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Acute Effect of German Volume Training Method on Autonomic Cardiac Control of Apparently Healthy Young

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ABSTRACT

Bavaresco Gambassi B, Queiroz C, Muniz D, Conceição A, Santos EC, Galvão V, Seguins Sotão S, Furtado Almeida AEA, Leite RD, Schwingel PA, dos Santos CP. Acute Effect of German Volume Training Method on Autonomic Cardiac Control of Apparently Healthy Young. **JEPonline** 2019;22(2):49-57. The aim of this study was to evaluate the acute effect of German Volume Training Method group (GVTMG) on autonomic cardiac control (ACC) 16 young subjects who were divided into the Control Group (CG) (n=8) and GVTM group (GVTMG) (n=8). Before and after each session ACC was evaluated. In the intergroup comparison, we found a higher value for LF/HF ratio (P=0.007) in the GVTMG, at 10-20 min. In the intragroup comparison, significant reductions were found for rMSSD (ms) [baseline vs. 5 moments (P=0.00; P=0.00; P=0.00; P=0.00; P=0.00)], pNN50 (%) [baseline vs. 3 moments (P=0.00; P=0.00; P=0.00)], HF band (nu) [baseline vs. 3 moments (P=0.00; P=0.00; P=0.002), as well as a significant increase in LF (nu) [baseline vs. 3 moments (P=0.00; P=0.00; P=0.00)] and in the LF/HF [baseline vs. 4 moments (P=0.00; P=0.00; P=0.00; P=0.00)]. GVTM promotes great stress upon ACC of apparently healthy young.

Key Words: Exercise, Heart Rate, Nervous System, Stimulus

INTRODUCTION

It is widely recognized that the practice of resistance training (RT) may provide several benefits for both healthy individuals and those affected by chronic degenerative diseases (2,8,9,10,16,17,19,20). However, coaches and strength professionals need to understand that acute exercise practice may promote a stress upon the organism, requiring a balanced prescription between workout and recovery.

In this sense, professionals should carefully assess and monitor clients and/or patients when prescribing a resistance exercise program by thoughtfully performing clinical and physical evaluations. Physiological parameters (e.g., heart rate variability) between each session should be determined to quantify the stress and provide the appropriate rest interval to achieve greater benefits with fewer risks. Additionally, James et al. (11) and others (12,14,15) have emphasized the role of heart rate variability (HRV) as a parameter to estimate stress on post-exercise ACC.

Thus, HRV assessment makes it possible to determine the impact of acute resistance exercise on ACC (6,7,13,18). Although some studies have demonstrated the acute effects of resistance exercise protocols on HRV, few studies have focused on investigating the response of alternative resistance exercise approaches (e.g., the German Volume Training Method) to post-exercise ACC.

Given the above, the aim of the present study was to evaluate the acute response of the heart rate variability to RT using the German Volume Training Method (GVTM).

METHODS

Subjects

The sample was selected using convenience sampling. Recruitment of the subjects was conducted by print media advertising, distribution of pamphlets and invitations by telephone in fitness centers from the city of Salvador, BA, Brazil.

The following criteria were adopted for subjects' recruitment: (a) nonsmokers; (b) absence of any kind of cardiovascular or metabolic disease; (c) no articular or bone injury; and (d) absence of any medication that could influence the cardiovascular response. All subjects signed the informed consent form after being properly informed about the study proposal. They were informed of the procedures they would be undergo, and the potential risks and benefits. The study was performed according to the Helsinki Declaration. All the procedures here described were approved by the Research Ethics Committee of the Bahiana School of Medicine and Public Health.

Procedures

Data collection was carried out by physical education undergraduate students from Bahiana School of Medicine and Public Health, Brazil. They had been previously trained by the researchers and professors from the Physical Education Department of the institution.

Subjects were instructed to avoid caffeinated and alcoholic beverages as well as strenuous exercise on the day before the test protocol. They were also instructed to have a light meal at least 2 hrs prior to the protocols (i.e., evaluations and performing of the method). Before and after each session (Baseline, Post, 10, 20, 30, and 40 min), ACC was evaluated by measuring time and frequency domain analyses of HRV.

At the first visit to the laboratory, the subjects were referred to the fitness facilities used in the research to become familiarized with location of the experiments. From the 2nd to the 6th day, anthropometric measurements and the one repetition maximum (1RM) procedures were undertaken (3).

