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# Effects of high-intensity interval training on the anthropometric profile of overweight and obese adult women

## *Efectos del entrenamiento físico intervalado de alta intensidad sobre el perfil antropométrico de mujeres adultas con sobrepeso u obesidad*

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**Ingrid Rivera-Torres**[1,2] • **Pedro Delgado-Floody**[3]

[1] Universidad Católica de Temuco - Technical College - Advanced Technical Degree in Physical Preparation - Temuco - Chile.
[2] Universidad Mayor - Temuco Campus - Faculty of Sciences - School of Nutrition and Dietetics - Temuco - Chile.
[3] Universidad de La Frontera - Faculty of Education, Social Sciences and Humanities - Department of Physical Education, Sports and Recreation - Temuco - Chile.

Corresponding author: Pedro Delgado-Floody. Department of Physical Education, Sport sand Recreation, Faculty of Education, Social Sciences and Humanities, Universidad de la Frontera, Uruguay No. 1980. Phone number: +56 45 2 325206. Temuco. Chile. Email: pedrodelgadofloody@gmail.com.

| Abstract |

**Introduction:** Sedentary lifestyle, overweight and obesity in adult women have high prevalence.

**Objective:** To determine the effects of a high intensity interval training program on the anthropometric profile of overweight or obese women.

**Materials and methods:** 24 adult women, including 16 with overweight and 8 with obesity, between 26 and 49 years of age, were selected to participate in a two month high intensity training program (three sessions per week). Weight, height, BMI, muscle mass percentage, and fat mass and visceral fat percentages were assessed.

**Results:** The adherent group (≥75% assistance) was composed by 16 participants, while the non-adherent group (assistance <75%), by 8 participants. No significant differences were found among both groups previous to and after the intervention (p≥0.05).The non-adherent group did not show any significant change, while the adherent group improved (p<0.05) their variables of weight (p<0.001), BMI (p<0.001), fat mass percentage (p<0.001), muscle mass percentage (p<0.001) and visceral fat percentage (p=0.020) after the intervention.

**Conclusions:** The training program improved the anthropometric profile of the participants without requiring specialized equipment or involving high costs, thus, this procedure is recommended for the treatment of malnutrition by excess in this type of population.

**Keywords:** Physical Exercise; Overweight; Obesity (MeSH).

| Resumen |

**Introducción.** Existe una alta prevalencia de sedentarismo, sobrepeso y obesidad en mujeres adultas.

**Objetivo.** Determinar los efectos de un programa de entrenamiento intervalado de alta intensidad sobre el perfil antropométrico de mujeres con sobrepeso u obesidad.

**Materiales y métodos.** 24 mujeres adultas (16 con sobrepeso y 8 con obesidad) entre 26 y 49 años fueron reclutadas para participar en un programa de entrenamiento de alta intensidad durante dos meses (tres sesiones/semana). Se evaluó peso, talla, IMC, porcentaje de masa muscular, porcentaje de masa grasa y porcentaje de grasa visceral.

**Resultados.** El grupo adherente (asistencia ≥75%) quedó compuesto por 16 participantes y el grupo no adherente (asistencia <75%) por ocho participantes. No existieron diferencias significativas pre y post intervención entre ambos grupos (p≥0.05). El grupo no adherente no presentó cambios importantes mientras que el grupo adherente mejoró (p<0.05) las variables peso (p<0.001), IMC (p<0.001), porcentaje de masa grasa (p<0.001), porcentaje de masa muscular (p<0.001) y porcentaje de grasa visceral (p=0.020).

**Conclusiones.** El programa de entrenamiento mejoró el perfil antropométrico de las participantes sin requerir implementos ni costos elevados para su desarrollo, por lo que es un procedimiento recomendable para el tratamiento de la malnutrición por exceso.

