

# Isometric handgrip training does not improve quality of life in hypertensives

## Treinamento isométrico com *handgrip* não melhora qualidade de vida em hipertensos

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**ABSTRACT:** Hypertensive patients have high blood pressure and poor cardiovascular health and it is known that hypertension negatively affects people's health-related quality of life. Meta-analyses have shown that isometric handgrip training (IHT) reduces blood pressure in hypertensives, but the effects of IHT on health-related quality of life is unknown. Therefore, we tested the hypotheses that the IHT improves health-related quality of life in hypertensives. In this randomized controlled trial, 48 hypertensive individuals were randomly assigned to two groups: IHT and control. IHT was completed thrice weekly ( $4 \times 2$  min at 30% of maximal voluntary contraction). Before and after 12 weeks health-related quality of life was assessment through Medical Outcomes Study Questionnaire Short Form 36 (SF36). No significant effect was observed for physical function (IHT:  $85.6 \pm 4.6$  vs.  $81.1 \pm 7.2$ ; Control:  $78.6 \pm 7.7 \pm 4.9$ ), physical problems (IHT:  $71.4 \pm 10.1$  vs.  $83.9 \pm 8.1$ ; Control:  $73.8 \pm 8.2$  vs.  $64.3 \pm 8.0$ ), general health (IHT:  $56.1 \pm 3.7$  vs.  $57.1 \pm 1.9$ ; Control:  $54.3 \pm 1.6$  vs.  $57.6 \pm 2.1$ ), pain (IHT:  $23.6 \pm 4.6$  vs.  $30.7 \pm 5.8$ ; Control:  $32.9 \pm 4.5$  vs.  $31.9 \pm 4.3$ ), social aspects (IHT:  $46.4 \pm 3.6$  vs.  $50.0 \pm 2.3$ ; Control:  $48.8 \pm 2.7$  vs.  $48.8 \pm 1.7$ ), emotional problems (IHT:  $85.7 \pm 8.4$  vs.  $92.9 \pm 5.2$ ; Control:  $79.4 \pm 7.8$  vs.  $71.4 \pm 6.6$ ), mental health (IHT:  $61.7 \pm 2.8$  vs.  $58.0 \pm 2.5$ ; Control:  $54.5 \pm 2.4 \pm 55.6 \pm 1.9$ ), and vitality (IHT:  $60.0 \pm 4.3$  vs.  $58.6 \pm 4.0$ ; Control:  $50.7 \pm 2.9$  vs.  $53.6 \pm 3.0$ ) after 12-weeks of supervised IHT ( $p > 0.05$  for all). In conclusion, 12-weeks of IHT does not improve health-related quality of life in hypertensives. Therefore, in order to improve quality of life, other exercises should be an indicated for hypertensive patients.

