as greater than those who do not carry out any intervention (22% and 10%). Some authors have observed that the reduction in BP through PE programs is greater in subjects with the highest BP (Battista et al., 2021). This systematic review and meta-analysis shows a greater change in studies of subjects with prehypertension or hypertension than in those without hypertension. This is the case in several studies with obese and overweight subjects, where a greater reduction in BP has been found in participants who perform PE compared to the CG, and in those whose initial BP is higher (Termklinchan et al., 2019; Clark et al., 2020). This effect is observed in studies carried out on a treadmill with post-training measurements (Rajalakshmi et al., 2011) and using high-intensity interval training for 12 weeks (Olea et al., 2017). Despite the lack of literature analysing the relationship between PE, the degree of overweight and BP, a study with 4183 subjects observed that those classified as physically active overweight subjects had a lower risk of developing hypertension compared to other normal weight but physically inactive subjects (Faselis et al., 2012).

There are certain limitations to our study. On the one hand, the different types of training performed were carried out in different groups. This implies that there may be variations in the effects of the intervention due to interindividual and pharmacological differences. On the other hand, no additional post-exercise BP measurements were included. Therefore, the values should only be interpreted within defined time periods after the exercise. Furthermore, diet could not be controlled for among participants in the different groups. This condition, as has been shown, can also influence BP recording and, therefore, lead to discrepancies in the different measurements analysed.

In conclusion, physical exercise can produce hypotensive effects on blood pressure depending on the type of exercise, body composition, and intensity of the sessions. Exercise causes greater changes in SBP with higher BMI and WHR values. Furthermore, it can be established as a control tool in subjects diagnosed with hypertension and receiving medication.

AUTHOR CONTRIBUTIONS

All co-authors have contributed significantly to all sections and approve the final manuscript for publication.

SUPPORTING AGENCIES

No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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