**Palabras clave:** Ejercicio físico; Sobrepeso; Obesidad (DeCS).

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## Introduction

Chile has evolved and its economy, technology and culture have progressed in such a way that, in recent decades, it has positioned itself as a developing country. However, there is an alarming increase of chronic non-communicable diseases: 93% of women are sedentary and 64% are overweight or obese (1); both pathologies are associated with the development of insulin resistance, type 2 diabetes and cardiovascular disease (2-5). The traditional pharmacology has not provided an effective response to battle obesity, instead, physical activity has proven to be one of the most effective solutions to counteract the effects associated with this condition (6). This benefit grows if the activity is performed regularly and intensity increases (7).

Obesity is defined as an excess of body fat or adipose tissue, and is produced by the increase in energy consumption and the reduction in caloric expenditure (8). This condition generates a series of processes that develop resistance to leptin, resulting in a vicious cycle of weight gain induced by genetic and environmental factors (9).

Physical exercise has been proved to be one of the most effective ways to prevent and treat modern chronic diseases (10). When training is aerobic, although beneficial health effects are generated, high volumes of exercise are required to produce significant changes in the body; taking into account that the lack of physical activity of the population is mainly caused by lack of time (11), considering methods that produce more sudden and profound effects is necessary. Low-volume, high-intensity interval training (HIIT) should be considered as a method for battling the negative effects of chronic diseases associated with lifestyle (12,13), as there is evidence that the accumulation of a variety of HIIT is effective for improving cardiopulmonary fitness, VO2max (14), metabolic capacity and insulin sensitivity (15,16).

The purpose of this study was to determine the effects of a high-intensity interval training program on the anthropometric profile of overweight or obese women.

## Materials and methods

### Participants

24 adult women, aged 26 to 49, voluntarily participated in this study and went through a HIIT program for two months, in the facilities of Universidad Mayor, Temuco Campus; 16 participants were overweight and 8, obese. The invitation was made through voluntary and free registration in three exercise sessions per week (24 sessions in total).

The study design was quasi-experimental and two study groups were created according to the percentage of assistance to the program by the participants: the adherent group (AG), with attendance to exercise sessions ≥75% (minimum 18 sessions, n=16, age: 38.4±13), and the non-adherent group (NAG), with assistance <75% (less than 18 sessions, n=8, age: 32.2±6). Each participant acted as self-supervisor after comparing the pre and post intervention.

The protocols coincided with the Declaration of Helsinki of 2013; the study was approved by the School of Nutrition of Universidad Mayor and each participant signed an informed consent to participate in the research.

Inclusion criteria included female subjects, aged 18 to 60 and at least three of the following factors: 1) high percentage of total fat >21%; 2) BMI >25, 3) sedentary lifestyle with the aim of performing <50 minutes per week of physical activity, and 4) percentage of muscle mass decreased by <40%.

Exclusion criteria considered the presence of any history of osteoarticular or ischemic disease, arrhythmias, tachycardias or chronic obstructive pulmonary disease that prevented doing HIIT exercises.

### Procedures

Weight, muscle mass percentage (% MM), body fat percentage (% BFP) and visceral fat were determined through a double bioelectrical impedance assessment —using an bioelectrical impedance meter OMROM HBF-510LA—, barefoot, in light clothes and without metal objects. Height was determined with the aid of a precision height rod —Health o Meter®, USA—, graduated at 0.1mm; to calculate body mass index (BMI), the Quételet formula was used. Overweight was classified as 25.0-29.9 kg/m$^2$, and obesity as ≥30 kg/m$^2$.

### Design of the intervention program

An interval exercise program with the 1x2x3 method (17) was designed; three sets per exercise were run for 60 seconds, each with an intensity that induced muscle failure at the end of this period and two minute breaks between sets. This methodology is similar to other studies (18,19).

The exercises were focused on abdominal muscles and knee and hip extensors, and they were performed with multi - joint movement chains (Table 1). The progression of the exercises was done to break the adaptability of the study subjects to the accumulation of stimuli.

