

## Effects of association of physical education and multidisciplinary intervention program on cardiovascular risk factors in obese elderly women

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### Abstract:

**Purpose:** The aim of the current study was to evaluate the effects of a multidisciplinary intervention program on cardiovascular risk factors in obese women. Participated 33 obese women, classified by the body mass index - BMI  $\geq 30\text{kg/m}^2$ . **Material:** The intervention program had a duration of the 12 weeks, and consisted of nutritional and psychological support, as well as physical exercise orientation, with a supervision single weekly session for 60 min, being the participants stimulated to do physical exercise in the other days of the week. Pre- and post-intervention were measured the anthropometrics, as body weight, stature, lean body mass, fat mass, BMI; metabolic, as total cholesterol, triglycerides, glucose; hemodynamic parameters, as blood pressure and heart rate; and autonomic cardiac from the heart rate variability, with analyses in the frequency-domain, through the relative power of the low-frequency band (0.04-0.15 Hz) in normal units (LFnu) and relative power of the high-frequency band (0.15-0.4 Hz) in normal units (HFnu). **Results:** The intervention program promoted significant decrease in the body weight (-2%), BMI (-1.9%), fat mass (-2.1%), triglycerides (-2%), diastolic blood pressure (-10.6%), LFnu (-22.1%) and increase of the HFnu (+53.1%), resulting in a reduction of the LF:HF ratio, reducing the cardiac sympathetic modulation and increasing the parasympathetic modulation. **Conclusions:** These results suggest that a multidisciplinary intervention program is effective in the beginning of the treatment of obesity and to the reduction of risk factors for cardiovascular and cardiometabolic diseases.

**Key Words:** obesity, multidisciplinary intervention, body mass index, heart rate variability.

### Introduction

Obesity is considered as a chronic disease, being a global health issue due their high prevalence and constant rising incidence every year in entire world (Carneiro, Kushnir, Clemente, Brandão, & Gomes, 2000; Oliveira, Mello, Cintra, & Fisberg, 2004; Ronque et al., 2005; Sabia, Santos, & Ribeiro, 2004).

The fat excess and the central obesity increase the risks to the development of metabolic abnormalities and cardiovascular disease in men and women, with outcomes as coronary artery disease (Lima & Glaner, 2006; Oliveira et al., 2004; Pitanga & Lessa, 2005). Moreover, increases of blood pressure, as demonstrated by Covassin et al. (2018), who submitted 26 healthy subjects to weight gain during eight weeks, and the increments of 3.7 kg of body weight and 13.8cm<sup>2</sup> in visceral fat resulted in the increases at 4 and 1.7 mmHg the 24-hour systolic and mean blood pressure, respectively.

These increased in the blood pressure can occur due to the increases of the renin-angiotensin system activity from the adipose tissue that produces angiotensinogen, the unique precursor of the angiotensin II (Pantanetti et al., 2004). Besides, an increase of the sympathetic nervous activity in the muscle vasculature muscular and in the kidneys has been observed in obese individuals (Guarino, Nannipieri, Iervasi, Taddei, & Bruno, 2017).

The cardiac autonomic function can be evaluated by the heart rate variability, that showed alterations with the weight gain, demonstrated by the increase in LF/HF ratio and LFnu, which indicates the increase in the sympathetic modulation (Costa, Moreira, Moreira, Delgado, & Silva, 2018; Guarino et al., 2017). These alterations can lead to metabolic abnormalities as high cholesterol, triglycerides, and glucose levels, as demonstrated by a study that monitored non-obese healthy adult's subjects from 20 years old for 11 years, who increased their body mass index – BMI (Hashimoto et al., 2017).

