

**PHYSICAL EXERCISE AND MORBID OBESITY: A SYSTEMATIC REVIEW***Exercício físico e obesidade mórbida: uma revisão sistemática*Sidnei Jorge **FONSECA-JUNIOR**<sup>1</sup>, Carlos Gabriel Avelar de Bustamante **SÁ**<sup>1</sup>,  
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**HEADINGS** - Physical activity. Body mass index. Weight loss. Bariatric surgery.

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**ABSTRACT - Introduction** - Physical exercise is an important component for the treatment of obesity. Little information is available about the best and safety form of physical exercise concerning the type and volume-intensity to be prescribed for individuals with morbid obesity. **Aim** - To investigate the effect of physical exercise programs in medical and surgical treatment for morbid obesity. **Methods** - Was used the systematic search model by databases of the Virtual Health Library in "Science in General Health" (Medline, Lilacs and Ibecs) and PubMed using the following headings: morbid obesity, severe obesity, grade 3 obesity, exercise and physical activity. Were selected papers that used physical exercise programs as an intervention in the treatment for morbid obese patients and those who were in accordance with the inclusion criteria. **Results** - Were selected 13 articles. Eight were conducted with individuals in clinical treatment, one in patients awaiting bariatric surgery and four in the postoperative period. It was observed that all selected studies used aerobic activities and six also included strength exercises on their programs. **Conclusions** - Aerobic and strength exercises programs proved being important components in the treatment of morbid obesity. Special care when establishing the volume-intensity exercise is required for adherence to treatment, and a proposal for a valid individualized exercise programs.

**RESUMO - Introdução** - O exercício físico é importante componente do tratamento da obesidade. Poucas são as informações sobre o melhor e mais seguro tipo de exercício e o volume-intensidade a ser prescrito para indivíduos com obesidade mórbida. **Objetivo** - Investigar os efeitos de programas de exercícios físicos no tratamento clínico e cirúrgico da obesidade mórbida. **Método** - Foi utilizado o modelo sistemático de pesquisa através das bases de dados Biblioteca Virtual em Saúde nas "Ciências em Saúde em Geral" (Medline, Lilacs e Ibecs) e PubMed, utilizando os seguintes descritores: morbid obesity, severe obesity, grade 3 obesity, exercise, physical activity. Foram selecionados estudos que utilizaram programas de exercícios físicos como intervenção no tratamento de obesos mórbidos que estavam de acordo com os critérios de inclusão. **Resultados** - Foram selecionados 13 artigos, dentre os quais, oito foram realizados com indivíduos em tratamento clínico para a obesidade, um em pacientes aguardando a cirurgia bariátrica e quatro no período pós-cirúrgico. Observou-se que todos os estudos selecionados utilizaram atividades aeróbicas e seis inseriram em seus respectivos programas os exercícios de contra-resistência. **Conclusões** - Programas de exercícios físicos aeróbicos e resistidos mostraram ser importantes componentes no tratamento da obesidade mórbida. Cuidados especiais no momento da determinação do volume-intensidade de exercícios físicos são necessários para a aderência ao tratamento, sendo válida proposta de programas de exercícios individualizados.

**INTRODUCTION**

Obesity is one of the main public health problems in the world, being considering a disease which worries due to social, psychological and metabolic issues. It is linked to the development of comorbidities that may even lead to death<sup>22</sup>. Individuals with body mass index (BMI) above 40 m / kg<sup>2</sup> are considered obese grade 3, severe or morbid. In this degree, increase the risk of developing cardiovascular diseases, diabetes, some cancers, high blood pressure, breathing difficulties, disorders on the locomotor system and dyslipidemia

beyond psychopathological disorders such as depression and binge eating<sup>22,15</sup>.

In combination, exercise and low-calorie diets promote the decrease of body fat, the increase of the lean mass and the remission of comorbidities generated by excess fat, making the clinical treatment of obesity along with the use of specific drugs<sup>15</sup>. Bariatric surgery is another form of treatment that has been increasing worldwide. It is considered more efficient in a long term than the clinical treatment<sup>27</sup>. However, before and after the surgical procedure, exercise should be included in a program of multidisciplinary surgical treatment<sup>15,17</sup>.