From the 10th to the 12th day, all subjects performed at least 2 sessions of resistance exercise to get familiarized with GVTM. All subjects were invited to begin the experiment after 72 hrs of familiarization with the protocols.

Design
This is an experimental study with pre- and post-treatment tests designed for 2 groups. The sample consisted of 16 healthy and active young men with at least 12 months of recreational experience in RT.

Before starting the experiment, 16 subjects were divided into the Control Group (CG) (n=8) (age: 24.8±4.3 yrs; body mass index: 24.0±3.4 kg·m^{-2}) and the GVTM Group (GVTMG) (n=8) (age: 26.8±5.3 yrs; body mass index: 25.7±2.9 kg·m^{-2}). The experiments were carried out in climate-controlled conditions (21 to 24°C) with relative air humidity of 30 to 50% and in the morning (8:00 to 11:00 a.m.).

Control Group
The subjects in this group were instructed to lie in the supine position at absolute rest.

German Volume Training Method Group
The resistance exercise protocol consisted of multiarticular exercises (leg press at 45º and bench press). The subjects performed 10 sets of 10 reps with an intensity of 50% of their individual 1RM followed by a 30-sec rest interval between each set (4). The intensity should have been 60% of 1RM. But, during the familiarization process, the subjects were unable to perform the exercises with the intensity proposed by Baker (4). The bench press (free weights) and leg press at 45º (machine) were performed with full amplitude using isotonic contraction lasting 3 sec for the concentric phase and 3 sec for the eccentric phase (6 sec per repetition). The subjects were instructed to avoid the Valsalva maneuver during the entire muscle contraction. A rest interval of 2 min between exercises was adopted.

Anthropometric Measurements
Total body mass in kilograms (kg) and height in centimeters (cm) were measured using an anthropometric scale (PL-200, Filizola S.A. Pesagem e Automação São Paulo, SP, Brazil), with an accuracy of 50 g and 0.1 cm, properly calibrated (NBR ISO/IEC 17025:2005). Body mass index was determined by body mass (kg) divided by the square of height (m^2).

One Repetition Maximum Test
The resistance exercise protocol consisted of multiarticular exercises (leg press at 45º and bench press). The test began with a warm-up with 50% of the predicted 1-rep maximum (1-RM). After a 5-min rest, each subject was encouraged to perform 1 rep with a heavier load. If

the attempt was successful, the load was increased and another attempt was made until the subject achieved the 1-RM. After 72 hrs, the 1RM test was repeated. The bench press (free weights) and leg press at 45º (machine) were performed with full amplitude using isotonic contraction lasting 3 sec for the concentric phase and 3 sec for the eccentric phase (6 sec per repetition). The subjects were instructed to avoid the Valsalva maneuver during the entire muscle contraction.

While performing the test the following strategies were adopted: (a) standardized instructions concerning testing procedures were given to the subjects before each test; (b) all subjects received standardized instructions on exercise techniques; and (c) verbal encouragement was provided during the testing procedure. The 1RM was determined in fewer than 5 attempts with a rest interval of 5 min between each series and exercise.

Autonomic Cardiac Control Evaluation (Heart Rate Variability)

To assess HRV, all subjects were placed at rest for at least 20 min in the supine position with a 30º head elevation, using the Polar V800 (Polar Electro Oy, Kempele, Finland) heart rate monitor to obtain beat-to-beat intervals (R-R interval). At the end of the examination, the series of R-R intervals was extracted in text format through a Kubios heart rate variability Standard software for Windows (Kubios Oy, Kuopio, Finland, Release 3.0.0) to obtain the variables related to time and frequency domain analyses of HRV.

The following variables were selected for time domain analyses: RMSSD (ms) (square root of the mean squared differences between adjacent normal R-R intervals) and PNN50 (%) (percentage of consecutive RR intervals that showed differences greater than 50 ms). Frequency domain assessment of HRV was performed using Fast Fourier Transform (FFT) in 5-min slots with an interpolation of 4-Hz and 50% overlap. The following variables were selected: Low Frequency (LF) (nu) [(from 0.04 to 0.15 Hz) (sympathetic and parasympathetic components with predominant of sympathetic)], high frequency (HF) (nu) [(HF, from 0.15 to 0.4 Hz) (parasympathetic component)], and the ratio between low frequency/high frequency (LF/HF). The LF/HF index was calculated based on normalized LF and HF.