The main strategy for the treatment of obesity is the modification of the lifestyle, including physical exercise to increase the energy expenditure and food restriction to promote a weight loss. In a large multidisciplinary intervention program, Barbato et al. (2006) observed that individuals aged 18-45 years, who reduced 5% of their body weight in the first 4-months showed significant improvements on blood pressure, blood glucose, and lipid profile. Hannesdottir, Gudmundsson, and Johannsson (2011), who submitted obese women aged 20-60 years to 21-months of a multidisciplinary intervention program focused on the weight loss, with significant reduction on the BMI, blood pressure and heart rate, and an increase of 18% on the maximum volume of oxygen (VO<sub>2</sub>max). The sympathetic muscular activity was reduced in obese women after an intervention program of only diet or diet and physical exercise for 4-months (Trombetta et al., 2003), and the autonomic cardiac presented improvements in the parasympathetic modulation (Baynard, Gouloupoulou, Sosnoff, Fernhall, & Kanaley, 2014; Ito et al., 2001). Besides, the obesity is strongly associated with increased odds of depressed mood in adults (Gibson-Smith et al., 2018), and for this, a multidisciplinary team should include a professional to give psychological support to remained the participants focused on their achieved weight loss (Scholes & Vaughan, 2002). In Brazil, the health public does not offer a public multidisciplinary program for weight loss in obese adults, who used to adopt medications or unbalanced diets with of the caloric restriction, being difficult to maintain over weeks. Thus, the purpose of this study was to evaluate the effect of 12 weeks of a multidisciplinary intervention program to weight loss in obese women on the anthropometric, metabolic, hemodynamic, and autonomic parameters.

## **Materials and methods**

### ***Participants***

Thirty-five obese elderly women (BMI  $\geq 30$  kg/m<sup>2</sup>, 65  $\pm$  5 years) were enrolled to participate in this study. The exclusion criteria adopted were: cognitive impairment, smoking, musculoskeletal or uncontrolled cardiovascular disease, medical complications confirmed by medical evaluation. The procedures of this study were approved by the Research Ethics Committee of the Universidade Nove de Julho and a written informed consent was signed by each participant.

### ***Procedures***

The first step was a clinical medical evaluation to certify the absence of disease or physical limitations that could prevent the participation of the women as volunteers of this study. After that, the participants that remained were subjected to 12 weeks of intervention as described below.

### ***Physical education***

The participants were submitted to physical activities to increase the energy expenditure as walking, strength exercises, and recreational activities, that included acyclic activities such as ball games. The intensity of walking was performed at 60% to 75% of maximal heart rate, and the strength exercises were performed at submaximal intensities, with three sets of fifteen to twenty repetitions, and one-minute of the interval between sets. These activities were weekly intercalated and were performed with a single weekly session of one hour. The recreational activities were the intensity controlled by the perceived exertion. The participants were instructed to performed physical exercise on the other days of the week and were instructed to give information in a questionnaire containing details about the type, volume, and intensity of the physical activities.

### ***Nutritional and physiological support***

The habits of the dietary were analyzed and the participants were instructed to make adjustments in the food diet during nutritional classes. Each participant received a food menu to follow, containing a balanced diet to lose weight. Psychologists and psychiatrists conducted a psychotherapy group and give a psychiatric support when required. Also, there was a psychotherapy group in a weekly session for twelve weeks to discuss subjects as body awareness and awareness of the psychological aspects involved in obesity.

### ***Evaluated parameters***

#### ***Anthropometric and body composition assessment***

The weight (kg) and height (cm) were measured to determine the BMI (kg·m<sup>-2</sup>) (Filizola, PL-180). The BMI as used to classify the obesity in class 1 (30 to 34,9 kg·m<sup>-2</sup>), class 2 (35 to 39,9 kg·m<sup>-2</sup>) and class 3 ( $\geq 40$  kg·m<sup>-2</sup>) (Eveleth, 1996). The body composition was assessed by bioimpedance (Bioimpedance Analyzer, Biodynamics BIA 450) being determined the fat mass and fat-free mass according to the recommendations of the Lukaski, Bolonchuk, Hall, and Siders (1986). For this measurement, the participants were instructed to suspend the use of diuretic drugs at 7 days before the test; also, to avoid the consumption of alcohol and caffeine 48 and 24 hours, respectively; to avoid physical activity in the last 24h; be fasting at least 4 hours, and to do not urinate

at last 30 minutes. The participants were instructed to keep in rest in supine position over 5 minutes before the test. The assessment was valid when the total body water presented at 68 to 75%.

#### **Assessment of metabolic profile**

The participants were fasting for four hours for this assessment. A local asepsis was performed using alcohol at 70%. A blood sample was withdrawn from the fingertip. Previously, the levels of glucose (Accu-Chek Advantage, Roche), triglycerides and total cholesterol (Accu-trend PLUS GTC, Roche) were analyzed using strip tests.

