Research Article
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Effects of an arm cycloergometer session on morbid obese women (acute exercise effect on morbid obese women)

Abstract

Introduction: The number of morbidly obese individuals has risen in percentages in comparison with different obesity levels and there are very few studies exploring the possibilities of physical exercise for such population.

Objectives: Verify the possibility of morbid obese to perform a 30-minute session of mild to moderate continuous aerobic exercise, analyzing the Excess Post-exercise Oxygen Consumption (EPOC) 30 minutes after exercise in addition to the acute cardiovascular effects.

Materials and methods: A clinical study was developed with 14 obese, morbidly sedentary pre-bariatric surgery women, aged between 28 and 51 years old. The patients took part in a clinical analysis, which consisted of body composition, maximal stress test and a 30 minutes-exercise session in an arm cycle ergometer, preceded by 3 minutes of warm up before any physical examination. A mild to moderate intensity was used at a reserve heart rate (HR) between 55 and 69% of maximal heart rate at moderate intensity. Energy exercise expenditure, EPOC, and the acute responses of the HR, blood pressure (BP) and oxygen saturation were checked and analyzed.

Results: Out the 15 patients evaluated, 14 were able to complete the prescribed exercise session within an average expenditure of 131.5 kcal in the exercise and 37.2 in EPOC. The only patient who could not complete the task was due to pain in her shoulder. No patient demonstrated desaturation or abnormalities for HR and BP.

Conclusions: These findings indicate that physical exercise in an arm cycle ergometer may be an alternative at improving health levels of morbidly obese patients, as it does not promote oxygen desaturation and shows expected standard responses for heart rate and blood pressure.

Keywords: exercise, morbid obesity, arm cycle ergometer, metabolism

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Renato Vidal Linhares[1,2,4–6] Felipe Monnerat Marino Rosa,[2] José Carlos Quaresma,[2,4] João Regis Ivar Carneiro,[2] Valéria Bender Braulio,[2–4] Fábio André Castilha,[1,2,4] Denise Pires de Carvalho,[4] José Fernandes Filho[1–3]

[1]Laboratory of Human Movement Biosciences (LABIMH), Brazil
[2]Clementino Fraga Filho Universitary Hospital, Federal University of Rio de Janeiro, Brazil
[3]Laboratory of Nutrology (Labonutro), Federal University of Rio de Janeiro, Brazil
[4]Federal University of Rio de Janeiro, Brazil
[5]Pedro II College Human Movement Science Research Group (GPC in Motion), Brazil
[6]Pedro II School Physical Education Research and Studies Group (GEPEFE), Brazil

Correspondence: Renato Vidal Linhares, Department of Endocrinology, Medicine Faculty, Federal University of Rio de Janeiro, RJ, Brazil, Email renatolinharesj@gmail.com

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Abbreviations: EPOC, excess post-exercise oxygen consumption; BP, blood pressure; HR, heart rate.

Introduction

Obesity levels are growing worldwide and is currently the most prevalent metabolic disease,[1] being even considered an epidemy[2] and one of the main public health problems[3] of the contemporary world.

According to the World Health Organization (WHO) obesity is classified by the body mass index (BMI), determined by the relationship between body mass (kg) and squared height (mt).[4,5] When BMI levels are above 40 kg/m², obesity is considered severe or severe grade III. Al-Awamreh et al.,[6] associate the prevalence of obesity mainly with changes in feeding habits and physical inactivity, that is, changes in population's lifestyle. As obesity causes and its impacts are diverse, multidisciplinary work is needed in the aim of making treatment more effective.[7–10]

In the Bariatric Surgery Program of the Clementino Fraga Filho University Hospital, Federal University of Rio de Janeiro (PROCIBA/HUCFF-UFRJ), obesity treatment is developed by a multidisciplinary team, which include professionals from the medical, nutrition, psychology, social work, physiotherapy and physical education areas, among others. This group provides expert information to support the weight loss treatment, as well as to analyze the aptitude for bariatric surgery. Although bariatric surgery is considered the intervention with best results in the treatment of severe obesity,[11] stimulating lifestyle changes, such as the incorporation of physical exercise is a must, not only because it is a less aggressive method, but also due the fact that the availability of surgeries is short and does not reach all morbidly obese people.[1] In order to choose the most appropriate type of exercise for such public, it is important to recognize the profile of the individuals. In morbidly obese people, there are posture difficulties[12] and musculoskeletal disorders, especially in the lower limbs,[13] which reflect directly on these people's motion, thus affecting the development of physical exercise. MacLellan et al.,[14] in a retrospective study (2011 to 2015), point out that 91% of obese grade III people report musculoskeletal pain; 69% report low back pain; and 59% knee pain. Such variables may interfere in the development of physical exercise for such people, optimizing sedentary behaviors.

Based on this, in the present study there was an interest in prescribing an aerobic activity to morbidly obese people using an arm cycle ergometer, equipment recommended for rehabilitation,

wheelchair users, pregnant women, people with spinal cord injury, and specific sports such as canoeing.[15] This study investigated the effects of a physical exercise session in an arm cycle ergometer and aimed at verifying the possibility of morbidly obese women to perform an aerobic exercise session for uninterrupted 30 minutes, as well as analyzing the acute effects in the heart rate (HR) blood pressure (BP), SPO_2, calories expenditure and EPOC in morbidly obese, sedentary and pre-bariatric surgery women.

