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Effect of a pompage protocol on hemodynamic behavior during and on isometric exercise recovery in elderly: randomized and controlled study

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ABSTRACT

Background: The aging process is associated with changes in hemodynamic control, such as reduced sensitivity of baroreceptors. Advanced evidence that some manual therapies, expanded physiotherapy specialty in the treatment of basic musculoskeletal disorders, be complementary to physical exercises performed in cardiovascular rehabilitation, studies that are very scarce in this area in Brazil. **Objective:** to evaluate the effect of a pomping protocol on hemodynamic behavior during isometric exercise in the elderly. **Methods:** A prospective randomized controlled interventional study was carried out. 503 elderly people were initially screened, of which 70 elderly were selected to participate in two randomized sessions held on different days: one with a pomping protocol based on Bienfait (1999) and another with a placebo protocol, totaling 140 transactions. **Results:** The elderly had a mean age of 69 ± 1.0 years. Regarding BP values (SBP,131±1.4 mmHg; DBP=83±1.6 mmHg), it is possible to observe that most of the elderly were classified as pre-hypertensive, according to the Brazilian Guidelines on Arterial Hypertension. (2020). We emphasize that there was a reduction in SBP only in the pompage group ($p < 0.001$), a reduction in DBP only in the pompage group in the first minute ($p=0.03$) and in the third minute ($p=0.04$) and a reduction in HR in both groups ($p < 0.001$ and $p = 0.02$). **Conclusion:** The pompagens protocol reduced the SBP of the elderly during isometric exercise with the handgrip and the DBP in the recovery from isometric exercise, while there was no change in SBP in the placebo group during isometrics and no change in DBP in the placebo group during recovery from isometric exercise.

Keywords: Aging; Musculoskeletal manipulations; Arterial pressure; Heart rate.

BACKGROUND

The increase in the life expectancy of the world population and the decrease in fertility rates contribute to global aging[1]. Brazil follows the world trend, and the elderly population is the fastest-growing population segment, where 14.6% of the population is elderly, representing 30.3 million inhabitants[2]. Thus, the age pyramid in Brazil is in transition with the increase in the number of elderly people, consequently generating prominence for the incidence of non-communicable chronic diseases that are directly associated with aging[3]. These include cardiovascular diseases, which are the first cause of death in this population[4].

Aging is associated with changes in cardiovascular autonomic control, with a decrease in vagal tone, an increase in sympathetic tone, and attenuation of autonomic regulatory mechanisms, such as baroreceptors[5,6], corroborating for greater blood pressure variation with postural changes[7]. These factors, in addition to the lower availability of nitric oxide due to endothelial dysfunction and reduced arterial compliance, result in increased peripheral vascular resistance and, consequently, increased blood pressure (BP)[8,9].

The ergoreflex, which comprises the mechanoreceptors and mainly the metaboreceptors, located in the peripheral muscles, and participate in the cardiovascular and blood pressure autonomic control during exercise, are also altered in aging[10,11].

One of the most used non-pharmacological tools to improve these cardiovascular disorders is physical exercise [12,13]. The availability of new techniques to prevent, delay or alleviate cardiovascular dysfunctions is essential for a better complement of cardiovascular therapy in this population. The pompage or pomping, manual therapy that consists of a fascial mobilization maneuver promoting the improvement of local circulation and tissue nutrition, reducing pain[14] is widely used to treat musculoskeletal disorders in the elderly, together with therapeutic exercises, offering strength gain and better balance in elderly patients[15].

Some manual therapies have been studied promoting an increase in parasympathetic activity, a reduction in cardiac sympathetic activity, and an improvement in the pressure control of patients, as observed by our research group in a recent systematic review[16], but there are still no studies in the literature of this type with the use of pompage. Any intervention aimed at fascia is also an intervention that influences the autonomic system and vice-versa, thus interfering with blood flow[17]. For this reason, this study was developed to analyze and propose a pomp protocol on hemodynamic behavior during and in the recovery of isometric exercise in the elderly.

