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# Influence of different frequencies of deep water running on oxidative profile and insulin resistance in obese women

Niara Medeiros [a, *], Alana Schraiber Colato [a], Fabiana Guichard de Abreu [a], Leandro Silva de Lemos [b], Luciane Cabral Fraga [b], Cláudia Funchal [a], Caroline Dani [a, b]

[a] *Department of Biochemistry, Research Center, Centro Universitário Metodista IPA, Porto Alegre, Brazil*
[b] *Department of Exercise Physiology, Centro Universitário Metodista IPA, Porto Alegre, Brazil*

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ABSTRACT

*Introduction:* Obesity is associated with health damages related to increased oxidative stress and insulin resistance. Aerobic exercise can be an ally in reducing the prevalence of obesity and its consequences. This study evaluated the effect of deep water running in two frequencies, with the same intensity, in anthropometric parameters, oxidative profile and insulin resistance in obese and sedentary women.
*Methods:* The study included 24 women with ages ranging from 47.33 ± 2.98 years old and body mass index of 33.39 ± 0.77 kg/m$^2$. They were divided into two groups: aerobic training 1 (AT1) (5 days/week) and aerobic training 2 (AT2) (3 day/week), both with moderate intensity (50–75% $VO_{2max}$ – Borg Scale), for 60 min each session. Anthropometric measurements, oxidative stress and insulin resistance were evaluated before and after the 26 training sessions.
*Results:* AT1 training provoke a significant reduction in anthropometric parameters, lipids peroxidation (TBARS) and protein oxidation (carbonyl), and increased enzymatic activity of superoxide dismutase and catalase ($p < 0.05$). On the other hand, AT2 reduced waist circumference, sulfhydryl levels and GPx activity; however, this training did not alter insulin resistance parameters.
*Conclusions:* The data suggest that the deep water running performed 5 days per week (AT1) proved to be more effective in reducing obesity rates. For this reason, this training could be an important choice to help reduce the anthropometric parameters and oxidative damage, and increase antioxidant defenses in obese women.



## 1. Introduction

Obesity is a multifactorial disease developed from the interaction of social, behavioral, psychological, metabolic, cellular and molecular factors (WHO, 2015). It is characterized by body fat accumulation, which could be associated with the development of human health complications such as cardiovascular disease, insulin resistance, diabetes mellitus (DM), dyslipidemia and other metabolic disorders (WHO, 2015; Grattagliano et al., 2008).

Different studies have reported that disorders associated with obesity and aging are directly involved with oxidative stress and insulin resistance (Grattagliano et al., 2008; Sanches et al., 2011). Although the mechanism aren't completely known, being obese for a long period of time can provoke the decline of antioxidant defenses and an increase of reactive species, corroborating to the oxidative stress. This condition could provoke molecular damages, such as lipids, proteins and deoxyribonucleic acid (DNA) (Amirkhizi et al., 2007).

Alternatively, regular exercise in suitable frequency and intensity minimize the increase of oxidative stress and insulin resistance in the obese population. It can also contribute positively to the oxidative homeostasis of cells and tissues, reducing oxidative damage and improving the antioxidant status (Powers and Jackson, 2008). Thereby, the practice of deep water running could be an alternative for obese individuals. Aquatic exercise showed an increase of calorie expenditure when compared to the training on regular ground, and it can reduce the risk of injury (Pasetti et al.,

*Abbreviations:* AT1, aerobic training 5 times per week; AT2, aerobic training 3 times per week; $VO_{2peak}$, peak oxygen consumption test; TBARS, thiobarbituric acid reactive substances; GPx, glutathione peroxidase; CAT, catalase; SOD, superoxide dismutase; DM, diabetes mellitus; BMI, body mass index.

* Corresponding author. Research Center, Centro Universitário Metodista IPA, 80, Joaquim Pedro Salgado Street, 90420-060, Porto Alegre, RS, Brazil.
*E-mail address:* niarasm@gmail.com (N. Medeiros).

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Therefore, in order to seek alternatives to reduce obesity rates and its consequential damages, this study aimed to evaluate anthropometric variables, insulin resistance and oxidative stress in obese and sedentary adult women, before and after training sessions of deep water running, with the same intensity, but with different frequencies.

## 2. Materials and methods

### 2.1. Participants

The women were invited by through media such as newspaper and posters to participate in the study at Centro Universitário Metodista IPA, Brazil.

A total twenty-four women participated in the study, over 18 years old, all sedentary (who did not practice more than 150 min of exercise during the week) and obese, with a body mass index (BMI) from 30 kg/m$^2$ to 40 kg/m$^2$. The study excluded volunteers with autoimmune disease history and cancer (self-declared), smoking or a physical exercise prohibition by a medical condition. All participants read and signed the Informed Consent, according to CNS Resolution N°. 466/2012. The Research Ethics Committee of the Centro Universitário Metodista IPA, under the 37/12 protocol, approved this study.