Materials and methods

Participants and procedures

This cross-sectional with case study typology design study involved grade III obesity patients, which were evaluated in physical and cardiorespiratory variables for the prescription of physical exercise and follow-up analysis of the acute effects of a physical exercise cycle ergometer exercise session. The sample consisted of 15 women, aged between 28 and 51 years. One individual could not perform the evaluation due to pain in her shoulder and was therefore excluded from the sample. The sample was selected by convenience; the patients were all adult women, dully enrolled in the Bariatric Surgery Program of Clementino Fraga Filho University Hospital, Federal University of Rio de Janeiro (PROCIBA/HUCFF-UFRJ), in the pre-operation phase for bariatric surgery. The study patients were part of PROCIBA/HUCFF – UFRJ. The inclusion criteria were: patients being evaluated for bariatric surgery, aged between 20 and 59 years; women; classified as obesity grade III (BMI ≥40<60 kg/m²); and with a sedentary lifestyle. Patients with untreated hypothyroidism; cognitive changes that could prevent the performance of the protocol; pacemakers users; pregnant women; neoplasm in remission for less than five years; in postoperative or infectious recovery; with previous bariatric surgery; with diabetes mellitus under insulin use; beta blockers users; with autoimmune disease; with physical or neurological inability to walk; were all excluded from the study.

According to Matins et al.,[16] physical inactivity is characterized as the lack of regular mild physical exercise for over 20 minutes, at least three times a week, in the previous three months. Or lack of leisure physical activity or strenuous work more than once a week. The exercise session prescription was followed by an aerobic power assessment protocol.[17] The physical exercise session prescription was planned according to the recommendations of the American College of Sports Medicine[10,11] for overweight and obese individuals, which include, exercises of mild to moderate intensity (reserve HR between 55 and 69% of the maximum HR). Thus, a 30-minute training session was established, preceded by 3 minutes of warm-up until reaching the HR target zone, followed then by 30 minutes of continuous exercise. After each training session, the patients remained seated for another 30 minutes in order to analyze the energy expenditure at the time of the extra post-exercise oxygen consumption (EPOC), which happens due to the higher consumption of oxygen and energy consequently, since the body is struggling to reach its balance (homeostasis). The test protocol and physical exercise session were performed on alternate days as a way of controlling possible results interference.

Instruments

Blood pressure (BP) was measured using a GLICOMED® cardiac stethoscope and a GLICOMED® sphygmomanometer. For checking the heart rate (HR) and oxygen saturation (SPO2), a CONTEC® oximeter was used. The room was prepared according to the recommendations of the CAREFUSION, VMax 29N Encore model, which recommends a quiet environment with no more than three evaluators; temperature should be between 20 and 24°Celsius and relative humidity around 50 or 60%. In addition, a TECHNOGYM arm cycle ergometer, EXCITE PRÓ model was used.

Statistical analyses

All project participants were volunteers and signed a free and informed consent letter, authorizing the conduction of the research, in accordance with the Declaration of Helsinki principles, resolution 196/96 of the National Research Ethics Council, as well as any regulations in place. The present study was approved by the research and ethics committee of the Federal University of Rio de Janeiro (CEO-HUCFF, process 132-13 of group III). Data treatment was performed using a descriptive statistical analysis with means, standard deviation, minimum and maximum values. In order to check the differences between the physiological variables, inferential statistics were used, with paired t-test (HR, BP, SBP) and When comparing the energy expenditure value found by indirect calorimetry with the one analyzed by the arm cycle ergometer, no significant difference was found ($p = 0.36$); Pearson correlation analysis also showed a strong correlation ($p = 0.71$) between variables. The level of significance assumed was of 5%.[18]

Results

Tables 1&2.

Table 1 Descriptive values for the anthropometry components and the body composition of the sample

Variables	Mean±SD	Minimum	Maximum
Age (years)	36,3±6,2	28,0	51,0
Body Mass (kg)	118,5±17,8	91,2	151,6
Height (m)	1,6±0,07	1,5	1,7
BMI (kg/m²)	46,0±4,3	40,5	54,1
WHR	1,1±0,03	1,0	1,12
Body Fat (%)	51,2±3,1	43,1	55,8
LBM (kg)	32,9±5,2	25,6	42,4

BMI, body mass index; WHR, waist and hip ratio; LBM, lean body mass.