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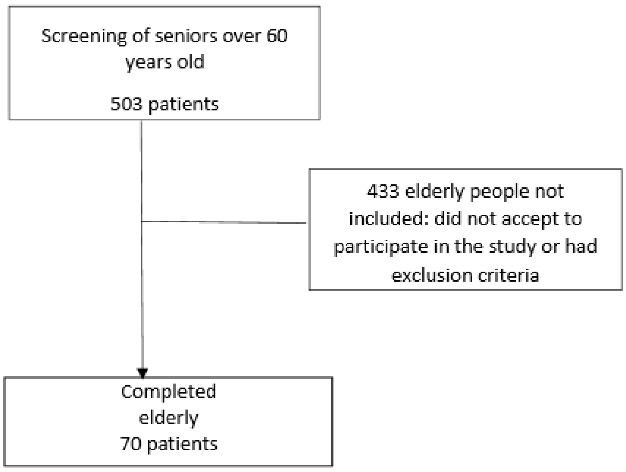
METHODS

A prospective, single-blind, randomized controlled trial was performed. Initially, 503 elderly were screened and, after applying the inclusion and exclusion criteria, 70 elderly people were selected who participated in the pompage and placebo sessions, totaling 140 sessions. The beginning of the study protocol was conditioned after the Ethics in Research on Human Beings Committee, carefully obeying CNS resolution 196/96, opinion number: 4.710.183 and CAAE: 46292321.4.0000.5492 (ANNEX A).

Elderly people aged 60 years or older, of both sexes, members of the Integrated Health Center (CIS) of Universidade Anhembi Morumbi and who agreed to sign the free and informed consent form were included in the research. Elderly people who used beta-blockers, had diagnosed arrhythmia, did not agree to participate in the study, or who did not sign the informed consent form were excluded from the study. All subjects were informed of the nature of the study and, after reading and agreeing to carry it out, they signed the consent form free and informed consent. Figure 1 shows the screening of patients

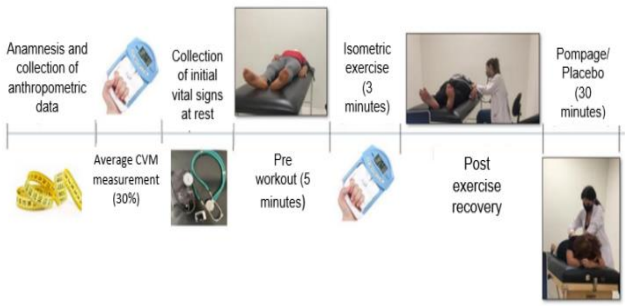
Figure 1. Flowchart of screened patients



Heart rate was assessed using a BIC oximeter and blood pressure using a RAPPAPORT sphygmomanometer, both assessed in the non-dominant arm and the supine position. The poms applied were: global, occipital, global fascia, upper trapezius, trunk, lumbar, psoas, quadriceps, and tibiotarsal. (5 repetitions with 15 seconds of tension maintenance and 10-second intervals[18] totaling 30 minutes per session, all applied with the patient in dorsal and ventral decubitus. In the placebo session, the elderly were positioned in the same way in decubitus dorsal and kept in this position for the same time, but instead of the pompage being performed, the therapist's hands were just positioned in the region where the pompage would be performed, without any movement.

The elderly arrived at the laboratory 10 minutes before the start of the experimental procedure. Initially, they underwent an anamnesis, where the inclusion and exclusion criteria mentioned above were used and the maximum voluntary contraction (MVC) of the elderly was evaluated to calculate the 30% of it and use it during isometric exercise with a handgrip (EH101, Camry). The MVC was evaluated with the elderly in the supine position, it was calculated by the average of three MVC attempts performed on the dominant limb. After entering the collection room, they lay on the stretcher in dorsal decubitus, and initial BP, HR, and oxygen saturation (SAT) assessments were performed at rest for 5 minutes and then during isometric exercise at 30% of MVC for 3 minutes. Subsequently, the pompage or placebo protocol was applied for 30 minutes, randomized for that specific session. Immediately after the intervention/placebo, the same assessments performed initially were repeated. Figure 2 represents the experimental protocol of the study

Figure 2. Implementation of the pompage protocol.