#### **Hemodynamic and cardiac autonomic assessment**

Systolic and diastolic blood pressure were measured after 5 minutes of rest in a seated position using the indirect auscultatory method, following the procedures of Lackland (2013). The heart rate and the R-R intervals were continuously recorded (Polar, model S810i), with a strap attached in the chest, for ten minutes after five minutes in a supine position. The data obtained were analyzed and the heart rate variability indexes were obtained. The data of interval R-R of heart rate were filtered using a moderate filter, and the heart rate variability indexes were obtained. The series of pulse interval were divided into segments of 509 beats. The heart rate variability indexes of the frequency-domain were obtained using the Fast Fourier Transform, which allows detecting the central frequency, number, and power of each component. The power spectrum is integrated into three frequency ranges of interest: high frequency (HF) between 0.15 and 0.4 Hz, which reflects vagal modulation, low frequency (LF) between 0.04 and 0.15 Hz, reflecting the sympathetic and vagal modulation, and very low frequency (VLF) below 0.04 Hz the spectral analysis of breathing pattern used as the control for defining the bands of frequencies, which can be presented as normality units (nu) ("Heart rate variability. Standards of measurement, physiological interpretation, and clinical use. Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology," 1996).

#### **Statistical analyses**

The normality of the data was tested by the Kolmogorov-Smirnov. The results were presented as a mean  $\pm$  standard error. To compare pre- and the post-intervention program was used Student t test, and the level of significance was set at 5%. When there were significant differences pre-post intervention, the magnitude of mean differences was analyzed by the Cohen's d effect size, considering 0.2 as small effect size, 0.5 as medium effect size, and 0.8 as large effect size (Cohen, 1969).

## **Results**

The results are described in table 1. Twelve weeks of a multidisciplinary program intervention resulted in significant reductions in body mass, BMI, and lean body mass, with a small effect size. There was no alteration in the fat mass. In the metabolic profile, there was a significant reduction in triglycerides, with a small effect between the mean differences. In the hemodynamic variables, there was a significant reduction in the DBP, with a medium effect size. The LFnu reduced, and HFnu increased, resulting in a reduction in the LF/HF ratio, considered as medium effect size. The coefficient of variation was similar pre- and post-intervention program.

Table 1. Anthropometric, metabolic, hemodynamic, and cardiac autonomic parameters of the obese women, expressed in media  $\pm$  standard error.

Parameters	Pre-intervention	CV (%)	Post-intervention	CV (%)	Cohen's d
<b>Anthropometric</b>					
Body mass (kg)	106.7 $\pm$ 6.6	33.9	104.5 $\pm$ 6.6*	34.6	0.1
BMI (kg·m <sup>-2</sup> )	42.6 $\pm$ 2.5	32.1	41.8 $\pm$ 2.5*	32.8	0.1
Lean body mass (kg)	57.8 $\pm$ 2.5	23.7	56.6 $\pm$ 2.6*	25.2	0.1
Fat body mass (kg)	48.7 $\pm$ 4.0	45	47.9 $\pm$ 4.0	45.7	-
<b>Metabolic profile</b>					
Total Cholesterol (mg·dL <sup>-1</sup> )	190.9 $\pm$ 10.1	29	191.0 $\pm$ 9.1	26.1	-
Triglycerides (mg·dL <sup>-1</sup> )	215.4 $\pm$ 26.5	67.4	186.7 $\pm$ 20.4*	59.8	0.2
Glucose (mg·dL <sup>-1</sup> )	104.2 $\pm$ 6.3	33.1	102.4 $\pm$ 5.6	30	-
<b>Hemodynamic profile</b>					
Heart rate (bpm)	50 $\pm$ 2	21.9	54 $\pm$ 2	20.3	-
Systolic blood pressure (mmHg)	130.6 $\pm$ 4.1	17.2	131.2 $\pm$ 4.4	18.4	-
Diastolic blood pressure (mmHg)	91.8 $\pm$ 3.0	17.9	82.1 $\pm$ 2.0*	13.3	0.7
<b>Heart rate variability</b>					
LFnu	70.5 $\pm$ 5.3	41.2	54.9 $\pm$ 6.4*	63.9	0.5
HFnu	29.4 $\pm$ 5.3	98.7	45.0 $\pm$ 6.4*	77.9	-0.5
LF/HF ratio	3.5 $\pm$ 0.7	109.5	1.7 $\pm$ 0.3*	96.7	0.6

