Does interset stretching change the autonomic modulation and hemodynamic responses in trained young men?

https://doi.org/10.11606/issn.1981-4690.2023e37180336

Lucas Rangel Affonso de Miranda*
Carlos Brendo Ferreira Reis*
Matheus Agnez de Oliveira*
Igor Alves Mello*
Leandro Moraes Pinto**
Cristiano Teixeira Mostarda**
Danilo Sales Bocalini*
Richard Diego Leite*

*Federal University of Espírito Santo, Vitória, ES, Brazil.
**Federal University of Maranhão, São Luís, MA, Brazil.

Abstract

The aim of the present study was to analyze the effect of interset stretching in the heart rate variability and hemodynamic responses. The sample consisted of 8 trained men (23 ± 2.72 years, 1.74 ± 0.07 meters, 75.66 ± 10.85 kg). The lower limbs training protocol started with three sets of 10 maximal repetitions in the back squat and leg press exercises, with 1-minute rest between sets. After that, 7 sets of maximal repetitions were performed on the leg extension machine with 30 seconds interval between sets, using the first 20 seconds for passive stretching of the quadriceps muscles. Hemodynamic responses and autonomic modulation were obtained at rest, during the session and immediately after for 15 minutes post-session. Autonomic modulation was monitored by heart rate variability. Significant reductions during and after resistance training protocol were observed for RR intervals, RMSSD, pNN50, SDNN, 2LV%, 2UV%, LF and HF in comparison with basal levels. Meanwhile, 0V% presented significantly increases during and after experimental protocol. Lower LF/HF, LFnu and HFnu values was observed during protocol. Systolic blood pressure (SBP), mean blood pressure (MBP), heart rate (HR) and rate pressure product (RPP) were significantly higher after session. After 15 minutes, SBP, DBP, MBP, and RPP returned to near baseline values. The sympathetic activity increased during the protocol and post 15 minutes.

Keywords: Resistance training; Interset stretching; Heart rate variability; Blood pressure.

Introduction

The resistance training (RT) workout involves mainly the manipulation of variables such as volume, load intensity, frequency, rest intervals between sets and others, to promote strength and hypertrophy development[1]. There are several RT workout formats studied in the literature such as superset, drop set, rest pause and others, characterized by manipulation of resistance training variables. In addition, the inter-set stretching have been used to induce higher metabolic stress resulting in cellular and molecular hypertrophy pathways activation[2].

In this sense, Evangelista et al.[3] demonstrated that traditional resistance training combined with interset stretching (ISS) during 8 weeks was able to induce higher muscle strength and hypertrophy in untrained individuals. Interestingly, the addition of ISS was able to induce significantly higher values of vastus lateralis muscle thickness in comparison to traditional resistance training, demonstrating the potential effect of interset stretching. Besides, the muscle contraction associated with stretching increase the vascular resistance increases because stretch/mechanical tension stimulus activates mechanoreceptors, resulting in vagal withdrawal, increased sympathetic nervous system activity and hemodynamic alterations blood pressure and Heart rate increases.

Lemos et al.[4] analyzed the effect of resistance training in the heart rate variability (HRV) and blood pressure (BP), using different exercise orders of upper body and rest intervals (40 and 90 seconds) in three sets of 12 repetitions. The results demonstrated that long rest interval (90 seconds) between sets induced a longer post-session hypotensive response in comparison with short rest interval (40 seconds). Frequency domain analysis of HRV demonstrated an increased sympathetic tonus until 60 minutes after session and no statistic difference was observed between exercise orders. Already, Figueiredo et al.[5] evaluated the response of HRV and BP in different number of sets (1, 3 and 5 sets) of 8-10 repetitions with 70% of 1RM and 2 minutes of rest interval. Low frequency normalized (LF-nu) increased significantly and high frequency normalized (HF-nu) decreased significantly after 10 and 20 minutes only after 5 sets.