### 2.2. Training protocol — deep water running

The deep water running is aquatic exercise, performed with the aid of a floatation vest, which serves to keep the body in an upright position and helps to prevent contact between the feet and the bottom (Kanitz et al., 2015). Individuals simulate a run on land, with a slight flexion of trunk. This modality without any impact on the lower limbs reducing the risk of injuries (Meredith-Jones et al., 2011).

Based on the Borg's Scale (Borg, 1982) of perceived exertion, peak oxygen consumption test was performed ($VO_{2peak}$), to assess the intensity with which women were performing the exercise and to follow a linear periodization with progressive intensity. The testes were carried out as follows: before the start of training, all the women performed the $VO_{2peak}$ test through a progressive test to exhaustion on a treadmill (Inbramed Millennium ATL, Porto Alegre, Brazil). To collect gas, we utilized an ergospirometer (V02000, Medgraphics, St. Paul, Minnesota USA). The test was conducted according to the Modified Bruce Protocol (Bruce, 1971). We used the Borg Scale Perceived to monitor the intensity of the test, so that the intensity could be reproduced during the training period in pool (Table 1). $VO_{2peak}$ was defined as the highest value found after processing the data of three blinded (or independent) researchers. All the participants received the maximum verbal encouragement during the test (ACSM, 2009).

The participants were randomly divided into two groups: aerobic training 1 (AT1), n = 13, which conducted the exercises five times per week and aerobic training 2 (AT2), n = 11, conducting the exercises three times per week. Both trainings followed a progressive intensity of 50–75% of $VO_{2peak}$ (Borg Scale). Under these conditions, the total training were composed of 26 sessions of 60 min each. The sessions were divided into five minutes of initial warm-up, 50 min of training and five minutes of stretching.

**Table 1**
Training protocol of deep water running.

| | Sessions | | | | | |
|---|---|---|---|---|---|---|
| | 1 to 3[a] | 4 to 9 | 10 to 15 | 16 to 21 | 22 to 24 | 25–26 |
| Intensity (%$VO_{2Pico}$) | – | 50 | 60 | 70 | 75 | 50 |
| Borg scale perceived | – | 12 | 13 | 14 | 15 | 12 |
| Duration (minutes) | – | 60 | 60 | 60 | 60 | 60 |

[a] 3 sessions for adaptation to deep water running movements.

### 2.3. Anthropometric measurements

The following parameters were assessed before and after training: body mass (kg) (semi analytical Welmy Scale); height (cm) (stadiometer attached to the semi analytical Welmy scale); body mass index (BMI, which is calculated by weight divided by height squared, kg/m$^2$); circumference (cm) of the abdomen, waist and hip (measured with tape); body composition (%) by bioelectrical impedance method (BIA Biodynamics 310E) presenting total fat percentage values (%) and basal metabolic rate (BMR) (kcal).

### 2.4. Biological samples, biochemical analysis and oxidative stress

To perform the analysis of Glucose, Insulin and oxidative stress parameters, we used serum from venous blood samples (10 mL) collected without anticoagulant after 8 h of fasting. This serum was obtained by centrifugation at 1000*g* for 10 min, then separated, aliquoted and frozen.

All parameters were analyzed before and after the training period. Fasting glucose and fasting insulin were analyzed automated methodology COBAS® C111 model mg/dL and Insulin ELISA Kit DRG, μUI/ml, respectively. The HOMA-IR (Homeostasis Model of Insulin Resistance) was calculated by the formula [Insulin fasting (μUI/ml) × Glucose fasting (mmol/L)/22.5].

We determined lipid peroxidation through the method of Thiobarbituric Acid Reactive Substances (TBARS) described by Wills, 1966, and Protein carbonyl levels were measured to determine protein oxidation as described by Reznick and Packer, 1994. Total sulfhydryl groups were determined with the technique described by Aksenov and Markesbery, 2001. The activities of antioxidant enzymes catalase (CAT) (Aebi, 1984), superoxide dismutase (SOD) (Mirsa and Fridovich, 1972) and glutathione peroxidase (GPx) (Wendel, 1981) were also determined. For all oxidative stress analyzes we used the colorimetric method.

### 2.5. Statistical analysis

The Shapiro-Wilk normality test was performed for all variables, and assuming normal distribution the Paired Samples *T*-test was performed before and after training. For comparison between groups, we used *T*-test for independent samples (in order to verify that the groups were homogeneous prior to the intervention). Results were expressed as mean ± standard error, $p < 0.05$ with statistical difference. All data were analyzed using the Statistical Package for Social Sciences (SPSS) 18.0.

## 3. Results

The volunteers' average age was 47.33 ± 2.98 years old. Both groups had baseline values with no statistical difference ($p > 0.05$), characterized as homogenous groups in baseline. AT1 group comprised 13 women, 46.08 ± 4.54 years old and with height of 159.65 ± 1.70 cm AT2 group consisted of 11 women with 48.82 ± 3.88 years old and with height of 160.54 ± 1.74 cm.

After the AT1 training period there was a significant reduction ($p < 0.05$) of body weight, BMI, body fat percentage and waist circumference and an increase of basal metabolic rate. The AT2 group only showed significant reduction ($p < 0.05$) in waist circumference (Table 2).