**Table 1.** Exercise protocol used in the intervention.

| | Characteristic | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Intensity** | Muscle failure after a minute of exercise. | | | | | | | |
| **Progression** | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 |
| | Half squat | Deep squat | Deep squat with side kick | Deep squat with jump side kick jump | Deep squat with side kick jump Crunch exercise | Deep squat with side kick jump Crunch exercise Cross-legged crunch | Deep squat with side kick jump Crunch exercise Cross-legged crunch Thrust | Deep squat with side kick jump Crunch exercise Cross-legged crunch Thrust |
| **Progression** | 9 minutes | 9 minutes | 9 minutes | 18 minutes | 18 minutes | 30 minutes | 40 minutes | 40 minutes |
| **Method** | One-minute exercise – two-minute passive rest to reach recovery pulse - three repetitions three times a week, on alternate days. | | | | | | | |
| **Materials** | No equipment implementation is required | | | | | | | |

Source: Own elaboration based on the data obtained in the study.

## Statistical analysis

Data are presented as mean ± standard deviation. All variables showed normal behavior ($p \geq 0.05$) and were measured through Shapiro Wilk test. A Student's t-test was used to evaluate pre- and post-intervention differences and for comparison between groups and independent groups. All analyzes were performed using SPSS version 22.0 and the confidence level was 95% ($p<0.05$).

## Results

The NAG (participation <18 sessions) did not show significant changes after the intervention, whereas the AG (participation ≥18 session) presented significant changes with HIIT intervention in the following variables: weight ($p<0.001$), BMI ($p<0.001$), BFP% ($p<0.001$),% MM ($p<0.001$) and visceral fat% ($p=0.020$) (Table 2).

**Table 2.** Features of pre and post high-intensity interval training intervention.

| Variables | Test | Non-adherent group (≥18 sessions) (n=8) | Adherent group (<18 sessions) (n=16) | Comparison between groups p |
|---|---|---|---|---|
| Weight | Pre | 68.40±11.72 | 74.70±13.28 | 0.268 |
| | Post | 68.08±11.14 | 72.29±12.61 | 0.432 |
| | V % | -0.48 | -3.61 | |
| | p value | 0.376 | **<0.001** | |
| BMI | Pre | 28.11±4.69 | 29.63±4.60 | 0.457 |
| | Post | 27.97±4.46 | 28.66±4.36 | 0.719 |
| | V % | -0.51 | -3.27 | |
| | p value | 0.337 | **<0.001** | |
| % Body fat | Pre | 42.36±5.72 | 43.86±5.79 | 0.556 |
| | Post | 42.06±5.70 | 41.66±5.86 | 0.873 |
| | V% | -0.71 | -5.02 | |
| | p value | 0.140 | **<0.001** | |
| % MM | Pre | 24.11±1.73 | 24.26±2.40 | 0.877 |
| | Post | 24.20±1.89 | 25.26±2.49 | 0.304 |
| | V% | 0.36 | 4.12 | |
| | p value | 0.630 | **<0.001** | |
| % Visceral Fat | Pre | 8.25±2.38 | 7.75±2.35 | 0.629 |
| | Post | 8.25±2.40 | 7.44±2.22 | 0.417 |
| | V% | 0.00 | -4.00 | |
| | p value | 0.999 | 0.020 | |

% MM: muscle mass percentage; BMI: body mass index; V%: percentage change between pre and post intervention. Source: Own elaboration based on the data obtained in the study.

