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Can low-level laser therapy (LLLT) associated with an aerobic plus resistance training change the cardiometabolic risk in obese women? A placebo-controlled clinical trial

Fernanda Oliveira Duarte [a,*], Marcela Sene-Fiorese [b], Antonio Eduardo de Aquino Junior [a,c], Raquel Munhoz da Silveira Campos [d], Deborah Cristina Landi Masquio [d], Lian Tock [e], Ana Claudia Garcia de Oliveira Duarte [f], Ana Raimunda Dâmaso [d], Vanderlei Salvador Bagnato [b,c], Nivaldo Antonio Parizotto [a,c]

[a] Therapeutic Resources Laboratory, Department of Physiotherapy, Federal University of São Carlos (UFSCar), Rodovia Washington Luis, Km 235, 13565-905 São Carlos, São Paulo, Brazil
[b] São Carlos Institute of Physics, University of São Paulo (USP), Avenida Trabalhador Sãocarlense, 400, PO Box 369, 13560-970 São Carlos, São Paulo, Brazil
[c] Post-Graduated Program of Biotechnology, Federal University of São Carlos (UFSCar), Rodovia Washington Luis, Km 235, 13565-905 São Carlos, São Paulo, Brazil
[d] Post-Graduated Program of Nutrition, Federal University of São Paulo (UNIFESP), Rua Marselhesa, 650, 04021-001 São Paulo, São Paulo, Brazil
[e] Weight Science, rua Teodoro Sampaio, 744, Cj. 98, 05406-000 São Paulo, São Paulo, Brazil
[f] Nutrition and Metabolism Applied to Exercise Laboratory, Department of Physical Education, Federal University of São Carlos (UFSCar), Rodovia Washington Luis, Km 235, 13565-905 São Carlos, São Paulo, Brazil

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ABSTRACT

Introduction: Obesity is one of the most important link factors to coronary artery disease development mainly due to the pro-inflammatory and pro-thrombotic states favoring atherosclerosis progression. The LLLT acts in the cellular metabolism and it is highly effective to improve inflammation. The same occur in response to different kinds of exercise. However, we have not known the associate effects using LLLT therapies with aerobic plus resistance training as strategy specifically with target at human obesity control and its comorbidities.
Objective: Investigate the effects of the LLLT associated with aerobic plus resistance training on cardiometabolic risk factors in obese women.
Methodology: Women aged 20–40 years (BMI ≥ 30 kg/m^2), were divided into 2 groups: Phototherapy (PHOTO) and Placebo. They were trained aerobic plus resistance exercises (in a concurrent mode), 1 h, 3 times/week during 16 weeks. Phototherapy was applied after each exercise session for 16 min, with infrared laser, wavelength 808 nm, continuous output, power 100 mW, and energy delivery 50 J. The body composition was measured with bioimpedance. Inflammatory mark concentrations were measured using a commercially available multiplex.
Results: LLLT associated with aerobic plus resistance training was effective in decrease neck ($P = 0.0003$) and waist circumferences ($P = 0.02$); percentual of fat ($P = 0.04$); visceral fat area ($P = 0.02$); HOMA-IR ($P = 0.0009$); Leptin ($P = 0.03$) and ICAM ($P = 0.03$). Also, the reduction in leptin ($P = 0.008$) and ICAM-1 (0, 05) was much more expressive in the phototherapy group in comparison to placebo group when analyzed by delta values.
Conclusion: LLLT associated with concurrent exercise (aerobic plus resistance training) potentiates the exercise effects of decreasing the cardiometabolic risk factors in obese woman. These results suggest the LLLT associated with exercises as a new therapeutic tool in the control of obesity and its comorbidities for obese people, targeting to optimize the strategies to control the cardiometabolic risk factors in these populations.

1. Introduction

Obesity is a complex disease and its pathogenesis is multifactorial, resulting mainly from sedentary behaviors coupled with inadequate eating habits [1,2]. It is strongly associated with subclinical inflammation, metabolic syndrome, type 2 diabetes and an elevated risk of cardiovascular diseases [3]. Some cytokines with higher concentrations in obesity promote the development of cardiovascular disease, mainly pro-inflammatory proteins such as leptin, plasminogen activator inhibitor (PAI-1), interleukin-6 (IL-6), tumor necrosis factors alpha (TNF-α), intracellular adhesion molecule 1 (ICAM-1) and vascular cell adhesion molecule 1 (VCAM-1), among others [4,5].

* Corresponding author at: Therapeutic Resourses Laboratory, Department of Physiotherapy, Federal University of São Carlos (UFSCar), Rodovia Washington Luis, Km 235, 13565-905 São Carlos, São Paulo, Brazil. Tel.: +55 16 3351 8985.
E-mail address: fefa.duarte74@gmail.com (F.O. Duarte).

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In this context, the obesity, mainly the visceral fat, is directly associated with major risk for cardiovascular and metabolic diseases and is a feature of systemic inflammation [6]. The hyperleptinemia and hyperinsulinemia configure the profile of most obese individuals and appear to be the key factors of the metabolic abnormalities, providing inadequate response to weight loss therapy [7]. Furthermore, the PAI-1 increase in plasma of the obese individuals leads to a hyperthrombotic state by hypofibrinolysis, hypercoagulability and platelets activation that leads to the development of atherosclerotic plaques formation, main predictor for myocardial infarction [8,9].