**Key Words:** Resistance exercise; Hypertension; Health-related quality of life; Exercise.

**RESUMO:** Pacientes hipertensos têm pressão arterial elevada e saúde cardiovascular prejudicada, e, sabe-se que a hipertensão também afeta negativamente a qualidade de vida relacionada a saúde. Meta-análises têm demonstrado que o treinamento de exercício isométrico com *handgrip* (IHT) reduz pressão arterial, mas os efeitos do IHT na qualidade de vida relacionada a saúde são desconhecidos. Portanto, foi testado a hipótese que o IHT melhora a qualidade de vida relacionada a saúde em hipertensos. Nesse ensaio clínico controlado randomizado, 48 hipertensos foram randomizados em IHT e controle. IHT foi realizado três vezes semanais ( $4 \times 2$  minutos a 30% da contração voluntária máxima). Antes e após 12 semanas, a qualidade de vida relacionada a saúde foi avaliada pelo *Medical Outcomes Study Questionnaire Short Form 36*. Nenhum efeito significativo foi observado para função física (IHT:  $85,6 \pm 4,6$  vs.  $81,1 \pm 7,2$ ; Controle:  $78,6 \pm 7,7 \pm 4,9$ ), problemas físicos (IHT:  $71,4 \pm 10,1$  vs.  $83,9 \pm 8,1$ ; Controle:  $73,8 \pm 8,2$  vs.  $64,3 \pm 8,0$ ), estado geral de saúde (IHT:  $56,1 \pm 3,7$  vs.  $57,1 \pm 1,9$ ; Controle:  $54,3 \pm 1,6$  vs.  $57,6 \pm 2,1$ ), dor (IHT:  $23,6 \pm 4,6$  vs.  $30,7 \pm 5,8$ ; Controle:  $32,9 \pm 4,5$  vs.  $31,9 \pm 4,3$ ), aspectos sociais (IHT:  $46,4 \pm 3,6$  vs.  $50,0 \pm 2,3$ ; Controle:  $48,8 \pm 2,7$  vs.  $48,8 \pm 1,7$ ), problemas emocionais (IHT:  $85,7 \pm 8,4$  vs.  $92,9 \pm 5,2$ ; Controle:  $79,4 \pm 7,8$  vs.  $71,4 \pm 6,6$ ), saúde mental (IHT:  $61,7 \pm 2,8$  vs.  $58,0 \pm 2,5$ ; Controle:  $54,5 \pm 2,4 \pm 55,6 \pm 1,9$ ), e vitalidade (IHT:  $60,0 \pm 4,3$  vs.  $58,6 \pm 4,0$ ; Controle:  $50,7 \pm 2,9$  vs.  $53,6 \pm 3,0$ ) após 12 semanas de IHT ( $p > 0.05$  para todos). Em conclusão, 12 semanas de IHT não melhora a qualidade de vida relacionada a saúde em hipertensos. Portanto, para melhorar a qualidade de vida, outras modalidades de exercício deveriam ser indicadas para pacientes hipertensos.

**Palavras-chave:** Treinamento de resistência; Hipertensão; Qualidade de vida; Exercício.

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## Introduction

Hypertension is characterized by sustained elevations in resting blood pressure and affects more than 1 billion people worldwide<sup>1</sup>. In addition, hypertension is the main risk factor for renal, cardiac and cerebrovascular diseases, such as kidney failure, heart failure, myocardial infarction and stroke<sup>2</sup>, accounting for 13% of global deaths<sup>3</sup>.

In addition to the impaired cardiovascular health, hypertensive patients have a poorer health-related quality of life compared than normotensive subjects<sup>4,5</sup>. Interestingly, health-related quality of life has been associated with better cardiovascular prognosis<sup>6-9</sup>. For example, large population-based cohort study<sup>7</sup> shown highest quality of life was inversely associated with long-term mortality, vascular and non-vascular, independently of baseline primary vascular risk factors. Therefore, interventions to improve both cardiovascular function and health related-quality of life should be considered when defining the therapy of hypertensive patients<sup>2</sup>.

The current therapeutic approach of hypertensive patients includes aerobic exercises complemented by resistance exercises, due to improvement in the cardiovascular system (e.g. decreases blood pressure and improvement of endothelial function), as well as in other health indicators such as body composition and muscle function.

However, recently, emerging data have supporting the potential of isometric handgrip training (IHT) in reduce systolic and diastolic blood pressure in hypertensive patients in 7 and 5 mmHg, respectively<sup>10-15</sup>. Interestingly, these decreases seem to be greater than those observed after aerobic and resistance training<sup>12</sup>. However, to date, no studies have investigated the effects of IHT on health-related quality of life. Therefore, we tested the hypotheses that the IHT improves health-related quality of life in hypertensives.

## Methods

### *Trial design*

This randomized controlled trial was registered with the [www.clinicaltrials.gov](http://www.clinicaltrials.gov) database under the registration number NCT02348138 and is part of the ISOPRESS network<sup>16</sup>. We have previously published the result of the effect of IHT on cardiovascular risk in hypertensives<sup>17</sup>. The study procedures were approved by the Institutional Review Board in compliance with the Brazilian National Research Ethics System Guidelines (CAAE: 30806014.0.0000.5207). Written informed consent was obtained from each patient before participation.

### *Participants*

Medicated hypertensive patients were recruited through local media advertising and through flyers distributed in hospitals in the surrounding area of the University of Pernambuco, Brazil. Patients were included if they met the following criteria: a) use of anti-hypertensive medications b) > 18 years old, c) no diabetes, d) no cardiovascular disease (other than hypertension), e) did not present limitations to performance of isometric handgrip training, f) were not involved in regular physical activity programs. Patients were excluded from the study if they joined an additional physical exercise program or attended fewer than 80% of sessions in the IHT group.