Statistical Analyses

Descriptive statistical analysis was performed using Prism software (GraphPad Inc., San Diego, CA, USA, Release 7.00). Continuous variables are presented as mean ± standard deviation after checking data normality using the Shapiro-Wilk test. The unpaired *t*-test was used to verify the differences between the two groups for baseline age and anthropometric characteristics. Comparisons between the means of the different times of evaluations (baseline, 10, 20, 30, 40) were undertaken by repeated measures analysis of variance (ANOVA) along with the Dunnett *post hoc* test. In addition, repeated-measures analysis of variance followed by the Sidak *post hoc* test was performed to detect differences among different times of evaluations and treatments. All measurements were two-tailed, and P values were calculated with significance levels set at 5%. Cohen's effect size (ES) d was calculated to determine the magnitude of the difference between the variables. An effect size between 0.20 and 0.49 was considered small, 0.50 and 0.79 medium, and an effect size ≥0.80 was considered the largest magnitude of effect (5).

RESULTS

A greater stress was observed on the ACC after the practice of the GVTM, as seen in Table 1. In the intergroup comparison, we found a higher value (1.6±1.0 vs. 5.0±2.3; P=0.007) for LF/HF ratio in the GVTMG, at 10-20 min. Additionally, in the intragroup comparison, significant reductions were found for the following indexes: rMSSD (ms) [baseline indexes vs 5 moments (44.6±23.2 vs. 13.7±10.7; P=0.000); (44.6±23.2 vs. 13.1±10.8; P=0.000); (44.6±23.2 vs. 16.8±10.9; P=0.000); (44.6±23.2 vs. 24.7±14.3; P=0.000) ;(44.6±23.2 vs. 29.2±18.8; P=0.001)], pNN50 (%) [baseline vs 3 moments (14.2±12.0 vs. 1.6±3.3; P=0.000); (14.2±12.0 vs. 2.3±3.8; P=0.000);(14.2±12.0 vs. 3.0±3.4; P=0.000)], high frequency band (nu) [baseline vs 3 moments (49.1±12.4 vs. 27.2±23.1; P=0.008); (49.1±12.4 vs. 20.3±11.8; P=0.000); (49.1±12.4 vs. 25.0±12.2; P=0.002)], as well as a significant increase in low frequency band (nu) [baseline vs 3 moments (50.8±12.3 vs. 72.7±23.1; P=0.008); (50.8±12.3 vs. 79.7±11.8; P=0.000); (50.8±12.3 vs. 75.0±12.2; P=0.002)] and in the low frequency/high frequency ratio [baseline versus 4 moments (1.2±0.5 vs. 4.4±3.1; P=0.000); (1.2±0.5 vs. 5.0±2.3; P=0.000); (1.2±0.5 vs. 4.0±2.3; P=0.000); (1.2±0.5 vs. 3.0±3.7; P=0.004)] (Table 1).

Additionally, the largest effect sizes were also observed for the GVTMG in the following indices: rMSSD (ms) (baseline vs. 4 moments), pNN50 (%) (baseline vs. 3 moments), LF band (baseline vs. 3 moments), HF band (baseline vs. 3 moments) and LF/HF ratio (baseline vs. 4 moments) (Table 1).

Table 1. Comparison of the Heart Rate Variability Intragroup and Intergroup.

	MOMENTS					
	Baseline Mean±SD	Post Δ	10-20 min Δ	20-30 min Δ	30-40 min Δ	40-50 min Δ
CG						
Time domain						
rMSSD (ms) ES	30.5±5.0	-2.34 d=-0.4 Small	-3.41 d=-0.7 Medium	-1.11 d=-0.2 Small	-4.28 d=-1.0 Large	-4.22 d=-1.0 Large
pNN50 (%) ES	10.9±6.4	-2.29 d=-0.4 Small	-3.24 d=-0.6 Medium	-1.47 d=-0.3 Small	-4.13 d=-0.9 Large	-4.35 d=-0.9 Large
Frequency domain						
LF (nu) ES	43.5±20.9	6.80 d=0.3 Small	12.93 d=0.7 Medium	13.67 d=0.7 Medium	17.61* d=0.9 Large	13.50 d=0.7 Medium
HF (nu) ES	56.5±20.9	-6.81 d=-0.3 Small	-12.94 d=-0.7 Medium	-13.64 d=-0.7 Medium	-17.66* d=-0.9 Large	-13.53 d=-0.7 Medium
LF/HF ES	1.1±1.1	0.68 d=-0.5 Medium	0.47 d=-0.5 Medium	0.62 d=-0.5 Medium	0.97 d=-0.8 Large	0.60 d=-0.5 Medium

