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EFFECTS OF WHOLE BODY VIBRATION INTERVENTION ON HANDGRIP STRENGTH OF BRAZILIAN HEALTHY SOLDIERS

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Abstract

Background: Whole body vibration (WBV) exercises have been investigated as an alternative and complementary method to traditional resistance programs for fitness improvements in healthy subjects. Active militaries must have a high fitness level and have to improve some physical abilities to accomplish some specific tasks in Army, as climb ropes, climb walls and pull up.
Materials and methods: Seven young and healthy soldiers from Brazilian Army were exposed to mechanical vibration in a push-up position, with different frequencies, as 25 (first session), 30 (second session), 35 (third session), 40 (fourth session) and 45 Hz (fifth session). The WBV intervention consisted of five WBV sessions over a consecutive two and a half-weeks period of time. A WBV session consisted of twenty bouts, each one with 10- second vibration, interspersed with 10 seconds of passive rest and 4 minutes pause after the first 10 bouts. Handgrip strength was measured, as proposed by American Society of Hand Therapists – ASHT, before and after the session using 25 Hz of frequency and 45 Hz of frequency (1st and 5th sessions).
Results: No significant results were found between groups.
Conclusion: Intervention of WBV exercises with 25 and 45 Hz of frequency applied by hands of healthy and young soldiers had no significant results. Further investigations should focus on the efficacy of WBV in the improvement of handgrip strength of young and healthy people.

Key words: mechanical vibrations, exercises, military, hand

Introduction

Whole body vibration (WBV) exercises are produced due to expositions to mechanical vibration generated in oscillating/vibratory platform (Rittweger, 2010). WBV exercises have been investigated as an alternative and complementary method to traditional resistance programs for fitness improvements in healthy subjects (Issurin 2005; Giminiani et al., 2014; Marín et al., 2010; Cardinale et al., 2003; Cochrane, 2011).

It has beem reported that WBV exercises can lead to strength and power enhancements in a short period of time (Cardinale et al., 2003). Moreover, in the first few weeks of WBV exercises, strength gains due to, probably, to neural performance aspects (Cardinale et al., 2003); changes in the morphology, architecture and size of muscle occur just at a later stage.

Considering the effects of WBV exercises involving the lower body, it has been noticed improvements in jump, sprint and neuromuscular performances, metabolic and hormonal changes, both acute and chronic. Studies have also described important effects of vibration exposure on upper body muscular activity, as an increase in skeletal muscle activity in the arms (Marín et al., 2015; Marín et al, 2011; Marín et al, 2013) and on the handgrip strength (Giminiani et al., 2014; Kurt et al., 2015).

Handgrip strength is an important characteristic of the hand in different sportiness activities and information about it is relevant to develop lesion prevention´s protocols and to train strength of hand (Lima et al., 2014).

The hand is one of the most important parts of the human body, distinguishing humans from other animals by peculiar grip movement, that can be by fingers flexion – the strength grip – and by approximation of thumb and second

finger – the precision grip (Lima et al., 2014; Baptista et al., 2013). The hand permits to make movements that involve high levels of strength to sustain or minimal strength to manipulate objects in exercises that demand precision (Lima et al., 2014). Handgrip is essential in different daily and sportiness activities (Baptista et al., 2013).

Measurement of handgrip strength can be used as assessment of upper limb strength (Alkurdi and Dweiri, 2010), as an indicator of general health status and can represent the total strength of 22 muscles of the body (Bonitch-Góngora et al., 2013). Evaluation of this parameter is also considered to be very important when assessing athlete´s performance in some sporting activities (Bonitch-Góngora et al., 2013) as well as in activities related to professional performance, as in military subjects.

Active militaries must have a high fitness level and have to improve some physical abilities to accomplish some specific tasks in Army, as climb ropes, climb walls and pull up. In Brazilian Army active militaries have to be evaluated three times a year about their physical fitness, according to *Manual de Campanha C20-20 – Treinamento Físico Militar* and the pull up exercise is one of the exercises tested in men militaries until 39 years old (Sammito et al., 2016).

As the improvement of performance of muscles of the upper limbs is necessary to various activities to military subjects, the aim of this study is to verify if WBV can bring additional increase in the handgrip strength of military soldiers of the Brazilian Army.

Material and Methods

This clinically registered trial is a randomised cross-over intervention based in the *Laboratório de Vibrações Mecânicas e Práticas Integrativas e Complementares* – LAVIMPIC, at *Universidade do Estado do Rio de Janeiro* (UERJ). The trial has the ethical approval of the Research Ethics Committee of the *Hospital Universitário Pedro Ernesto*, UERJ (*Certificado de Apresentação para Apreciação Ética (CAAE)*: 47933015.1.0000.5259).

Participants, inclusion and exclusion criteria and recruitment

Seven soldiers were recruited from *Hospital Central do Exército*, Brazilian Army.

The inclusion criteria considered soldiers males aging from 18 to 25 years old, volunteers, healthy, with no clinical abnormality reported on the evaluation that was done by a clinical physician.

The exclusion criteria considered females, participants with more than 25 years old, with orthopeadics diseases, neurological diseases that could cause fear of falling from platform, another clinical diseases judged by the investigator and the soldiers that refused to sign the voluntary Consent Term.

The body mass and the height of the soldiers were determined before and after the WBV exercises intervention (Park et al., 2015). The body mass index (BMI) was also calculated.

These soldiers provided informed voluntary consent to participate. Outcome measures included acute and cumulative responses to exercise.