\*p  $\leq$  0.05 in relation to pre-intervention. Values expressed in mean  $\pm$  error deviation. LFnu: Relative power of the low-frequency band (0.04-0.15 Hz) in normal units; HFnu: Relative power of the high-frequency band (0.15-0.4 Hz) in normal units; LF/HF ratio: Ratio of LF-to-HF power.

## Discussion

The main finding of this study is that 12 weeks (three months) of the multidisciplinary intervention program was effective in the treatment of obesity, improving not only the anthropometric profile, as body weight (-2%), BMI (-1.9%), fat body mass (-2.1%, non-significant), but also the metabolic profile, as a reduction of 2% in the triglycerides, and hemodynamic profile, as a 10.6% of reduction in the diastolic blood pressure, and autonomic parameters, as a reduction in 22.1% in the LFnu and an increase in the HFnu of the 53.1%, which represents improvements to the parasympathetic modulation.

Trombetta et al. (2003), submitted obese women to four months of an intervention program of hypocaloric diet or hypocaloric diet associated with exercise training, which was performed three times per week with 60 minutes, consisting of 30-40 min of aerobic cycling and 20 min of resistance and flexibility exercises, and both groups showed decreased body weight (-10.1 to -10.6%), BMI (-10%), and fat-mass (-12.9 to -17.9%), however, the obese women submitted to the only diet reduced the lean body mass in 4.2 kg, while those who were submitted to exercise training presented a less reduction of 1.2 kg in lean body mass. Our study presented reductions in a less scale, because the less duration of the intervention, but there was a similar result in relation to the reduction of 1.2 kg in the lean body mass, which could be related to the strength exercises performed by the participants.

Barbato et al. (2006), found higher improvements in the health of women that received a monthly orientation about a good lifestyle during four months, as a reduction of the body weight, total cholesterol, and reduction in the diastolic blood pressure (-4 mmHg) in obese women (grade I). Another similar study, conducted by Kim and Kim (2012), submitted obese postmenopausal women to 16 weeks of aerobic exercise of dance, performed three times for week for 60 min per session at 55-80% of the age-predicted maximum heart rate, and observed higher improvements in the anthropometric variables, metabolic and hemodynamic profile. Part of these results are similar to this study, but the improvements presented less magnitude, except to diastolic blood pressure (-10.6%), which presented a higher magnitude of reduction (-9.7 mmHg).

Regarding the cardiac autonomic modulation, Ito et al. (2001) submitted middle-aged obese women to three-month of an intervention aimed at increasing physical activity and modifying eating behavior. There was an increase of HF component and a reduction of the LF component, meaning an improvement in the parasympathetic modulation. Baynard et al. (2014) observed an increase in the HF, without significant modification in the LF in obese individual men and women with low cardiac parasympathetic modulation, who were submitted to 16 weeks of aerobic exercise training (30-45 min of walking for 4 days for a week at 65% of VO<sub>2peak</sub>).

The gain in body weight increases the sympathetic modulation to stimulate the higher resting energy expenditure, promoting the restoration of the body weight (Guarino et al., 2017), as observed in our study. A reduction of the body weight after the multidisciplinary intervention program, based in nutritional support and physical exercise promoted similar results to the studies above cited, being observed not only an increase of the HFnu but also a reduction of the LFnu, resulting in a higher parasympathetic modulation and a reduction of the sympathetic modulation.

## Conclusion

The results suggest that 12-weeks of a multidisciplinary intervention program was effective to begin of the treatment of the obesity and to reduce the risk factors for cardiovascular and cardiometabolic diseases. A multidisciplinary intervention program longer than 12-weeks could probably to result in a deeper positive healthy modification in the evaluated parameters to obese women.

## Conflict of Interest

Authors declare there are not have any conflict of interest.

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