

QUALITY OF LIFE OF PATIENTS WITH METABOLIC SYNDROME IS IMPROVED AFTER WHOLE
BODY VIBRATION EXERCISES

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Abstract

Background: Whole body vibration exercises (WBVE) improve the quality of life (QoL) of different populations. Metabolic syndrome patients (MetS) may be favored by physical activity. Questionnaires are used to assess the QoL. The aim was to evaluate the QoL of patients with MetS that have undergone WBVE with a brief WHOQOL (WHOQOL-BREF).

Material and Methods: MetS patients were randomly divided into three groups: (i) control group (CG), (ii) treated with WBVE once per week (WBVE1) and (iii) treated with WBVE twice per week (WBVE2). In the first session, the patient was sat in a chair in front of the platform with the feet on its base in 3 peak to peak displacements (2.5, 5.0 and 7.5 mm) and frequency of 5 Hz was used. From the second to the last session, patients were subjected to the same protocol, however they were standing on the base of the platform and the frequency was increased up to 14 Hz. The patients fulfilled the WHOQOL-BREF before the first and after the last sessions. Cronbach coefficients were determined to each domain of the WHOQOL-BREF and test Wilcoxon ($p < 0.05$) was used.

Results: The patients of the WBVE1 group had improvements in the physical, psychological and environment domains while in the WBVE2, the improvements were in the physical and social relationships domain of the WHOQOL-BREF.

Conclusion: It was observed that the WBVE in a protocol (one or two times per week) with a progressive and increased frequency improves the QoL of patients with MetS in different domains of the WHOQOL-BREF.

Keywords: whole body vibration exercises, metabolic syndrome, WHOQOL-BREF.

Introduction

Mechanical vibration is a physical stimulus characterized by an oscillatory motion. In a vibratory/oscillating platform are generated vibrations with sinusoidal and deterministic characteristics (Cardinale and Wakeling, 2005; Rauch *et al.* 2010; Rittweger, 2010). When mechanical vibrations are transmitted to a person, it is generated whole body vibration exercise (WBVE) (Cardinale and Wakeling, 2005; Prisby *et al.* 2008). Considering the movement of the base is possible to identify devices with (i) vertical displacement machines (synchronous platform) of the base with up and down movement, (ii) side-alternating displacement machine (alternating platform), while the right site is low, the left side is high and vice-versa and (iii) triplanar machines (triplanar platform) with up and down, forward and back, and side- to- side movements (Cardinale and Wakeling, 2003; Rittweger, 2010; Signorile, 2011).

WBV exercise has been considered in different populations, as in healthy person (Yeung *et al.* 2015), in elderly (Lark *et al.* 2015) and persons with diseases (Braz *et al.* 2015). WBVE is used in the athletic conditioning, in the rehabilitation programs and in the fitness approaches (Cardinale, 2005; Issurin, 2005). Authors have described the WBVE improves the quality of life (Pessoa *et al.* 2016; Bruyere *et al.* 2005; Olivares *et al.* 2011), the muscle strength (Sañudo *et al.*, 2010), the flexibility (Marín and Rhea 2010), the balance (Osugi *et al.* 2014), the joint pain (Houston *et al.* 2013), the blood flow (Elfering *et al.* 2013). In addition, patients with various diseases have been benefited with WBVE, as with fibromyalgia (Sañudo *et al.* 2010), Parkinson disease (Kaut *et al.* 2011), spinal cord injury (Herrero *et*

al. 2011), cerebral palsy (Dickin *et al.* 2013) and chronic obstructive pulmonary disease (Braz *et al.* 2015; Greulich *et al.* 2014).

The metabolic syndrome (MetS) is a complex and undesirable disorder with pro-atherogenic metabolic abnormalities. Furthermore, it is a major and escalating public-health and clinical challenge worldwide. It is commonly associated with several clinical conditions, as abdominal obesity and insulin resistance, dyslipidemia, reduction of HDL cholesterol, increase of triglycerides, hypertension and presence of a pro-inflammatory state (Ford *et al.* 2010; Kaur, 2014; Roberts *et al.* 2013). It has been demonstrated that the prevalence of MetS is increasing worldwide. Using racial or ethnic-specific *International Diabetes Federation* criteria for waist circumference, the age-adjusted prevalence of MetS was 38.5% for all participants, 41.9% for men, and 35.0% for women. Prevalence increased with age, peaking among those aged 60-69 years (de Carvalho-Vidigal *et al.* 2013). Patients MetS have compromised their quality of life (QoL) (Slagter *et al.* 2015). Quality of life as the perception of the subject about his position in life in the context of cultural and value systems in relation to his objectives, beliefs, and expectations (Slagter *et al.* 2015). The evaluation of quality of life (QoL) permits to verify the impact of a disease and the efficacy of different treatments at a personal level. An improvement in the QoL is an important outcome in determining therapeutic benefit of a technique (Rezaei *et al.* 2013; WHOQOL Group, 1998; Yang *et al.* 2016; Braz *et al.* 2015; Álvarez-Barbosa *et al.* 2014).