Accordingly, in order to ensure greater security in exercise prescription and your adherence - besides generating greater scientific knowledge of its effects in relation to weight loss and health in general - comes the importance of analyzing the studies that used physical exercise programs as intervention in the treatment of morbid obese (MO).

The aim of this study was, through a systematic review, to investigate the effects of exercise training programs in clinical and surgical treatment of morbid obese patients.

## METHODS

The literature review consisted of searching in the Virtual Health Library in the database of the "Health Sciences in General" (Medline, Lilacs and IBECs) and PubMed. Initially, the terms used in the Virtual Health Library were "morbid obesity" or "several obesity" or "grade 3 obesity" and "exercise" or "physical activity". However, it was noted that the terms "grade 3 obesity" and "physical activity" reduced the ability of the search, being removed after the observation that the titles found with their insertions were duplicates of another search without their insertions. In PubMed, the terms used were ("morbid obesity" or "several obesity" or "grade 3 obesity") and ("exercise" or "physical activity"), the filters being used in accordance with the inclusion criteria.

Were included in the selection only articles in English, Spanish and Portuguese, with human beings, published from January 2000 until July 2012, which used an intervention program of physical exercise in the treatment for weight loss or any other aspect of health in general morbid obese adults (mean BMI of participants greater than 40 m / kg<sup>2</sup>), with application of tests and re-tests (pre-and post-intervention) for the dependent variables, there could use or not control groups.

To capture articles from past years to the search - or even those not found within the search system - it was decided to accept articles within the inclusion

criteria cited in the selected or queried.

Initially, we analyzed all titles and abstracts of the search by three evaluators. Each evaluator selected those who were apparently within the inclusion criteria. Subsequently, discussed the selections and what articles would be pursued in full over the Internet or by Switching Bibliographic Program, and were excluded articles not freely available on the internet or on the Portal Capes, libraries or universities. After reading the articles by evaluators, it was discussed the possibility of including some cited articles that were in accordance with the inclusion criteria. Articles that after the reading were not in full accordance with the inclusion criteria were excluded.

Searching in the Virtual Health Library resulted in 321 abstracts, with 22 selected for reading the full articles. The PubMed search resulted in 293 abstracts, of which 160 were duplicates search the Virtual Health Library Of the 133 abstracts evaluated, seven were selected to read the full article.

Of the total of 29 papers selected for reading, three were not freely available on the internet, on the Portal Capes and on Programme Switching Bibliography. One had been disregarded by the publisher. Another had no detailed description of the intervention and after reading 13 articles were discarded because they did not fit the inclusion criteria. Finally, it was considered include two articles mentioned that, after reading, it was found that they were in accordance with the inclusion criteria. Thus, 13 articles were used in this study.

## RESULTS

Table 1 presents a summary of the selected articles, the profile of treatment and the overall objectives of the studies. After a briefly description of the methodological characteristics, types of exercise, volume, intensity and the observed effects.

Sukata et al.<sup>30</sup> used 26 individuals with type 2 diabetes mellitus ( BMI = 43.8 ± 9.5 kg / m<sup>2</sup> ), and 18 completed the intervention which consisted of 16 weeks of exercise, performed on alternate days, lasting 40 minutes to an hour. After randomization, one group performed resistance training exercises that contemplated eight major muscle groups being conducted in two or three series. The loads were increased when subjects could perform 10 repetitions. Another group performed aerobic training on a cycle ergometer with loads ranging between 65 and 85 % of heart rate reserve. Loads increased as the training adaptations. HbA1c remained elevated in both groups after training. However, there was a reduction in systolic and diastolic blood pressure and increased serum triglycerides in the group that performed aerobic

training. The greater adherence to the training significantly reduced waist circumference.