GVTMG						
Time domain						
rMSSD (ms) ES	44.6±23.2	-30.95* d=-1.8 Large	-31.51* d=-1.9 Large	-27.85* d=-1.6 Large	-19.95* d=-1.1 Large	-15.36* d=-0.7 Medium
pNN50 (%) ES	14.2±12	-12.65* d=-1.6 Large	-11.95* d=-1.5 Large	-11.28* d=-1.5 Large	-5.95 d=-0.5 Medium	-2.63 d=-0.2 Small
Frequency domain						
LF (nu) ES	50.8±12.3	21.83* d=1.2 Large	28.82* d=2.4 Large	24.18* d=2.0 Large	11.90 d=0.7 Medium	8.82 d=0.6 Small
HF (nu) ES	49.1±12.4	-21.86* d=1.2 Large	-28.78* d=2.4 Large	-24.13* d=2.0 Large	-11.86 d=0.7 Medium	-8.8 d=0.6 Small
LF/HF ES	1.2±0.5	3.30* d=1.8 Large	3.88* d=2.7 Large	2.80*† d=2.0 Large	1.88* d=0.9 Large	1.18 d=0.7 Medium

SD = Standard Deviation of the Mean; **CG** = Control Group; **GVTMG** = German Volume Training Method Group; **ES** = Effect Size; **Rmssd** = Square Root of the Mean, Squared Differences between Consecutive R-R Intervals; **pNN50** = Percentage of Consecutive R-R Intervals Showing Differences Greater than 50 ms; **LF** = Low Frequency; **HF** = High Frequency; **LF/HF** = Ratio between Low and High Frequency Components. *Significant difference intragroup between baseline and each of the 5 evaluated moments; †Significant difference intergroup.

DISCUSSION

The main findings of the present study lie in the negative alterations on the ACC after the practice of the GVTM. These results are demonstrated by important modifications in the LF/HF ratio at 10-20 min and significant reductions for the following indexes: rMSSD (ms), pNN50 (%), LF (nu), HF (nu), and LF/HF.

Corroborating with our results, Figueiredo et al. (6) and Figueiredo et al. (7) observed increased stress on HRV after the practice of resistance exercise. Additionally, Rezk et al. (16) demonstrated negative alterations in the ACC after resistance exercise using a protocol with different volumes and intensities. Although some studies have focused on the effects of resistance exercise on HRV, few of them have analyzed the HRV response induced by the GVTM.

The findings in the present study indicate that the method applied promote stress upon ACC and maybe may be contraindicated in individuals at high cardiovascular risk. In individuals with such pathologies (hypertensive, diabetic, postoperative cardiovascular surgery, and obese among other high-risk conditions), the prescription of RT would have to closely follow the recommendations of the American College of Sports Medicine (ACSM) (1) with adequate volumes and intensities for higher benefits with the lowest possible risk. In this sense, strength and conditioning professionals need to closely monitor and assess their clients and/or patients' clinical and physical evaluations before proposing any RT method, since there are no randomized clinical trials to investigate the effects of different RT methods on individuals at high risk of cardiovascular events. On the other hand, according to ACSM (1), when the individual is considered low risk, high intensity exercises are not contraindicated and protocols placing greater stress upon the organism are relatively safe.

Limitations in this Study

There are some limitations in the present study that should be included in future studies to gain a better comprehension of the findings, such as the short period of intervention and limited sample size. However, the findings of our study may be considered relevant and encourage more researchers to examine and or compare different methods with more time devoted to monitoring HRV.

CONCLUSIONS

We conclude that GVTM promotes great stress upon ACC of apparently healthy young subjects. However, it is necessary to carry out randomized research with comparing different methods, as well as a longer time to monitor HRV to provide greater scientific contribution to coaches and strength professionals in developing safe exercise prescriptions.

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