Questionnaires have been used as a tool for assessing the QoL of people in several clinical conditions (Braz *et al.* 2015; Slagter *et al.* 2015; Wang *et al.* 2015; Yang *et al.* 2016; Álvarez-Barbosa *et al.* 2014). The World Health Organization (WHO) has proposed a questionnaire to evaluate the QoL (WHOQOL) (WHOQOL Group, 1998) that has been translated for several countries. WHOQOL-BREF (The World Health Organization Quality of Life) is a resumed version of the WHOQOL and it was used to assess overall QoL (WHOQOL Group, 1998). It was translated and validated to the Portuguese language (Fleck *et al.* 2000). This instrument has 26 items that produce scores in four domains related to QoL: physical health, psychological health, social relationships, and environment (Fleck *et al.* 2000).

The number of publications in the PubMed database with the keywords “whole body vibration” and Whoqol was (August 23rd 2016) 1,385 and 1,738 respectively. However, publications with these keywords together were not found. This consideration strengthens the argument for the development of a study involving these subjects. Furthermore, as the physical activity is very relevant to the patients with MetS, the study about different modalities of exercises are welcome. Moreover, Beavers *et al.* (2013) have suggested that the presence of clinical disorder is strongly associated with poorer physical performance in older adults. These considerations have stimulated this investigation to evaluate the QoL of patients with MetS who were submitted to WBVE in a simple and secure protocol using the WHOQOL-BREF questionnaire. The aim of this study was to evaluate the effect of WBVE on the quality of the life of individuals with MetS through the WHOQOL-BREF questionnaire. The hypothesis of this study is that WBVE might be an important tool for improvement of the quality of life of patients with MetS.

Material and Methods

Subjects and Ethical approach

This study was approved by the Research Ethics Committee of the *Hospital Universitário Pedro Ernesto* (HUPE), *Universidade do Estado do Rio de Janeiro* (UERJ) with the number *Certificado de Apresentação para Apreciação Ética* - CAAE 54981315.6.0000.5259, and *Registro Brasileiro de Ensaaios clínicos* - ReBEC: RBR 2bghmh. The selection of the participants was made through a screening performed by the medical staff of HUPE/UERJ and *Programa de Saúde da Família (PSF)*, Mesquita, Rio de Janeiro, Brazil. The individuals have signed a consent form before any procedure and the principles embodied in the Declaration of Helsinki were followed.

Selection of the groups

Subjects who were selected by a physician after the diagnosis of MetS were admitted in the investigation. Twenty-one patients were selected and randomly divided in three groups: (i) control group (CG) (7 patients); (ii) treated with WBVE once time per week (WBVE1) (7 patients); (iii) treated with WBVE twice times per week (WBVE2) (7 patients). Their demographic characteristics are presented in Table 1.

Inclusion and Exclusion criteria

For this prospective study, the inclusion criteria were patients over 40 years-old, both genders, with previous clinical diagnosis of MetS. These patients were selected by a clinical physician who has followed MetS criteria described by the *International Diabetes Federation* (Alberti *et al.* 2009).

The exclusion criteria were patients without diagnosis confirmation of MetS, with very high blood pressure ($\geq 180 \times 110$ mmHg), cardiovascular disease (coronary artery disease or stroke), neurological, musculoskeletal or rheumatologic disease that do not permit to be on the oscillating platform and who refused to sign a consent form for participation in the study.

Interventions

The oscillating/vibratory platform (OVP) - Novaplate Fitness Evolution, DAF *Produtos hospitalares Ltda. São Paulo*, used is side-alternating displacement machine that while the right site is low, the left side is high and vice-versa (Cardinale and Wakeling, 2005; Rittweger, 2010).