**TABLE 1** - Profile of the treatment and overall objective of the studies selected \*

References	Profile of the treatment and sample used	Overall objective
<b>Clinical treatment</b>		
Sukata et al. <sup>30</sup>	G1=9 individuals (TR) G2=9 individuals (TA)	To evaluate the effects of two different exercises to improve glycated hemoglobin (HbA1c) and cardiometabolic variables.
Goodpaster et al. <sup>10</sup>	T1=67 individuals T2=63 individuals	To determine the effectiveness of weight loss and physical activity in adverse health risks.
Annesi et al. <sup>1</sup>	57 volunteers	To investigate relationships between physical activity, mood and weight change.
Christiansen et al. <sup>4</sup>	249 individuals	To evaluate the maintenance of weight loss of two to four years after the lifestyle intervention focusing on physical activity for weight loss of morbidly obese patients.
Sartorio et al. <sup>25</sup>	28 men 67 women	To compare changes in body composition, strength and power production in men and women after intervention to reduce weight through calorie restriction and exercise.
Facchini et al. <sup>8</sup>	40 individuals	To evaluate the effects of a program to reduce body weight composed of caloric restriction and exercise high intensity heart rate variability in morbidly obese.
Sartorio et al. <sup>26</sup>	57 individuals	To evaluate the effects of a multidisciplinary program of weight reduction including nutritional education and exercise on plasma leptin levels and body composition.
Laforntuna et al. <sup>14</sup>	G1= individual training G2= group training	Compare the effects of two different interdisciplinary programs to reduce body weight composed of different caloric restriction and physical training protocols.
<b>After surgery</b>		
Stegen et al. <sup>29</sup>	EG=8 individuals CG=7 individuals	To investigate the effects of bariatric surgery on physical exercise and determine the benefits of an exercise program in the first four months.
Shah et al. <sup>28</sup>	EG= 20 individuals GC=8 individuals	To evaluate the feasibility of implementing a program of high volume workouts and analyze their effects on physical performance improvement, weight loss, comorbidities and quality of life.
Castello et al. <sup>3</sup>	GE=11 individuals CG=10 individuals	To analyze the impact of a 12-week program of aerobic exercise on heart rate variability and functional capacity in women.
<b>Before surgery</b>		
Marcon et al. <sup>17</sup>	EG=34 individuals CG=27 individuals	To evaluate the impact of a minimum program of supervised exercise on functional capacity and cardiometabolic risk factors in morbidly obese individuals.
<b>Clinical treatment / after surgery</b>		
Berggren et al. <sup>2</sup>	Extremely obese= 9 Obese after weight loss= 5	To investigate whether clinical interventions for weight loss, comprising physical training, could reverse the impairment in fatty acid oxidation evident in extremely obese subjects.

EG= experimental group; GC=Control Group; G1=Group 1; G2=Group 2; RT= resistance training; TA= aerobic training; before surgery= studies conducted with subjects who were waiting for bariatric surgery; **After surgery** = studies conducted with subjects who performed bariatric surgery. \* All studies were performed with morbid obese.

On the study of Goodpaster et al.<sup>10</sup> participated in 130 morbid obese patients of a community selected from messages on television and in newspapers. After randomization, one group underwent intervention in lifestyle for 12 full months with diet and exercise (walk of moderate intensity, with progressions to perform for 60 minutes a day five days a week). The other group also suffered

diet for 12 months, but had the exercise program, initiated only in the last six months. Both treatments provided improvements for the cardiometabolic risk, but the reduction in body weight and abdominal fat from the liver was most significant in the group that exercises 12 months.

The study Annesi et al.<sup>1</sup> was conducted with volunteers' women who did not practice exercises, did not do any kind of treatment for obesity and were not pregnant or intended to be. The exercise program was conducted in a center of physical activity, the individual was able to choose between activities such as walking or aquatic, which, for adherence, were individually adjusted in intensity and duration. Were prescribed three exercise sessions per week for a total of 72 sessions (24 weeks / six months). It was verified the improved in mood, reduced symptoms of depression and stress state. It was also observed association between BMI reduction with such psychosocial variables.

Christiansen et al.<sup>4</sup> investigated the effects of a 21-week on camping for weight loss containing hypocaloric diet, intense physical activity and behavioral therapy. Physical training consisted of five days with 120 minutes of aerobic exercises like swimming, walking, stationary bike and weight training with intensity estimated 50-60% of VO<sub>2</sub>max. On average, subjects lost 15% of body weight at the end of the training. Afterwards the authors found that only 28% of morbid obese patients maintained their weight loss after four years of camping.