Data were presented as mean ± standard error. To assess differences between the proportions of categorical variables between the groups, the Chi-square test was applied. The response of the variables (delta) was obtained by subtracting the value of the last minute of the isometric exercise by the baseline value (Δ = last-minute value – baseline), analyzed by the unpaired Student's “t” test. The effects of hemodynamic control interventions on recovery after isometric contraction were expressed by mean values of post values about pre-intervention values. P<0.05 was accepted as a significant difference. Statistical analysis was performed in Microsoft Excel version 2010.

RESULTS

Table 1 shows the physical and hemodynamic characteristics of the elderly studied. We can highlight that the mean age among the participants was 69 ±1.0 years, in addition, most of them are overweight. Regarding blood pressure values (SBP,131±1.4 mmHg; DBP=83±1.6 mmHg), it is possible to observe that most of the elderly are classified as pre-hypertensive, according to the Brazilian Guidelines on Hypertension Arterial - (2020).

Table 1. Anthropometric and hemodynamic characteristics of the elderly studied

Variables	Sample (n=70)
Age, years old	69±1,00
Body massl, Kg	67,59±1,45
Sex, F/M	58/12
Stature, m	1,60±0,01
BMI, Kg/m2	26,18±0,46
SBP, mmHg	131±1,38
DBP, mmHg	83±1,59
HR, bpm	73±1,33
SAT	96±0,20
Maximum palm grip, kgf	14±0,59

***Note:** Results presented as mean value ± standard error of mean. BMI=body mass index, SBP=systolic blood pressure, DBP=diastolic blood pressure, HR=heart rate, SAT=oxygen saturation

Then, in table 2, there is a representation of the continuous use of drugs used by patients who participated in the study. In view of the analysis, 50% of the patients used antihypertensive drugs.

The effects of interventions on hemodynamic control during isometric contraction were expressed in delta (hemodynamic values of the third minute of the handgrip exercise about the last minute of rest) of the values post in regarding pre-intervention values, both for the pompage intervention and the placebo intervention were shown in Table 3. We emphasize that there was a reduction in SBP only in the pompage group (p < 0.001) and a reduction in heart rate in both groups (p < 0.001 and p=0.02), respectively pomp and placebo. There was no change in DBP in both groups (p = 0.27 and p = 0.18), respectively pomp and placebo.

Table 2. Representation of medications used by the elderly

	(n, %)
Arterial Hypertension	35 (50%)
Losartana	24 (34%)
Enalapril	3 (4%)
Hidrocolotizida	7 (10%)
Renitec	1 (1%)
Pressat	1 (1%)
Benicar	1 (1%)
Degraler	1 (1%)
Anlodipino	1 (1%)
Clortalidona	1 (1%)
Diabetes (type II)	17 (24%)
Glicazida	11 (16%)
Glifagem	4 (6%)
Metformina	3 (4%)
Dyslipidemia	12 (17%)
Sinvastatina	9 (13%)
Zinpass	1 (1%)
Rosuvastatina	1 (1%)
Xarelto	1 (1%)
Hypothyroidism	7 (10%)
Levotiroxina	4 (6%)
Puran	1 (1%)
Levoid	1 (1%)
Estradot	1 (1%)

***Note:** Data expressed in number and percentage of medications used by the sample.

Table 3. Delta values of hemodynamic variables during isometric exercise in the pompage and placebo group.

	Pompage			Placebo		
Delta	**Before**	**After**	***P***	**Before**	**After**	***p***
SBP Exercise	11±1,6	4±1,6	0,001*	11±1,6	11±1,7	0,63
DBP Exercise	8±1,6	5±1,4	0,27	8±0,18	2±1,4	0,18
HR Exercise	3±0,6	-1±0,7	0,001*	1±0,02	-2±1,5	0,02*

***Note:** SBP= systolic blood pressure; DBP= diastolic blood pressure; HR= heart rate. p<0,05.

The effects of hemodynamic control interventions on recovery after isometric contraction were expressed as mean values of post-intervention values compared to pre-intervention values in two tables, one for the pompage intervention and one for the placebo intervention, shown in tables 4 and 5 respectively. We emphasize that there was a reduction in DBP only in the pompage group in the first minute (p=0.03) and the third minute (p=0.04). Regarding SBP, there was a reduction in the pompage group (p=0.001) in the first, second and third minutes and a reduction in the placebo group only in the third minute. As for heart rate in both groups, there was a reduction, and in the placebo group, this reduction occurred in the first minute (p=0.001) and the third minute (p=0.003), and in the pompage group, it occurred in the first minute (p=0.001) and the second minute (p=0.001).