Iglesias-Soler et al.[6] studied the HRV and hemodynamic responses in 10 young male judo fighters, in two different resistance training methods on the back squat exercise. The participants performed the traditional training (3 sets until concentric fail) with 4 RM load and 3 minutes rest interval) and the cluster training with 45 seconds of rest between each repetition with 4 RM load. The results demonstrated higher values of SBP, HR and RPP in traditional training in comparison with cluster training. The HRV did not present statistic difference between methods.

Recently, studies demonstrated that greater cardiovascular stress could be promoted by resistance training methods such German Volume Training (GVT) and Sarcoplasma Stimulating Training (SST)[7,8,9]. Nevertheless, Muniz et al.[8] did not found statistically difference in HRV between GVT and SST methods with different volumes. This result can be associated with greater intensity of SST method and also with different set configuration, such rest interval between sets.

In this sense, understand the effects of training methods and session configuration in autonomic and hemodynamic response is important for exercise prescription. Thus, the aim of the present study was to analyze the effect of Interset stretching (ISS) on autonomic modulation and hemodynamic responses in trained young men.

Methods

Sample

The sample consisted of eight male volunteers (23 ± 2.72 years, 75.66 ± 10.85 Kg, 1.74 ± 0.07 m, 24.79 ± 1.78 Kg.m², 8.48 ± 1.69 %BF), all participants should have at least one year of resistance training experience (4.75 ± 3.65 years) and have not suffered any musculoskeletal injuries in the last 6 months. Subjects were asked to abstain from any other type of exercise during experimental period.

The research study was approved by the Research Ethics Committee of Federal University of Espírito Santo (process number 2.542.6/26) in accordance with the Helsinki Declaration, and all participants provided informed written consent before participation.

Anthropometric data

Participants body weight (Kg) and height (m) was determined using a clinical scale and stadiometer (Modelo: LS500; Marte®). Body mass index was calculated by dividing the body weight by the squared height. Seven skinfold thickness were measured: triceps, suprailiac, thigh, chest, subscapular, midaxillary, and abdomen (Cescorf®). Percentage of body fat was calculated using the Jackson and Pollock 7 skinfold protocol.

Maximal strength assessment (10RM)

The 10-RM testing began with a two sets warm-up with 50% of the predicted 1RM and one-minute rest. After warm-up, up to 5 attempts of the 10 RM testing protocol were applied. The allowed resting period was 5 minutes between attempts and 10 minutes between exercises (back squat and leg press). In the first attempt, the participants started with 100% of estimated load and each subject was encouraged to perform 10 maximal[10]. Re-test was performed after 72 hours[11].

The participants received standardized instructions concerning about testing procedure and the exercise technique. The load lifted in 10-RM back squat exercise and leg press machine were 104 ± 32.01 Kg and 298 ± 62.80 Kg, respectively. The load used in the knee extension exercise was 95 kg for all participants.

Heart rate and heart rate variability analysis

Heart rate variability (HRV) and heart rate (HR) were used to evaluate the autonomic modulation. Heart rate monitor V800 was used with a sampling frequency of 1.000 Hz (Polar, Kempele, Finland) for acquisition of RR intervals from each heart beat cycle.

Baseline data (RR intervals and HR) were collected during 10 minutes with participants lying in supine position in a quiet room after five minutes of rest. During training session, recording started before the first set of back squat exercise and finished after the last set of knee extension exercise. The post-session data was recorded (15 minutes) with participants in seated position immediately after the last set. Data were recorded and analyzed in HRVanalysis® software.

The analysis were made from time domain: iRR (RR intervals), SDNN (standard deviation of all normal R-R intervals), RMSSD (standardized deviation of differences between adjacent normal R-R intervals), and pNN50 (percentage of normal R-R intervals).

The spectral analysis in the frequency domain was performed by Fourier transforms algorithm. HRV parameters were analyzed according to the components of low frequency (LF: 0.04 – 0.15 Hz) to provide information about the sympathetic nervous system and high frequency (HF: 0.15 a 0.4 Hz) for parasympathetic nervous system activity. LF/HF ratio was calculated based on standard LF and HF in normalized units (HFnu).