The control group (CG) followed the same protocol-treated group, however, kept the platform off. The treatment groups performed the protocol and one group maintained WBVE1 once a week and the other group performed WBVE 2 twice per week.

In the first session of WBVE, all patients were sat in a chair placed in front of the platform with flexion of the knees. Their feet were on the platform base in three positions (peak to peak displacements of 2.5, 5.0 and 7.5 mm) and frequency of 5 Hz. The working time in each position was one minute followed by rest of one minute. This sequence was repeated two more times.

From the second session to the last session, patients were subjected to exactly the same protocol of the first session, however they were standing on the platform base in squat position and the frequency was progressively increased in one unit for each session up to 14 Hz in the ending of protocol. The procedure was performed weekly (one session a week WBVE1) and (two sessions a week WBVE2) during ten weeks.

Questionnaire

Each patient was asked to complete the WHOQOL-BREF questionnaire by themselves before the first and after the last session. The WHOQOL-BREF consists of four domains (Physical health, Psychological health, Social relationships, and Environment) and two items concerning Overall QoL and General health. These two items are not included in the calculation of domain scores. The response scales, all five-point Likert type ranging from 1 (not at all/never/very dissatisfied/very poor) to 5 (extremely/always/very satisfied/very good) (Fleck *et al.* 2000).

Statistical analysis

Statistical analysis of the various domains of the WHOQOL-BREF was performed and Cronbach coefficients were determined to each domain: physical domain, psychological domain, social relationship domain and environment domain. These coefficients represent the reliability of patient response for each domain. The values vary from 0 the 1.0. The values close 1 indicate a larger reliability between indicators (Landis and Koch, 1977). After that, the test of Wilcoxon was done and $p < 0.05$ was considered for statistical difference.

Results

Table 1 shows the demographic characteristics of the twenty-one subjects (7 men/14 women) with metabolic syndrome that have participated in this investigation. The value of the body mass index of this studied population indicates that the participants of this investigation can be considered "overweight".

Table 1: Demographic characteristics of the subjects

Variable	Mean±SD
Age (years old)	66.65±2.90
Stature (m)	1.67±0.09
Body mass (kg)	75.00±16.03
BMI (kg/m ²)	28.28±1.76

BMI- Body mass index, SD- Standard derivation

The Cronbach's coefficients that were generated for verifying the reliability of the responses of each domain the WHOQOL- BREF (physical, psychological, social relationship and environment) are shown in Table 2. The Cronbach's coefficients varied between 0.215 and 0.896 in each domain. Following Landis and Koch (1977), the values of the Cronbach's coefficients obtained in this study indicate that the reliability of the response of the patients, in general in the different domains and groups, is moderate.

Table 2: The Cronbach's coefficients generated for verifying the reliability of the responses of each domain the WHOQOL- BREF.

Domains	Control group Before	Control group After	Group WBVE1 Before	Group WBVE1 After	Group WBVE2 Before	Group WBVE2 After
Physical	0.731	0.805	0.615	0.896	0.250	0.548
Psychological	0.570	0.605	0.631	0.796	0.215	0.250
Social relationship	0.355	0.447	0.690	0.770	0.603	0.861
Environment	0.813	0.823	0.230	0.507	0.603	0.611

WBVE 1- Whole body vibration exercise, once time per week, WBVE 2- Whole body vibration exercise, twice times per week.

Table 3 shows the scores obtained in the physical, psychological, social relationship, environment domains of the WHOQOL- BREF, as well as the overall score of the individuals in the control group before the intervention and after the tenth session with the OVP turn off. No statistical differences were observed in control group, comparing the subjects in the beginning (before) and in the final (after) of the procedures performed.

Table 3: Scores obtained with the domains of the WHOQOL- BREF in the control group

Domains	Before	After	<i>p</i> -value
Physical	3.14± 0.62	3.08±0.45	0.271
Psychological	3.04±0.81	3.08±0.77	0.153
Social relationship	3.37±0.29	3.95±0.63	0.101
Environment	3.07±0.37	3.25±0.34	0.140
Overall score	3.15±0.41	3.34±0.28	0.080

Table 4 shows the scores of the domains of the WHOQOL- BREF (physical, psychological, social relationship, environment), as well as the overall score of the individuals of the group WBVE1. For individuals who were exposed to WBVE once a week, statistical differences were found with improvement in the physical, psychological and environment domains of the WHOQOL- BREF, as well as in the overall score after the procedure involving whole body vibration exercise once a week.