Table 4. Mean values of hemodynamic variables during recovery in the pompage group.

Pompage	**Recovery (1 min)**	**Recovery (2 min)**	**Recovery (3 min)**
SBP (Before)	133±12	130±14	129±12
SBP (After)	129±14	126±15	123±15
P	0,001*	0,01*	0,001*
DBP (Before)	85±12	83±12	83±13
DBP (After)	82±10	83±12	81±9
P	0,03*	1,00	0,04*
HR (Before)	72±12	70±14	70±11
HR (After)	69±11	68±12	67±14
P	0,001*	0,12	0,003*

***Note:** Results presented with mean value ± standard deviation of mean SBP= systolic blood pressure; DBP=diastolic blood pressure; HR= heart rate. p<0,05*.

Table 5. Mean values of hemodynamic variables during recovery in the pomp group.

Placebo	**Recovery (1 min)**	**Recovery (2 min)**	**Recovery (3 min)**
SBP (Before)	134±15	130±15	128±15
SBP (After)	135±13	132±15	131±
P	0,27	0,13	0,02*
DBP (Before)	85±13	83±16	83±13
DBP (After)	86±13	98±99	83±14
P	0,60	0,20	0,75
HR (Before)	73±11	72±12	72±12
HR (After)	71±11	70±12	69±14
P	0,001*	0,001*	0,08

***Note:** Results presented as mean value ± standard deviation of mean SBP=systolic blood pressure; DBP=diastolic blood pressure; HR= heart rate. p<0.05*.

DISCUSSION

The main results of this study are that only the pompage protocol reduced the SBP of the elderly during the isometric exercise with the handgrip and reduced the DBP in the recovery of the isometric exercise. There was no change in SBP during isometric exercise or in DBP in recovery from isometric exercise in the placebo group. Furthermore, there was a reduction in HR in both groups and there was no change in DBP in the pompage session or the placebo session during isometric exercise. In the recovery from isometric exercise, there was a change in SBP both in the placebo group and in the pompage group, and at rest, there was no result.

The benefits of physical exercise on the cardiovascular system are well established in the literature. The 7th Brazilian Directive on Arterial Hypertension (2016) described several benefits of regular physical exercise for hemodynamic dysfunctions that occur in the elderly, especially in the hypertensive elderly. Exercise, when practiced with adequate intensity, duration, and frequency, causes adaptations in cardiovascular autonomic control(19), improving the sensitivity of baroreceptors(20) and mechano and metaboreceptors(21). Aerobic and resistance exercise reduces sympathetic nervous activity, as well as blood pressure and peripheral vascular resistance (22-26).

However, knowing that some patients do not respond adequately to physical exercise, do not show post-exercise hypotension(27), and are aware of the musculoskeletal limitations that some elderly people may have, studies of other non-pharmacological complementary therapies are necessary to this population.

A recent systematic review by our group showed that some manual therapies have an impact on increased parasympathetic activity, reduced cardiac sympathetic activity, and improved blood pressure control in healthy young and middle-aged patients or those with diseases, discomfort, hypertension, and back pain associated with the presence of myofascial trigger points(16),but there are still no studies in the literature of this type using pompage. Additionally, it was identified that new randomized controlled trials are needed for clinical applications of manual therapies in cardiac autonomic control as a complement to the treatment performed. From the result of this individual session, a multi-session treatment protocol can be proposed for a new study.

In relation to manual therapies, the pomping technique is used as a method of muscle relaxation, circulation optimization, and joint regeneration(28). Furthermore, there is an improvement in tissue nutrition and analgesic effect(29). It is already documented that fascia is the connective tissue that encompasses muscles, muscle groups, blood vessels, and nerves. In addition, according to an experimental study, pompage promotes an improvement in quality of life related to functional capacity, and limitations of physical and social aspects(30). Fascial tone can therefore be influenced and regulated by the state of the autonomic nervous system. Any intervention aimed at fascia is also an intervention that influences the autonomic system and vice-versa, thus interfering with blood flow(17).