The symbolic dynamics analysis was distributed in six levels and all possible standards were divided in four groups. Following the standards; 0V (no variation, all 3 symbols were equal, sympathetic activity prevalence), 1V (patterns with one variation 2 consequent symbols were equal and the remaining symbol was different associated with sympathetic and parasympathetic modulation), 2LV (two like variations, parasympathetic activity predominance) and 2UV (two unlike variations, parasympathetic predominance)[12].

Hemodynamic assessment

With the participants in seated position, the blood pressure (BP) was measured using a sphygmomanometer (Heidji®), and a phonendoscope for analysis of systolic blood pressure (SBP) and diastolic blood pressure (DBP). In the pre-intervention moment, hemodynamic data were measured after HRV analysis and after 1, 2, and 3 sets in back squat and leg press exercises. In knee extension exercise it was measured only after 7 sets, because of the small rest between sets. After post-intervention period, hemodynamic data were measured in 5, 10, and 15 minutes. Mean blood pressure (MBP) was calculated by MBP = DBP + [SBP – DBP]/3 and rate pressure product (RPP) was calculated by RPP = HR x SBP[13].

Interset stretching (ISS) protocol

Two sets of 10 repetitions with 50% of 10-RM in back squat exercise with one-minute rest between sets were used as warm-up. After two minutes rest interval, the participants performed the ISS protocol with 3 sets of maximal repetitions (10-RM load) in back squat exercise with one-minute rest between sets. After that, the same protocol was carried out in the leg press exercise. Then, 7 sets of maximal repetitions were completed in the knee extension machine with standardized load of 95Kg (maximum machine load) and 30 seconds interval between sets.

Between all 7 sets (knee extension exercise), quadriceps muscle inter-set passive stretching and little hip extension were performed during the first 20 seconds. Subjects were kept lying down in prone position, with knee joints supported by one step. The maximal stretching intensity was verbally determined by participant.

Statistical analysis

Data are presented as the means ± standard deviation. Initially, data were analyzed using Shapiro-Wilk normality test, then statistical differences between moments were analyzed by one-way variance (ANOVA) and post-hoc Tukey test for multiple comparisons. Statistical analyses were performed using GraphPad Prism 6.01 software (GraphPad, San Diego, California, EUA). The statistical significance level was $p < 0.05$.

Results

Autonomic modulation

The RR interval decreased significantly during session (p = 0.000289) and until 15 minutes after it (p= (p= 0.001107). The same results were observed for pNN50, RMSSD (p<0.0001) and SDNN (p< 0.01) index (TABLE 1).

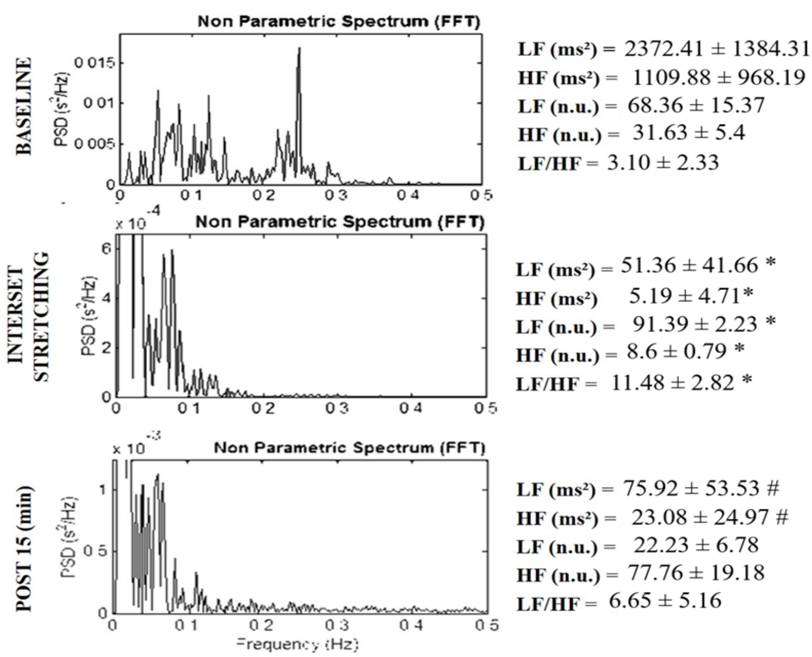
Symbolic analyses demonstrated that 0V% index increased significantly during (p=0.000289) and 15 minutes later (p=0,001107) in comparison with baseline. On the other hand, 2LV% e 2UV% decreased significantly during and after 15minutes (p<0.0001) in comparison with baseline values.