Whole body vibration intervention

The WBV intervention consisted of five WBV sessions over a consecutive two-and-a-half weeks period of time. The participants performed two WBV sessions per week separated by at least 48 hours.

The participants postured themselves in the push-up position on the vibration base of a triplanar oscillating/vibratory platform Power Plate pro5 ™ (Power Plate International LTD, The Netherlands) while flexing the elbow at 90º and kept their hands far 50 cm between them (Figure 1), as reported by Giminiani et al. (2014).

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Figure 1: Participant postured himself in the push-up position on the vibration base of a oscillating/vibratory platform, while flexing the elbow at 90º and kept their hands far 50 cm between them, trunk parallel to platform´s base and eyes down.

The participants were encouraged to keep their trunks parallel to platform´s base, with no shoes (Marín et al., 2009) and their eyes down. A WBV session consisted of twenty bouts, each one with 10- second vibration, interspersed with 10 seconds of passive rest and 4 minutes pause after the first 10 bouts, as early described (Giminiani et al., 2014).

Participants were exposed to mechanical vibration at high amplitude, with different frequencies, as 25 (first session), 30 (second session), 35 (third session), 40 (fourth session) and 45 Hz (fifth session). Giminiani et al. (2014) have used 25 and 30 Hz (Figure 2). During the rest, participants will keep themselves out of the platform´s vibration base.

	1st session	2nd session	3rd session	4th session	5th session
Frequency (Hz)	25	30	35	40	45

Figure 2. Timeline of frequencies used per session.

Handgrip strength measurement

Handgrip strength was measured as proposed by American Society of Hand Therapists – ASHT (Severijns et al., 2015). The subjects were in seated position, arm in adduction, with 90º forward at elbow joint, forearm in neutral position, wrist with extension between 0 and 30º and ulnar flexion between 0 and 15º. Subjects performed three maximum attempts with a manual dynamometer (EMG832WF, EMG System, São José dos Campos/SP) with dominant hand, during 6 seconds each, verbal encouragement and 30 seconds of rest. The average value of these trials was recorded and used to analysis (Incel et al., 2002; Massy-Westropp et al., 2011).

Handgrip strength was measured before and after the session using 25 Hz of frequency and 45 Hz of frequency (1st and 5th sessions).

The relative changes in the maximal isometric contraction during handgrip pre-post vibrational intervention in 25 Hz, 45 Hz and 25/45 Hz was calculated.

Statistical analyses

The analyses were performed using BioStat v5 statistical software. Before statistical analyses data were found to be normally distributed by Shapiro-Wilk's test and therefore the analysis was carried out using parametric statistical test (Student´s t-test). Statistical significance was set at $p \leq 0.05$.

Results

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Table I shows anthropometric characteristics of the soldiers that were exposed to the WBV exercise. No significant differences were found in body mass index.

Table I – Anthropometric characteristics of participants

	Initial	Final	*p* value
Participants	7	7	-
Age (years)	20.57 ± 0.79	-	-
Mass (kg)	64.13 ± 12.25	64.76 ± 11.86	0.92
Height (m)	1.71 ± 0.07	1.71 ± 0.07	-
BMI (kg/m^2)	21.88 ± 3.44	22.19 ± 3.48	0.87

BMI- body mass index

The relative changes in the maximal isometric contraction during handgrip pre-post vibrational intervention in 25 Hz, 45 Hz and 25/45 Hz are shown on Table II. No significant difference was found between groups.

Table II – Changes in the maximal voluntary isometric contraction during handgrip (pre-post vibrational interventions) in 25 Hz, 45 Hz and 25/45 Hz

	25 Hz	45 Hz	25 Hz / 45 Hz
Dynamometry initial (kgf)	36.69 ± 2.44	31.61 ± 2.89	36.69 ± 2.44
Dynamometry final (kgf)	31.35 ± 2.46	31.54 ± 2.92	31.54 ± 2.92
p value	0.16	0.98	0.18

Discussion

This current study investigated maximal voluntary isometric contraction during handgrip, pre-post vibrational interventions in 25 Hz, 45 Hz and 25/45 Hz by the use of manual dynamometry in young and healthy soldiers from Brazilian Army.

The use of WBV exercises has been studied for various fitness improvements, including upper limbs muscle function (Marín et al., 2015). As active soldiers must have a generally high fitness level, especially strength and endurance of arms and hands (Sammito et al., 2016), the present study has been aimed to assess the influence of WBV exercise on handgrip strength of brazilian soldiers.

WBV can potentiate handgrip performance, according to Kurt et al. (2015). The results revealed a significant interaction of pre-post × intervention for the handgrip test, indicating a significant performance increase of moderate effect after WBV intervention. WBV intervention consisted of four isometric exercises targeting forearm, leg and trunk muscles with 26 Hz of frequency.

Muscular activation of the forearm of healthy subjects can increase with vibration stimuli according to Fattorini et al. (2015). Subjects were exposed to vibration stimuli of 20, 30, 33 and 40 Hz of frequency.

In contrast, Giminiani et al. (2014) showed no significant difference on handgrip strength. Thirty male students were randomly assigned to a high vibration group (HVG), a low vibration group (LVG), or a control group (CG) and were exposed to a series of 20 trials 10 s of synchronous WBV with a 10-s pause between each trial and a 4-min pause after the first 10 trials. The CG participants assumed an isometric push-up position without WBV.

Conclusions

In summary, the intervention of WBV exercises with 25 and 45 Hz of frequency applied directly to hands of healthy and young soldiers had no significant results. Further investigations should focus on the efficacy of whole body vibration in the improvement of handgrip strength of young and healthy people.

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