The pomps distribute mechanical tensions generated by muscle activity, performing the sliding between the muscles(31), in this way, we suppose that pumping would stimulate the mechanoreceptors, and consequently the sympathetic activity. For this reason, to assess the integrity of the cardiovascular system, we used the handgrip isometric exercise protocol to stimulate the central command through peripheral mechanoreceptors and muscle metaboloreceptors, informing about cardiovascular reactivity(32).

It is known that during isometric exercise, several reflexes are activated leading to an increase in sympathetic nervous activity. Before the start of exercise, a central neural activity known as a central command is activated, regulating increased sympathetic constrictor activity. According to mechanoreceptors, when stimulated by muscle contraction, they contribute to increasing the reflex of sympathetic nervous activity(33). Finally, the metabolites accumulated during exercise stimulate muscle metaboreceptors, chemosensory afferent nerve fibers that when stimulated increase sympathetic activity for both exercised and non-exercised limbs. And the metaboreflex is the main reflex mechanism that activates the sympathetic nervous system during isometric exercise(34,35).

Passive muscle stretching can cause a transient increase in heart rate and sympathetic nerve activity by the isolated stimulation of mechanoreceptors and these responses are measurable, but due to the baroreflex, these responses are small and transient(36). Stretching will stimulate cardiac autonomic modulation via mechanoreceptors and we hypothesize that pompage provides the same stretching stimulus.

Physical exercise promotes physiological changes that lead to hemodynamic and autonomic adaptations. After exercise, there is a drop in systemic vascular resistance that results in a decrease in blood pressure(11). In addition, low-intensity physical exercise causes a reduction in cardiac output, which can be explained by a decrease in sympathetic tone, due to lower activation of the sympathetic nervous system. Reductions in BP may still be associated with vasoactive substances, an improvement in insulin sensitivity, and a reduction in plasma noradrenaline, which suggests reduced sympathetic activity[37].

During isometric exercise, there is an increase in the activity of the Sympathetic Nervous System and a decrease in the activity of the Parasympathetic Nervous System, but this is reversed after the end of the contraction, leading to a decrease in Blood Pressure in the recovery of isometric exercise[38].The work results in a decrease in BP during isometric exercise, this decrease being greater in the pompage protocol. We suggest that sympathetic activity is lower in the pompage intervention during isometric exercise and in recovery, this BP decrease is also significant.

The study has limitations, which we can highlight, the small sample and the fact that the sensitivity of mechanoreceptors was not evaluated in isolation, which will be investigated in the next study of our group. Clinically, it is essential to study new therapies that are complementary to the hemodynamic control of the elderly and the treatment of cardiovascular diseases, which are the main cause of death in this population[4].

CONCLUSION

The pompagne protocol reduced the SBP of the elderly during isometric exercise with the handgrip and DBP in the recovery from isometric exercise, while there was no change in SBP in the placebo group during isometrics and no change in DBP in the placebo group during recovery of isometric exercise. Additionally, there was a reduction in HR in both groups and there was no change in DBP both in the pompage session and in the placebo session during the isometric exercise and the SBP changed in both the placebo group and the pompage group in the recovery from isometric exercise. There was no hemodynamic change at rest.