### *Randomization and allocation*

The participants were block randomized using a random number table, stratified for sex and baseline brachial systolic blood pressure (by a researcher not involved directly in the recruitment and data collection), into two groups: isometric handgrip training and control group. Allocation was concealed to the researchers conducting measurements.

### *Interventions*

Patients assigned to IHT group trained three times per week, for a total of 12 weeks. Each session consisted of four sets of 2-min isometric contractions (alternating the hands) performed using a handgrip dynamometer using (Zhongshan Camry Electronic Co. Ltd. Zhongshan Guangdong, China) at 30% of maximal voluntary contraction (MVC) and 1-min rest interval, load adjustments were performed in the 6<sup>th</sup> week<sup>18</sup>.

The MVC was evaluated for both arms prior to the start of the study in all patients. The MVC test was conducted by requesting participants to undertake three measurements on each arm, with an interval of one minute between each maximal effort. The result was the highest value of the three measurements. The intraclass correlation coefficient for the MVC test was 0.986 for the non-dominant arm and 0.989 for the dominant arm<sup>18</sup>.

Patients assigned to the control group were advised to maintain dietary habits and physical activity levels. The isometric exercise program was offered to the control group after completion of the study for ethical reasons.

### *Health-related quality of life*

Health-related quality of life was assessed with the Medical Outcomes Study 36-Item Short Form Health Survey<sup>19</sup>, instrument that includes multi-item questions assessing eight health subscales. Four of the subscales are related to physical aspects, which includes physical function, physical problems, general health, and pain. The remaining four subscales are related to emotional aspects, which includes social aspects, emotional problems, mental health, and vitality. For each subscale, multiple item scores are standardized into a scale of 0 to 100, with higher scores reflecting better health states.