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Table 2 Variables of the Acute Physical Exercise in the Arm Cycle Ergometer in Morbid Obese Women

Variables	Mean±SD	Minimum	Maximum	p
Average HR (Cycle Ergometer) (HRM)	132,2±9,9	117	150	-
Max HR achieved (Cycle Ergometer) (HRM)	139,8±11,5	126	163	-
Callories Spenditure (Kcal)	131,5±13,9	110	149	-
Callories Spenditure (Calorimetry) (Kcal)	132,6±19,3	103,9	168	-
EPOC: Total (Kcal)	37,2±6,8	26,7	48,4	-
% EPOC/ Exercise	28,3±3,9	22,7	36,1	-
HR at rest (HRM)	83,3±8,5	72,0	98,0	-
SPO_2 at rest (%)	98,0±0,7	97,0	99,0	-
SBP at rest (mmHg)	120,0±7,8	110,0	136,0	-
DBP at rest (mmHg)	86,0±7,0	76,0	96,0	-
HR pos-exercise (HRM)	118,7±16,9	92,0	140,0	<0,001
SPO_2 pos-exercise (%)	98,0±0,5	97,0	97,0	= 0,76
SBP pos-exercise (mmHg)	127,8±17,1	94,0	150,0	0,071
DBP pos-exercise (mmHg)	75,0±14,1	53,0	94,0	0,109

EPOC, extra post-exercise oxygen consumption; HR, heart rate, SPO_2, oxygen saturation; SBP, systolic blood pressure; DBP, diastolic blood pressure

Discussion

According to Poirier et al.,[19] in order to treat obese patients, appropriate body mass control techniques should be implemented, as well as the knowledge of weight loss clinical effects, since weight loss after bariatric surgery affects the improvement of aerobic capacity and physical exercise tolerance.[20] In addition, for a greater adherence, either mild or moderate activity intensity is advisable, especially for sedentary individuals.[21,22] Such issues highlight the importance of aerobic exercise programs for obese individuals, as these are directly affected by abnormalities in their structure,[23,24] reduced mobility, which makes it difficult for them to follow weight loss programs;[25] morbidly obese individuals usually present bad posture which in long term may affect the musculoskeletal structure.[26] In this sense, studies on the variation of physical exercises which allow obese people to take part on (such as the arm cycle ergometer), is a current need; the arm cycle ergometer smooths the development of aerobic exercises and consequently allows the individual to achieve better results, both in weight loss and in cardiorespiratory fitness, since supervised and low-frequency exercises are able to improve the metabolic, physical and functional profile of morbidly obese individuals.[27]

As obesity tends to be associated with osteoarthritis problems, especially in the lower limbs,[28] the choosing of an arm cycle ergometer allowed 9 of the 10 patients to complete the training session, which highlights that such exercise may be viable for this population. In addition, Donnelly et al.,[29] report that 150 minutes of aerobic exercise per week may help lowering co-morbidities and risk factors[30] which are part of obese individuals' lives[31] (30 minutes for 5 times a week). Another issue that needs to be highlighted is regarding energy deficit. Jakicic et al.,[32] recommend it should be between 500 and 1000 kcal a day for a safe weight loss. In this study involving morbid obesity, an average energy expenditure of 131.5 kcal was found by indirect calorimetry, which times 5 (training sessions per week), adds up to 657,5 kcal per week. When comparing the energy expenditure value found by indirect calorimetry with the one analyzed by the arm cycle ergometer, no significant difference was found ($p = .36$); Pearson correlation analysis also showed a strong correlation ($p = 0.71$) between variables.

When measuring the basal metabolic rate of morbidly obese women, Cesar et al.,[33] reported a consumption of 2023 kcal per day. The exercise energy expenditure (137.4 kcal) plus the EPOC measured in the first 30 minutes after the training session (37.2 kcal on average) was 176.3 kcal. It is recommended that the energy expenditure from physical exercise should be between 15 and 30% of the basal energy expenditure in healthy individuals.[34] The morbidly obese women from this study had an expenditure of 8.3%. In addition, a drop of about 25% after the first 10 minutes of exercise ending was noted, and remained close to this until the end of the 30th minute. According to Schuenke et al.,[35] EPOC can last between 14 minutes and 48 hours and can be influenced by the type, intensity and duration of the exercise, as well as being able to reach up to 20% of the energy session expenditure;[36] at the time of 60 minutes post-exercise, these values tend to return to rest levels.[37]

With regards to the acute responses of cardiovascular variables such as HR, BP (SBP, DBP), SPO_2, a significant difference between the rest and post-exercise values in HR was noticed ($p<0,001$), which rises with the oxygen demand for the muscular area involved in exercise with an arm cycle ergometer. SBP not differed significantly (between rest and post-exercise) although due to the blood requirement of the muscles involved in the activity.[38] However, PAD has shown a drop tendency, a phenomenon described as an acute hypotensive

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effect after physical exercise.[39] SPO_2 showed no alteration, therefore, it indicates that the patients did not desaturate, pointing out that the cycle ergometer may be a good way to promote body mass loss and overall health improvement in morbidly obese individuals, as lipid profile improved.

It is concluded, therefore, that the physical exercise performed in an arm cycle ergometer in mild to moderate intensity is able to promote an energy expenditure, which may help in reducing the body mass of morbidly obese women. Thus, it can be an alternative at improving the health levels of this population, besides being a safe method which allows the monitoring of the heart electrical activities during exercise. It stands out as a great alternative for morbidly obese individuals who have difficulties in ambulate due to osteoarticular problems, especially in the spine and knees.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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