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REFERENCES

1. UNFPA – United Nations Population Funf. Envelhecimento Populacional, Brasil, 2020.
2. IBGE - Instituto Brasileiro de Geografia e Estatística. Estratégia Brasil Amigo da Pessoa Idosa, 2017.
3. Silva JVF, Da Silva EC, Da Rodrigues APRA, Miyazawa AP. A relação entre o envelhecimento populacional e as doenças crônicas não transmissíveis: sério desafio de saúde pública. Caderno De Graduação - Ciências Biológicas E Da Saúde. 2015;2(3):91–100.
4. Massa CHK, Duarte OPY, Chiavegatto-Filho PDA. Análise da prevalência de doenças cardiovasculares e fatores associados em idosos, 2000-2010. Ciência & Saúde Coletiva. 2019;24(1):105-114.
5. Monahan KD. Effect of aging on baroreflex function in humans. Am J Physiol Regul Integr Comp Physiol. 2007l;293(1):R3-R12.
6. Vanderlei LCM, Pastre CM, Hoshi RA, De Carvalho TD, De Godoy MF. Noções básicas de variabilidade da frequência cardíaca e sua aplicabilidade clínica. Brazilian Journal of Cardiovascular Surgery. 2009;24(2):205-217.
7. Esquenazi D, Da Silva SB, Guimarães MA. Aspectos fisiopatológicos do envelhecimento humano e quedas em idosos. Revista Hospital Universitário Pedro Ernesto. 2014;13(2):11-20.
8. Liu P, Zheng JG. Blood Pressure Targets in the Hypertensive Elderly. Chin Med J (Engl). 2017;130(16):1968-1972.
9. Bonotto NCA, Barbisan F, Maia-Ribeiro EA, Ribeiro EE, Turra BO, Cruz IBM, Oxido nítrico como biomarcador associado a hipertensão arterial em idosos ribeirinhos da Amazônia. Revista Brasileira de Ciências do Envelhecimento Humano. 2019;16(2):55.
10. Milia R, Roberto S, Mulliri G, Loi A, Marcelli M, Sainas G, Milia N, Marongiu E, Crisafulli A. Effect of aging on hemodynamic response to metaboreflex activation. Eur J Appl Physiol. 2015;115(8):1693-703.
11. Monteiro M.F., Filho D.C.S., Physical exercise and blood pressure control. Rev Bras Med Esporte, Nov/Dez, 2004, Vol. 10, Nº 6.
12. Kamada M, Clemente JS, Monteiro AFF, De Barros LVG, Helene AHE, Morato DM. Correlação entre exercício físico e qualidade de vida em pacientes com doença de Alzheimer. Rev Soc Bras Clin Med. 2018;16(2):119-22.
13. Cardozo D, Destro D, Cardozo L. Influência Do Exercício Físico No Controle Barorreflexo Na Hipertensão Arterial. RBPFEX. Revista Brasileira De Prescrição E Fisiologia Do Exercício. 2012;6(34).
14. Moretti EC, De Araújo MEMV, Campos AG, Santos LRH, De Araújo MGR, Tenório AS. Efeitos da pompage associada ao exercício aeróbico sobre dor, fadiga e qualidade do sono em mulheres com fibromialgia: um estudo piloto. Fisioterapia e Pesquisa. 2016;23(3):227-233.