Table 4: Scores obtained with the domains of the WHOQOL- BREF in the WBVE1 group.

Domains	Before WBVE1	After WBVE1	<i>p</i> -value
Physical	2.65±0.21	3.12±0.39	0.010
Psychological	2.88±0.34	3.25±0.45	0.009
Social relationship	2.92±0.85	3.18±0.37	0.171
Environment	2.61±0.52	3.21±0.22	0.010
Overall score	3.14±0.19	2.72±0.22	0.009

WBVE1- Whole body vibration exercise (Once time per week)

Table 5 shows the scores of the domains of the WHOQOL- BREF (physical, psychological, social relationship, environment), as well as the overall score of the individuals of the group WBVE twice a week. For individuals who were exposed to WBVE twice a week (WBVE2) statistical differences were noted in the physical and social relationship domains and in the overall score after procedures.

Table 5: Scores obtained with the domains of the WHOQOL- BREF in the WBVE2 group.

Domains	Before	After	<i>p</i> -value
Physical	2.84±0.18	3.15±0.25	0.010
Psychological	3.37±0.61	3.47±0.50	0.113
Social relationship	3.78±0.61	3.95±0.63	0.040
Environment	3.05±0.47	3.24±0.05	0.171
Overall score	3.65±0.59	3.45±0.58	0.020

WBVE2- Whole body vibration exercise (twice times per week).

Discussion

Questionnaires have been useful to assess the quality of life of people in different clinical conditions (Arranz *et al.* 2014; Zubaran *et al.* 2011; Slagter *et al.* 2015; Gomes *et al.* 2014). Authors have described that the analysis of the result of a questionnaire related to the QoL permits to verify the impact of a procedure in the life of a subject (Rezaei *et al.* 2013; Yang *et al.* 2016; Braz *et al.* 2015; Álvarez-Barbosa *et al.* 2014; Wang *et al.* 2015).

Some questionnaires have been used to evaluate the QoL after a clinical procedure, as the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) (Olivares *et al.* 2011; Sañudo *et al.* 2010) and Fibromyalgia Impact Questionnaire (FIQ) and 15 Dimensional Questionnaire (15D) (Olivares *et al.* 2011).

The WHO has proposed a questionnaire to evaluate the QoL (WHOQOL) that has a resumed version, the WHOQOL-BREF. The WHOQOL-BREF is utilized in some investigations, as by Van *et al.* (2011) in a study to assess of the QoL of women with breast problems, Rezaei *et al.* (2013), to evaluate of the QoL in pregnant women with sleep disorder and Aggarwal *et al.* (2014) to verify the QoL in North Indian patients with bronchial asthma.

Concerning to the importance of the WBVE in the QoL of patients the SF-36 (Sañudo *et al.* 2010) and FIQ and the 15D questionnaire (Olivares *et al.* 2011) are some questionnaires which have been used to try to verify the influence of these exercises that involve the use of vibrations generated in oscillating/vibratory platforms.

As Beavers *et al.* (2013) have suggested, poorer physical performance in older adults is also associated with patients with MetS. Then, it would be relevant to evaluate the QoL of MetS patients who have undergone WBVE.

Sañudo *et al.* (2010) and Olivares *et al.* (2011) have used different questionnaires to assess the relevance of WBVE in other clinical conditions. The current findings (Table 4 and 5) are highly relevant due the improvements in the (a) physical, psychological and environment domains, as well as in the overall score to the individuals that have performed WBVE one time per week and (b) physical, and social relationships domains, as well as in the overall score to the individuals that have performed WBVE two times per week. This finding observed after the intervention indicates with the proposed protocol with WBVE is suitable to the patient with MetS. In addition, Beavers *et al.* (2013) have suggested that poorer physical performance also associated with MetS patient and the results with WBVE, that is very simple and safe, would be relevant to the MetS patient.

One of the limitations of study was the small number of individuals who participated in this investigation, nevertheless, other investigations (Leroy *et al.* 2017), involving the evaluation of the quality of life have used a reduced number of participants. Although, the WBVE covers other important clinical outcomes for the assessment of the effects of this type of exercise, only the evaluation of the QoL was considered in the current work.

Despite the limitations, important findings with statistical difference were observed.

In conclusion, it was observed that the WBVE in a protocol (one or two times per week) with a progressive and increased frequency improves the QoL of patients with MetS in different domains of the WHOQOL-BREF.

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