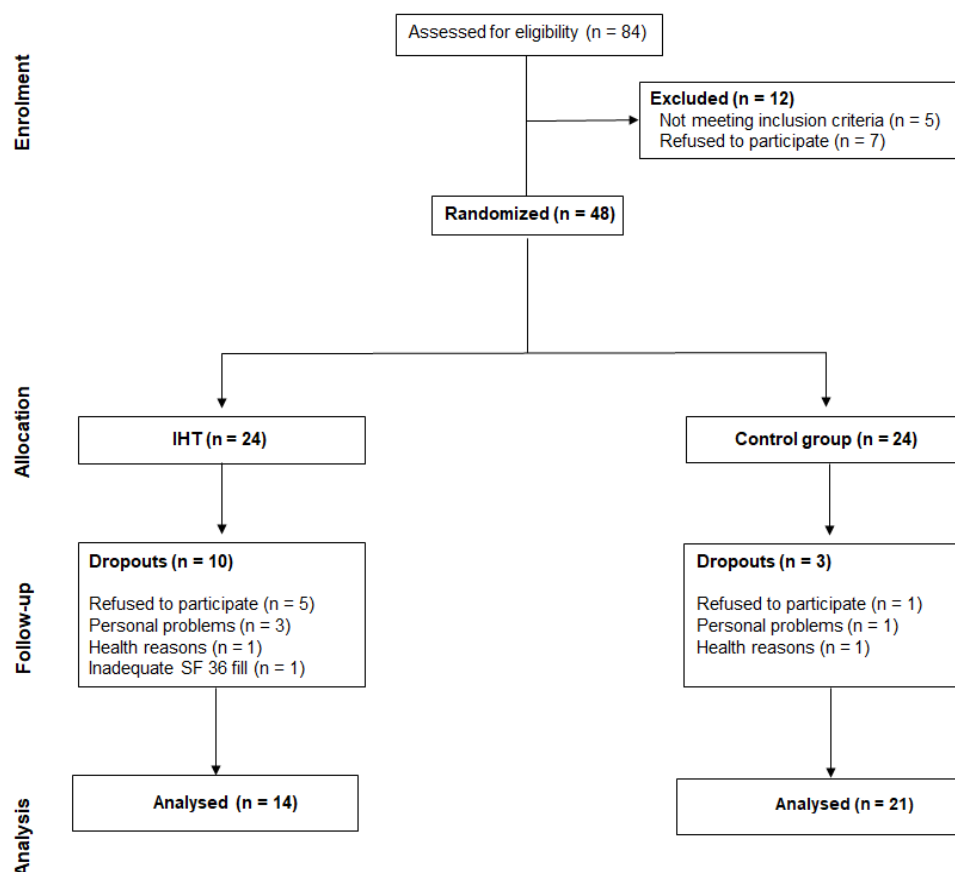
### *Statistical analysis*

The data were stored and analyzed using the Statistical Package for the Social Sciences (SPSS Version 17.0 for Windows). Normality was checked using the Shapiro-Wilk test and the Levene test was used to analyze the homogeneity of variances. Continuous variables were summarized as mean and standard deviation, whereas categorical variables were summarized as frequencies. The clinical characteristics among groups compared using one-way analysis of variance or Kruskal-Wallis test for continuous variables and chi-square test for categorical variables.

To compare the effects of interventions on health-related quality of life, Generalized Estimating Equations was used. The Spearman rank correlation coefficient was used to analyze the relationships between blood pressure change and health-related quality of life change. The significance level was set at  $P < 0.05$  for all analyses.

## **Results**

Recruitment and intervention periods occurred between July 2015 and August 2016. The study flowchart is shown in Figure 1. General characteristics are presented in the table 1. Groups were similar at baseline in clinical variables and health-related quality of life indicators (physical function, physical problems, general health, pain, social aspects, emotional problems, mental health, and vitality).



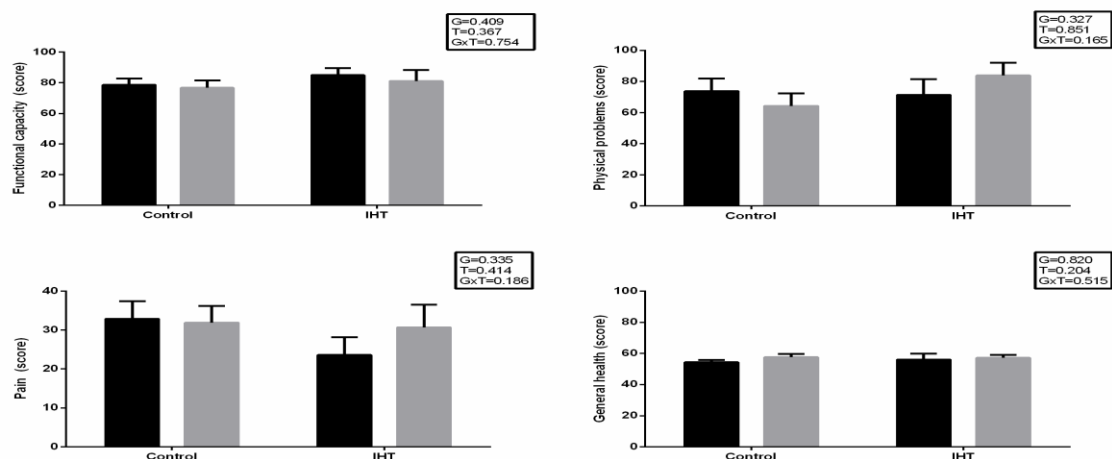
**Figure 1.** Flowchart of study.