15. Gondim ITGO, Torres ABC, De Lacerda ATB, Fernandes DQK, Couto MC, Pedrosa MAC. Effects of a therapeutic exercises program associated with pompage technique on pain, balance and strength in elderly women with knee osteoarthritis. Fisioterapia em Movimento. 2017;30(1):11-21.
16. Sousa KA, Cardoso LB, Pela FMP, Viscardi L. GA, Sarmento AO. Effect of manual therapies on cardiac autonomic control: a systematic review. Revista terapia manual. 2021;19:1-12.
17. Henley CE, Ivins D, Mills M, Wen FK, Benjamin BA. Osteopathic manipulative treatment and its relationship to autonomic nervous system activity as demonstrated by heart rate variability: a repeated measures study. Osteopath Med Prim Care. 2008;2:7.
18. Bienfait M. Estudo e Tratamento do Esqueleto Fibroso Fáscias e Pompages. 5ª edição. Brasil: Summus Editorial, 1 jan. 1999. 112 páginas.
19. Selig SE, Carey MF, Menzies DG, Patterson J, Geerling RH, Williams AD, et al. Moderate-intensity resistance exercise training in patients with chronic heart failure improves strength, endurance, heart rate variability, and forearm blood flow. J Card Fail. 2004;10(1):21-30.
20. Sarmento AO, Antunes-Correa LM, Alves MJNN, Bacurau AVN, Fonseca KCB, Pessoa FG, et al. Effect of exercise training on cardiovascular autonomic and muscular function in subclinical Chagas cardiomyopathy: a randomized controlled trial. Clin Auton Res. 2021;31(2):239-251.
21. Antunes-Correa LM, Nobre TS, Groehs RV, Alves MJ, Fernandes T, Couto GK, et al. Molecular basis for the improvement in muscle metaboreflex and mechanoreflex control in exercise-trained humans with chronic heart failure. Am J Physiol Heart Circ Physiol. 2014;307(11):H1655-66.
22. Monteiro WD, Silva NSL, Farinatti PTV. Influência da ordem dos exercícios sobre o número de repetições e percepção subjetiva do esforço em mulheres jovens e idosas. Revista Brasileira de Medicina do Esporte. 2009;5(3): 219–223.
23. Sarmento AO, Cruz AS, Brasileiro-Santos MS. Effect of physical exercise on cardiac autonomic modulation in the elderly: systematic review. ConScientiae Saúde. 2011;10(2):380-386.
24. Sarmento AO, Santos ADC, Trombetta IC, et al. Regular physical exercise improves cardiac autonomic and muscle vasodilatory responses to isometric exercise in healthy elderly. Clin Interv Aging. 2017;12:1021-1028.
25. Olher Rdos R, Bocalini DS, Bacurau RF, Rodriguez D, Figueira A Jr, Pontes FL Jr, et al. Isometric handgrip does not elicit cardiovascular overload or post-exercise hypotension in hypertensive older women. Clin Interv Aging. 2013;8:649-55.
26. Cornelissen VA, Smart NA. Exercise training for blood pressure: a systematic review and meta-analysis. J Am Heart Assoc. 2013;2(1):e004473.
27. Marques-Silvestre ACO, Brasileiro-Santos MS, Sarmento AO, Silva FTM, Santos AC, *et al.,* Magnitude da hipotensão pós-exercício aeróbio agudo: Uma revisão sistemática dos estudos randomizados. Motricidade. 2014;10:99-111.
28. Sá LTS, Costa CLA, Da Conceição MS, Lima MO, Da Cruz CB, Brito RS, *et.al.* Os recursos fisioterapêuticos na reabilitação de mulheres pós mastectomizadas. Revista Eletrônica Acervo Saúde. 2020;44:e2788.
29. Pereira MPM, Parissoto D, Eduardo CMF. Efeito imediato da pompage dorsal sobre a dor e mobilidade vertebral em pacientes com algia torácica decorrente de maus hábitos posturais. Rev Uniandrade. Campos de Andrade, Brasil. 2017;18(2):116-121.
30. Antunes MD, Favoreto AB, Nakano MS, Morales RC, Junior JRAN, Oliveira DV, et al. Análise comparativa dos efeitos da massoterapia e pompage cervical na dor e qualidade de vida em mulheres. ConScientiae Saúde. 2017;16(1):109-115.
31. Silva LMV, Maia FB. Contribuições da Pompage na prática da terapia ocupacional em reabilitação física. Rev. Interinst. Bras. Ter. Ocup. 2018;2(3):654-667.
32. Reed AS, Tschakovsky ME, Minson CT, Halliwill JR, Torp KD, Nauss LA, et al. Skeletal muscle vasodilatation during sympathoexcitation is not neurally mediated in humans. J Physiol. 2000;525 Pt 1(Pt 1):253-62.
33. Vissing SF, Scherrer U, Victor RG. Stimulation of skin sympathetic nerve discharge by central command. Differential control of sympathetic outflow to skin and skeletal muscle during static exercise. Circ Res. 1991;69(1):228-38.
34. Middlekauff HR, Nitzsche EU, Nguyen AH, Hoh CK, Gibbs GG. Modulation of renal cortical blood flow during static exercise in humans. Circulation Research. 1997;80(1):62-68.
35. Ray CA, Mark AL. Sympathetic nerve activity to nonac tive muscle of the exercising and no exercising limb. Medicine & Science in Sports & Exercise, Lowa City, EUA, 1995;27(2):183-187.
36. Cui J, Blaha C, Moradkhan R, Gray KS, Sinoway LI. Muscle sympathetic nerve activity responses to dynamic passive muscle stretch in humans. J Physiol. 2006 Oct 15;576(Pt 2):625-34.
37. Kolb GC, De Abreu LC, Valenti VE, Alves TB. Characterization of the post-exercise hypotensive

response. Arquivos Brasileiros de Ciências da Saúde. 2012;37(1):44-48.

38. António MAS, Cardoso MA, Do Amaral JAT, De Abreu LC, Valenti VE. Cardiac autonomic modulation adjustments in isometric exercise, MedicalExpress.2015;2(1).