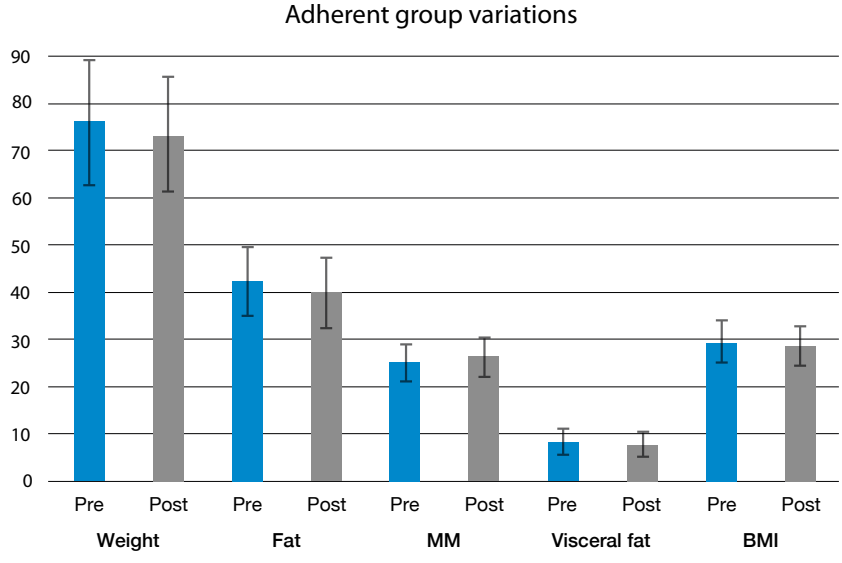


**Figure 1.** Significant variations - adherent group. Source: Own elaboration based on the data obtained in the study.

## Discussion

The purpose of this study was to determine the effects of a of high-intensity interval training program on the anthropometric profile of 8 overweight women and 16 obese women. The results indicated that the implementation of this program or training method, without the use of specialized equipment, allowed achieving changes in body composition, especially in reducing the fat mass of the adherent group.

Overnutrition was associated with the development of insulin resistance and risk factors for cardiovascular disease (20). In this research, weight and BMI reported changes after eight weeks of HIIT ($p<0.001$), results that differed from other studies where similar methodologies were applied but failed to achieve significant changes in nutritional status (21,22); higher weight losses in subjects with obesity and morbid obesity were reported only in cases in which patients also received counseling and nutrition education (23). In addition, fat mass percentage significantly decreased by 5.02% in the adherent group ($p<0.001$).

The research conducted by Zhang *et al.* (24) implemented a 12-week training program with Asian women that included high-intensity sprint and showed a decrease in the percentage of body fat, thus making HIIT the most effective method to control visceral and subcutaneous fat. The study by Kordi *et al.* (25), with sedentary women, proved that high-intensity interval training is an appropriate method for reducing body fat and improving anthropometric indices; likewise, Mancilla *et al.* (26) implemented this method on subjects with impaired glucose and excess weight, achieving a body fat reduction of 4.2kg. Postmenopausal women showed similar results through aerobic and overload exercise (27) and brisk walking (28).

In this study, muscle mass increased by 1.25%, similar to other groups of study with pre-diabetic predisposed subjects (29), where resistance exercises were applied until muscle failure for three months. A group of elder Japanese women proved that when obesity is combined with muscle weakness, there is a greater risk of developing mobility limitation than with only obesity (30), which is why it must be a priority in the treatment of women with this condition if quality of life is intended to improve.

In the research by Zapata-Lamana *et al.* (31), performed with adult women for three months, a physical exercise program, similar to the reported in this study, was implemented; improvements in cardiovascular health were observed when blood lipids and cholesterol were significantly altered.

This research allowed producing significant changes in the variables studied without requiring a high duration per session, which confirmed that this type of HIIT methodologies are time-efficient, improve muscle function and produce skeletal muscle adaptations that result in an increased fat and glucose oxidation (32-35); this is evident in the increase of % MM and the decrease of BFP% of the studied overweight or obese women.

It is important to incorporate, for future research, psychosocial variables to assess, from a holistic perspective the effect of physical exercise as the main limitation of this study is that only anthropometric variables were considered.

## Conclusions

The intervention conducted in this study improved the anthropometric profile of women with overnutrition subjected to intervention and that accomplished adherence to the program (>18 sessions); similarly, the patients significantly reduced their weight and body fat ($p<0.001$). It is noteworthy that this program managed to meet the target without requiring additional equipment.

The evaluation of plasma levels, aerobic capacity and blood pressure are planned for future research in order to further complement the benefits of this program.

## Conflicts of interest

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