**Table 1.** General characteristics of experimental groups at baseline.

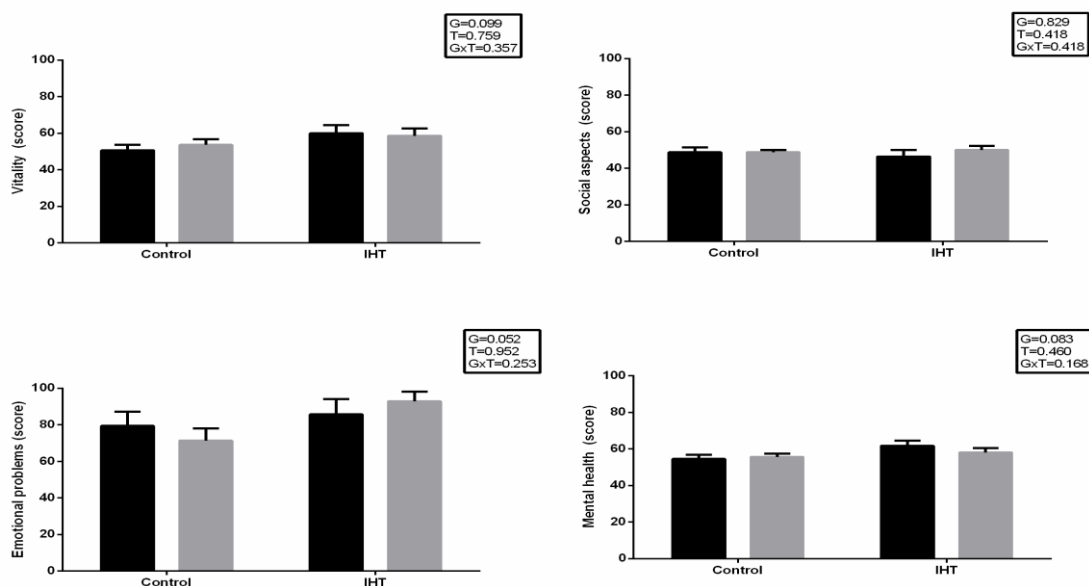
Variables	Control n = 21	IHT n = 14	p
Sex (% women)	71.4	71.4	1.000
Age (years)	58 ± 10	57 ± 8	0.660
Body mass index (kg/m <sup>2</sup> )	30.1 ± 6.2	31.3 ± 4.8	0.526
Brachial systolic BP (mmHg)	130 ± 18	133 ± 15	0.578
Brachial diastolic BP (mmHg)	74 ± 9	73 ± 7	0.454
Handgrip strength (kgf)	30.2 ± 9.2	30.0 ± 12.3	0.953
Physical function (score)	78.6 ± 18.9	85.0 ± 17.1	0.249
Physical problems (score)	73.8 ± 37.5	71.4 ± 37.8	0.803
General health (score)	32.9 ± 20.5	23.6 ± 17.4	0.855
Pain (score)	54.3 ± 7.3	56.1 ± 13.9	0.164
Vitality (score)	50.7 ± 13.3	60.0 ± 15.4	0.082
Social aspects (score)	48.8 ± 12.4	46.4 ± 13.4	0.495
Emotional problems (score)	79.4 ± 35.7	85.7 ± 31.3	0.702
Mental health (score)	54.5 ± 11.0	61.7 ± 10.4	0.089

Values are presented as mean ± standard deviation or frequency. IHT – isometric handgrip training. BP – blood pressure. p – significance level.

The effects of intervention in quality of life are presented in figures 2 and 3. No significant effect was observed for physical function (IHT:  $85.6 \pm 4.6$  vs.  $81.1 \pm 7.2$ ; Control:  $78.6 \pm 76.7 \pm 4.9$ ), physical problems (IHT:  $71.4 \pm 10.1$  vs.  $83.9 \pm 8.1$ ; Control:  $73.8 \pm 8.2$  vs.  $64.3 \pm 8.0$ ), general health (IHT:  $56.1 \pm 3.7$  vs.  $57.1 \pm 1.9$ ; Control:  $54.3 \pm 1.6$  vs.  $57.6 \pm 2.1$ ), pain (IHT:  $23.6 \pm 4.6$  vs.  $30.7 \pm 5.8$ ; Control:  $32.9 \pm 4.5$  vs.  $31.9 \pm 4.3$ ), social aspects (IHT:  $46.4 \pm 3.6$  vs.  $50.0 \pm 2.3$ ; Control:  $48.8 \pm 2.7$  vs.  $48.8 \pm 1.7$ ), emotional problems (IHT:  $85.7 \pm 8.4$  vs.  $92.9 \pm 5.2$ ; Control:  $79.4 \pm 7.8$  vs.  $71.4 \pm 6.6$ ), mental health (IHT:  $61.7 \pm 2.8$  vs.  $58.0 \pm 2.5$ ; Control:  $54.5 \pm 2.4$  vs.  $55.6 \pm 1.9$ ), and vitality (IHT:  $60.0 \pm 4.3$  vs.  $58.6 \pm 4.0$ ; Control:  $50.7 \pm 2.9$  vs.  $53.6 \pm 3.0$ ) after 12-weeks of supervised IHT ( $p > 0.05$  for all).