TABLE 1 - Comparison of linear methods and symbolic analysis of heart rate variability.

Parameters	Baseline	Interset Stretching	Post 15 min
iRR (ms)	914.62 ± 184.75	411.12 ± 31.16*	523.00 ± 47.53#
pNN50 (%)	4.47 ± 2.28	1.06 ± 1.02*	0.00 ± 0.00#
SDNN (ms)	74.52 ± 17.84	72.86 ± 23.83	47.20 ± 11.32#†
RMSSD (ms)	46.93 ± 16.91	10.40 ± 5.10*	4.85 ± 1.36#
0V%	2.79 ± 8.47	91.52 ± 2.07*	85.25 ± 5.66#
1V%	48.34 ± 3.61	6.64 ± 1.42*	12.73 ± 5.30#†
2LV%	12.92 ± 6.53	0.20 ± 0.14*	0.05 ± 0,08#
2UV%	13.93 ± 9.08	1.62 ± 0.81*	1.96 ± 0.98#

Data are presented as mean ± standard deviation.
Minutes (min);
RR interval (iRR);
milliseconds (ms);
percentage of differences between adjacent normal RR intervals exceeding 50 ms (pNN50);
standard deviation of normal RR intervals (SDNN);
square root of the mean squared differences between consecutive RR intervals (RMSSD).
* p <0,05 vs baseline;
# p<0,05 vs baseline;
† p<0,05 vs ISS.

The frequency domain analyses demonstrated that LF, HF, LF (n.u), HF (n.u) and LF/HF values were significantly lower during session (p<0.05). After 15 minutes, significantly lower values were observed for LF and HF (p<0.05) in comparison with baseline values (FIGURE 1). No statistically difference were observed for LF/HF index, LF (n.u) and HF (n.u) after 15 minutes post-exercise.



Low frequency (LF);
high frequency (HF);
Low-frequency/high-frequency ratio (LF/HF).
Data are presented as mean ± standard deviation.
*Difference between Baseline and during ISS (p≤0.05).
Difference between Baseline and post 15 minutes in ISS (p≤0.05).
† Difference between during session and post 15 minutes (p≤0.05).

FIGURE 1 - Spectral analysis of participants heart rate variability.

Hemodynamic responses

Heart rate values were significantly higher (p<0.05) during and post ISS training session in comparison with baseline values. After ISS training session (post-5, -10, -15), were observed significantly lower heart rate values in comparison with heart rate values in the squat, leg press and Leg extension exercise.

SBP, RPP e MBP values were significantly higher in all exercises and sets in comparison with baseline values. No Statistically difference were observed for DBP values (p>0.05) (TABLE 2).

TABLE 2 - Hemodynamic responses before, during and post ISS training session.