Data supports that the interdisciplinary intervention model associated to aerobic plus resistance training was more effective in improving the visceral adiposity, inflammatory markers and metabolic profile in obese adolescents [10,11]. In addition, Jackson and colleagues [12] find changes in the body composition as in circumferential measurements across waist, hips, and thighs compared to placebo subjects after LLLT treatment, with a total of six treatments across 2-weeks. The authors suggest that change in the adipose tissue occurs due to adaptations in the membrane permeability of adipocytes, releasing fatty acids in blood circulation, but their removal and metabolism mechanisms still remain unclear [12].

Actually the advance in studies involved low-level laser therapy (LLLT) or light-emitting diode (LED) therapy has allowed a better understanding of their mechanisms in the biologic tissues. Therefore, the use of light in different applications like LLLT as ancillary non-invasive treatment has been disseminated in recent years, mainly in controlling pain, inflammation, mucositis, tissue repairs besides the muscle performance and also in the aesthetic treatments [13–16].

Although, recently a pioneer study of our research group demonstrated that phototherapy when associated with swimming training was efficient to potentiate the weight loss, as well as ameliorate the lipid profile in exogenous obese rats [17]. Nonetheless, we did not find studies using the association between LLLT therapies with aerobic plus resistance training as strategy specifically with target at human obesity control and its comorbidities.

This way, we hypothesized that the LLLT associated with aerobic plus resistance training may promote a reduction in pro-inflammatory and prothrombotic markers, contributing to reduce cardiometabolic risk factors in obese women in a placebo-controlled clinical trial.

2. Material and Methods

The details about experimental design are shown in Fig. 1.

2.1. Subjects

For this study, a total of 64 adult obese women, with the age of 20–40 years were involved in this randomized double blind controlled clinical trial. The volunteers were recruited by impress and electronic media, TV and radio. The inclusion criteria were: 1) primary obesity, body mass index (BMI) between 30 and 40 kg/m^2 and 2) age between 20 and 40 years old. Exclusion criteria were: 1) the use of cortisone, anti-epileptic drugs; 2) history of renal disease; 3) alcohol intake; 4) smoking and 5) secondary obesity due to endocrine disorders.

The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the ethics committee on human research at Universidade Federal de São Carlos — UFSCar (#237.050) and registered at Clinical Trial: 231.286. All procedures were made clear to the volunteers and consent for research was agreed. The evaluations were performed at different times: in the beginning and the end of therapy; and in the middle (4 months) of interdisciplinary intervention. The main reasons for dropping out (n = 12) in our study were pregnancy, family problems and job opportunities.

The volunteers were randomly assigned between two groups through the sample randomization program (www.randomization.com): placebo group and phototherapy group (PHOTO). The treatment consisted in physical exercise intervention – moderate aerobic plus resistance training – and the individually application of phototherapy immediately after the end of the training. The same interventions of phototherapy group were applied for placebo group voluntaries however, during the application of phototherapy the placebo group did not received the incidence of laser light, characterizing the study as a placebo-controlled clinical trial. This one is the blind analyzer and the other is the person that analyzed the data, without the knowledge of the treated group. The voluntaries do not know which group they belonged. During the experimental

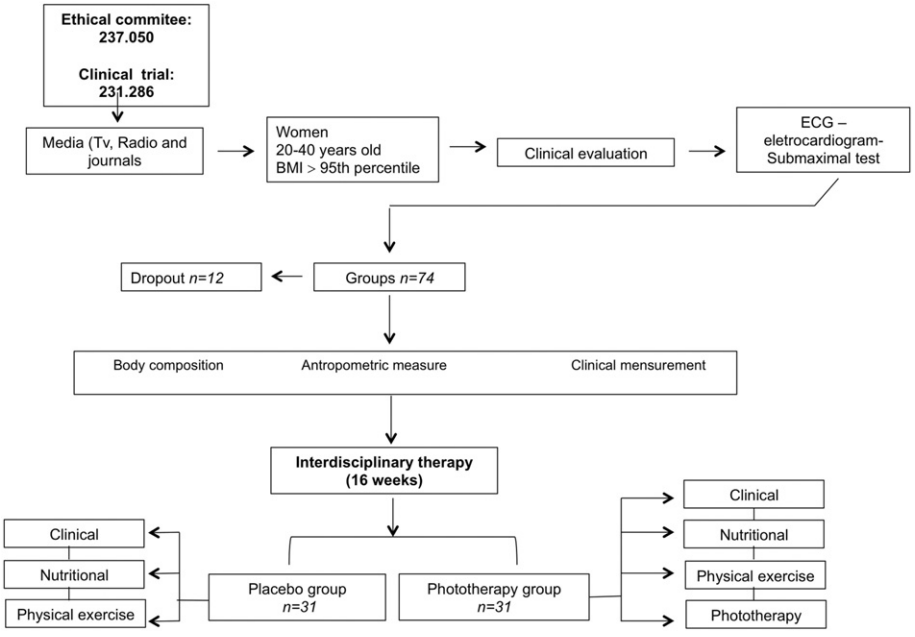

Fig. 1. Methodological description.