**Figure 2.** The effects of isometric handgrip training on health-related quality of life (physical aspects) in hypertensives. G – group effect. T – time effect. GxT – Interaction group x time.



**Figure 3 -** The effects of isometric handgrip training on health-related quality of life (emotional aspects) in hypertensives. G – group effect. T – time effect. GxT – Interaction group x time.

The relationship between changes in blood pressure and changes in quality of life are presented in table 2. No significant relationship was observed between blood pressure changes and changes in health-related quality of life (table 2).

**Table 2.** The relationship between changes in blood pressure and changes in quality of life in hypertensive of isometric handgrip training group.

Health-related quality of life indicators	$\Delta$ SBP	
	<i>rho</i>	p
$\Delta$ Physical function (score)	0.021	0.946
$\Delta$ Physical problems (score)	0.355	0.233
$\Delta$ General health (score)	0.077	0.802
$\Delta$ Pain (score)	-0.228	0.453
$\Delta$ Vitality (score)	0.457	0.117
$\Delta$ Social aspects (score)	-0.167	0.585
$\Delta$ Emotional problems (score)	0.367	0.218
$\Delta$ Mental health (score)	-0.020	0.949

$\Delta$  - Change (post-pre); SBP - systolic blood pressure. *rho* - spearman's correlation coefficient. p - significance level.

## Discussion

The main results of the present study were: a) 12 weeks of supervised IHT did not improve health-related quality of life in hypertensives, and b) changes in blood pressure were not related to changes in health-related quality of life indicators.

The effects of IHT on blood pressure in hypertensive patients have been well described in the literature<sup>10-14</sup>. However, this is the first study to analyze the effects of IHT on health-related quality of life in hypertensive patients. The results demonstrated that IHT did not improve health-related quality of life in hypertensives. It is possible to speculate that because the IHT involves only the contraction of the forearm, which is related to very specific activities (manual grip), and with a muscle mass involved is very small, not influencing the quality of life of hypertensive individuals, especially in the physical aspects. In fact, studies have shown that lower limbs muscle strength is a better predictor of quality of life than upper limbs muscle strength, due to better association with functional capacity<sup>20,21</sup>. In addition, the short session time (around 11 minutes) may also have influenced, particularly in the emotional aspects, given the difficulty formalizing links with professionals and other patients.

The changes in blood pressure was not related to changes in health-related quality of life. Therefore, it is possible to speculate that other health indicators are stronger predictors of health-related quality of life than the blood pressure level in hypertensives. For example, body composition, strength function and cardiorespiratory fitness<sup>22,23</sup>. Therefore, given that the IHT does not alter body composition, muscle function or cardiorespiratory fitness would not have repercussions on the health-related quality of life, especially physical aspects.

In this sense, Kekäläinen *et al.*<sup>24</sup> demonstrated that a 9-month resistance training intervention improved the quality of life in older adults and observed that the increase in strength was directly associated with an improvement in functional capacity. Similarly, Gui study<sup>25</sup> shown that 16-weeks both high-intensity intermittent and moderate-intensity continuous aerobic training improved physical function, physical role, general health condition, vitality, emotional role and mental health in hypertensive patients. Meta-analysis study shown that the aerobic with resistance training improved the quality of life in patients with chronic heart failure<sup>26</sup>.

The IHT has emerged as a potential new tool to treatment in the hypertensive population. However, the results of this study did not support the use of IHT to improve health-related quality of life in this group. Therefore, from a clinical point of view, in order to improve quality of life, other exercise modalities aerobic and resistance exercises should be prescribed<sup>24,25</sup>.

This study has some limitations that should be considered. The sample of the study was composed of

medicated hypertensives, thus not making it possible to generalize the results to other populations (advanced hypertension or clinical other populations). Also, the sample size did not allow a stratified analysis by class of medication.

In conclusion, 12-weeks of supervised IHT do not improve health-related quality of life in hypertensives and changes in blood pressure after IHT were not related to changes in health-related quality of life indicators. This raises the need for new studies that seek to evaluate the effects of isometric exercise alongside other modalities of training, such as aerobic or resistance exercise in the health-related quality of life of these subjects, to clarify whether the effects of isometric exercise in this population can go beyond cardiovascular aspects.

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