	SBP (mmHg)	DBP (mmHg)	HR (bpm)	RPP (bpm*mmHg)	MBP (mmHg)
BASELINE	117.5 ± 7.07	75 ± 5.34	69.13 ± 13.22 @*†	8812.5 ± 809.65	89 ± 4.24
BACK SQUAT					
Set 1	146.25 ± 13.02 #*†	77.5 ± 4.62	175.63 ± 9.81 #@*†	11375 ± 1539.71#†	100.37 ± 6.98 #†
Set 2	150 ± 15.11 #*†	76.25 ± 5.17	179.75 ± 8.64 #@*†	11475 ± 1666.26#†	100.75 ± 7.45 #†
Set 3	152.5 ± 13.88 #*†	76.25 ± 7.44	180.50 ± 9.27 #@*†	11612.5 ± 1428.72#@*†	101.62 ± 6.13 #@*†
LEG PRESS					
Set 1	151.25 ± 13.56 #@*†	78.75 ± 3.53	173.88 ± 6.6 #@*†	11900 ± 1084.96#@*†	103 ± 4.53 #@*†
Set 2	152.5 ± 12.81 #@*†	78.75 ± 3.53	174.75 ± 8.51 #@*†	12012.5 ± 1190.96#*†	103.5 ± 5.01 #*†
Set 3	156.25 ± 10.60 #@*†	80 ± 0	174.63 ± 8.45 #@*†	12500 ± 848.52#@*†	105.37 ± 3.66 #@*†
LEG EXTENSION MACHINE					
Set 1	-	-	173.00 ± 5.42 #@*†	-	-
Set 2	-	-	174.38 ± 5.97 #@*†	-	-
Set 3	-	-	175.25 ± 7.44 #@*†	-	-
Set 4	-	-	175.00 ± 8.46 #@*†	-	-
Set 5	-	-	174.88 ± 8.49 #@*†	-	-
Set 6	-	-	174.25 ± 7.94 #@*†	-	-
Set 7	150 ± 9.25 #@*†	77.5 ± 4.62	175.00 ± 8.88 #@*†	11637.5 ± 1148.83#†	101.75 ± 5.20 #†
POST-5	127.5 ± 12.81	75 ± 5.34	114.38 ± 6.61 #	9575 ± 1294.76	92.37 ± 6.06
POST-10	115 ± 5.34	75 ± 5.34	110.13 ± 8.07 #	8637.5 ± 886.30	88.12 ± 4.70
POST-15	113.75 ± 5.17	75 ± 5.34	108.50 ± 8.86 #	8537.5 ± 803.45	87.75 ± 4.36

SBP: Systolic blood pressure;
DBP: diastolic blood pressure;
HR: heart rate;
RPP: Rate pressure product;
MBP: Meas blood pressure.
BS = Back Squat;
LP = Leg Press;
LEM = Leg Extension Machine.
# = Statistically difference in comparison with BASELINE values;
@ = Statistically difference in comparison with POST-5;
* = Statistically difference in comparison with POST-10;
† = Statistically difference in comparison with POST-15.

Discussion

The aim of the present study was to evaluate the effect of interset stretching on HRV and hemodynamic variables in trained young men. The protocol induces significant increases of sympathetic activity during and after training session in comparison with baseline values. Also, we observed a significant increase of SBP, HR, RPP and MAP during the protocol. Furthermore, hemodynamic indexes demonstrated a quick reduction after training session, although, the values did not reach the same baseline values after 15 minutes.

Heart rate and contractile increase could be related to higher sympathetic activity and the withdrawal of vagal influence. The higher sympathetic activity is associated with metabolic factors (blood lactate, hydrogen ions, inorganic phosphate and carbon dioxide). The SBP is associated with increase in sympathetic activity, inactive muscles vasoconstriction during exercise, and higher local metabolic demand inducing vasodilation in the active muscles[14].

The ISS protocol promoted higher sympathetic tonus during and 15 minutes after the training session. Corroborating our results, Figueiredo et al.[5] studied the effects of one, three and five sets with 10 repetitions (70% of 1RM) on heart rate variability. The authors observed that only 5 sets induced higher sympathetic activity after 10 and 20 minutes after session, demonstrating that higher training volumes are related to a sympathetic activity after training session.

Iglesias-Soler et al.[6] analyzed the effects of multiple sets versus cluster training on autonomic and hemodynamic indexes. SBP, HR and RPP were higher when multiple sets were performed in comparison with cluster training. The results observed could be related to lower time under tension in the cluster training because of the pause between the repetitions during each set, modifying the Valsalva's maneuver duration. This maneuver increases the thorax muscle stability during concentric phase, raising thoracic pressure[14].

We observed in the present study that ISS increased significantly the SBP during session. However, there was a significant reduction near baseline values after 15 minutes. The results can be explained by sustained higher sympathetic activity after the training session, indicating cardiac stress caused by the training protocol. Lemos et al.[4] studied the effects of exercise order (small/ large muscle group; large/small muscle group) and different rest intervals (40 and 90 seconds). The authors observed an increased sympathetic activity 10 minutes after the training session in all experimental groups. Hypotensive responses were observed after 10 minutes when training session started with small group with 90 seconds of rest interval. In contrast, for other experimental groups it was observed only 20 minutes after the session.

The behavior of the autonomic and hemodynamic data may be related to the increase of the under-tension time, which promotes an increase of the external compression force on the vessels, stimulating mechanoreceptors. As a result, there is an increase in sympathetic activity, causing a reduction of blood flow, O2 availability and increased peripheral vascular resistance (PVR), stimulating increases in HR and BP[15]. Furthermore, stretching between sets promotes events related to hypertrophy[3] as increasing the under-tension time and metabolic responses (Lac+ accumulation, H+ ions, Na+ ions and Pi), such as an increase in GH levels[3,16]. These metabolites stimulate metaboreceptors, which induce the increase of the sympathetic activity, BP and PVR[16].

Some limitations should be addressed on the present study. First, the short time of this investigation on hemodynamic and HRV analysis after training session and the sample size does not permit data generalization. Besides that, future studies should help us understand the effects of this type of resistance training protocols on HRV and hemodynamics for a longer recovery time, so that the real impact in the sympathovagal balance after training session becomes clearer.

The ISS resistance training protocol induced significant increases in the sympathetic activity, SBP, HR, RPP and MAP, however, the DBP did not present statistic difference between baseline and ISS protocol. After session, there were significant reductions for all hemodynamic indexes, except for DBP.

Disclosure of interest

The authors declare no conflict of interest.

Resumo

O alongamento inter-séries altera a modulação autonômica e as respostas hemodinâmicas em homens jovens treinados?

O objetivo do presente estudo foi analisar o efeito do alongamento inter-séries na variabilidade da frequência cardíaca e nas respostas hemodinâmicas. A amostra foi constituída por 8 homens treinados (23 ± 2,72 anos, 1,74 ± 0,07 metros, 75,66 ± 10,85 kg). O protocolo de treino dos membros inferiores começou com três séries de 10 repetições máximas nos exercícios de Agachamento Livre e Leg Press, com 1 minuto de descanso entre as séries. Em seguida, foram realizadas 7 séries com repetições máximas na Cadeira Extensora com 30 segundos de intervalo entre as séries, utilizando os primeiros 20 segundos para alongamento passivo dos músculos do quadríceps. As respostas hemodinâmicos e a modulação autonômica, fora obtidos em repouso, durante a sessão e imediatamente após durante 15 minutos após a sessão. A avalição da modulação autonômica, foi feita pela variabilidade da frequência cardíaca. Foram observadas reduções significativas durante e após o protocolo os intervalos RR, RMSSD, pNN50, SDNN, 2LV%, 2UV%, LF e HF em comparação com os níveis basais. Entretanto, 0V% apresentou aumentos significativos durante e após o protocolo experimental. Foram observados valores mais baixos de LF/HF, LFnu e HFnu durante o protocolo. A pressão arterial sistólica, a pressão arterial média, a frequência cardíaca e o duplo-produto foram significativamente mais elevados após a sessão. Após 15 minutos, a pressão arterial sistólica, a pressão arterial diastólica, o duplo-produto e a pressão arterial média voltaram próximos aos valores basais. A atividade simpática aumentou durante o protocolo e após 15 minutos.

Palavras-chave: Treinamento de força; Alongamentos inter-séries; Variabilidade da frequência cardíaca; Pressão arterial.

References

1. Paz GA, Maia MF, Salerno VP, Coburn J, Willardson JM, Miranda H. Neuromuscular responses for resistance training sessions adopting traditional, superset, paired set and circuit methods. J Sports Med Phys Fitness. 2019;59(12):1991-2002.
2. Souza AC, Bentes CM, Salles BF, et al. Influence of inter-set stretching on strength, flexibility and hormonal adaptations. J Hum Kinet. 2013.
3. Evangelista AL, Souza EO, Moreira DCB, et al. Interset stretching vs. traditional strength training: effects on muscle strength and size in untrained individuals. J Strength Cond Res. 2019;33(00):S159-S166
4. Lemos S, Figueiredo T, Marques S, et al. Effects of strength training sessions performed with different exercise orders and intervals on blood pressure and heart rate variability. Int J Exerc Sci. 2018.
5. Figueiredo T, Rhea MR, Peterson M, et al. Influence of number of sets on blood pressure and heart rate variability after a strength training session. J Strength Cond Res. 2015;29(6):1556-1563
6. Iglesias-Soler E, Boullosa DA, Carballeira E, et al. Effect of set configuration on hemodynamics and cardiac autonomic modulation after high-intensity squat exercise. Clin Physiol Funct Imaging. 2015.
7. Gambassi BB, Queiroz C, Muniz D, et al. Acute effect of german volume training method on autonomic cardiac control of apparently healthy young. J Exerc Phys Online. 2020;22(2).
8. Muniz DLC, Santos CP, Conceição AF, Queiroz CO. Do different volumes of resistance training cause different acute answers of cardiac autonomic modulation? Moj Anatomy & Physiology. 2019;6(5):185-188.
9. Gambassi BB, Queiroz C, Nogueira R, et al. Response of the autonomic cardiac control induced by resistance training using the sarcoplasma stimulating training method. J Exerc Phys Online. 2020;23(3).
10. Baechle TR, Earle RW. Essentials of strength training and conditioning. Human Kinetics. 2000.
11. Simão R, Farinatti PDTV, Polito MD, Maior AS, Fleck SJ. Influence of exercise order on the number of repetitions performed and perceived exertion during resistance exercises. J Strength Cond Res. 2005.

12. Barroso R, Silva-Filho AC, Dias CJ, et al. Effect of exercise training in heart rate variability, anxiety, depression, and sleep quality in kidney recipients: A preliminary study. J Health Psychol. 2016;24(3):299-308.
13. Paulo AC, Forjaz CLM, Mion D, Silva GV, Barros S, Tricoli V. Blood pressure increase in hypertensive individuals during resistance training protocols with equated work to rest ratio. Frontiers in Physiology. 2020;11.
14. Macdonald JR. Potential causes, mechanisms, and implications of post exercise hypotension. J Hum Hypertens. 2002;16(1):225-236.
15. Kruse NT, Scheuermann BW. Cardiovascular responses to skeletal muscle stretching: "Stretching" the truth or a new exercise paradigm for cardiovascular medicine? Sport Med. 2017;47(12):2507-2520.
16. Mohamad NI, Nosaka K, Cronin J. Maximizing hypertrophy: possible contribution of stretching in the interset rest period. Strength Cond J. 2011;33(1):81-87.
17. Boushel R. Muscle metaboreflex control of the circulation during exercise. Acta Physiol. 2010;199(4):367-383.

Address
Lucas Rangel Affonso de Miranda
Federal University of Espírito Santo
Av. Presidente Castelo Branco, 5
29070-220 - Vitória - ES - Brazil
Email: lucasram14@gmail.com

Submitted: 12/23/2020
Revised: 06/20/2022
Accepted: 12/31/2022