Sartorius et al.<sup>25</sup> compared men and women who performed physical exercise five days a week for three weeks. Each session consisted of aerobic training with 10 minutes of stationary bike pedaling at 50-60 rpm, 20 min walk on a treadmill with a slope of 0-3%, and five minutes of arm ergometer. The intensity for all exercises was 50% of VO<sub>2</sub>max during the first week and 60% in the others two. They also performed three isotonic strength exercises: legpress, bench press and vertical traction with 15 repetitions each at 40% of the maximum strength in the first week and 50% and 60% during the second and third week, respectively. Were given in all sessions nutrition education and psychological consultation. Among the improvements related to the body composition was observed to reduce BMI in both sexes, with body mass was more pronounced in men and fat mass in women; in women there was maintenance of fat-free mass. There was increased the maximal isotonic strength (1RM) in both genders, the power output per unit of fat-free mass in women, whereas in men only increased in absolute numbers.

Facchini et al.<sup>8</sup> investigated the effect of a short three-week multidisciplinary program for weight reduction based on dietary restriction with a nutritionist, psychological counseling and physical training of high intensity and low volume.

Five times per week was conducted a program of aerobic exercise on a cycle ergometer, treadmill, arm ergometer for 35 min per day at 50% of VO<sub>2</sub>max during the first week and then at 60% of VO<sub>2</sub>max in the two weeks later. Was modified favorably the cardiac autonomic profile of the sample, there was also a significant reduction in BMI.

In the study of Sartório et al.<sup>26</sup> 54 individuals participated in a weight reduction program consisting of dietary restriction, moderate aerobic exercise, strength training program, psychological counseling and educational lectures. The exercise program was performed five times a week and consisted of 10-minute sessions of exercise bike pedaling at 50-60 rpm, 20 minutes treadmill with slope of 0-3%, and five minutes of arm ergometer intensity for each type exercise 50% VO<sub>2</sub>max during the first week and 60% in the next two weeks. Strength training was conducted with three isotonic exercises: legpress, bench press and vertical traction. Were performed 15 repetitions of each exercise at 40% of maximum strength in the first week and 50% and 60% in the second and third week. Was observed increased levels of plasma leptin, increased fat-free mass and fat mass reduction.

In the study of the Lafortuna et al.<sup>14</sup> both groups participated in a program of weight reduction consisting of calorie restriction, psychological counseling, nutrition education, and two different types of exercise programs supervised for three weeks. The first group performed individualized training, low volume and moderate intensity, with 30 minutes of stationary bike with constant load 60W, causing average heart rate of 30-45 % VO<sub>2</sub>max, two days a week was performed 50-70 minutes' walk leisurely averaging 45-60 % of VO<sub>2</sub>max; within five days of the week were performed movements dynamic force for 30 minutes calisthenics standing and on the ground using arms and legs. In the second group the exercises were not individualized, had high volume and low intensity aerobic training in all sessions, with 10 minutes of stationary bike pedaling at 50-60 rpm, 20 minutes' walk on a treadmill with a slope of 0-3 % and five minutes of arm ergometer . The intensity for all exercises was 50 % of VO<sub>2</sub>max during the first week and 60% in another two weeks. Also conducted three isotonic strength: legpress, bench press and vertical traction with 15 repetitions each at 40 % of maximum strength during the first week and 50 % and 60 % during the second and third week, respectively. We observed reduced body weight in both groups, an increase in VO<sub>2</sub>max in both relative and absolute groups only in the first, increase in the maximum muscular strength, being more pronounced in the former and an increase of average running speed in the second group. After six months it was found that the first group had greater tendency to practice exercises.

In the study by Stegen et al.<sup>29</sup> 15 morbid obese patients were evaluated before surgery, immediately after the study group was submitted to an exercise program that consisted of ten minutes of warm-up, 25 minutes of resistance training (work of flexion elbow extension and knee flexion, starting with two sets of 15 repetitions with 60% of repetition maximum and ending with three sets of 15 repetitions with 75% of one repetition maximum), 30 minutes of aerobic activity (starting with 60% and finishing training with 75% frequency of booking). After four months of intervention subjects were reassessed. The maintenance of muscle strength, increased aerobic capacity and functional capacity was observed in the experimental group, the reduction of body fat and fat-free mass was assessed in both groups.

Shah et al.<sup>28</sup> 33 individuals divided randomly into study group and control group, of which 28 completed the study. All had up to three months of post-bariatric-surgery. Study subjects were advised to spend more than 2000 kcal per week of moderate intensity aerobic activity (60-70% VO<sub>2</sub>max) for 12 weeks. The activities were carried out on a cycle ergometer, rowing machine and walks outdoors with intensity controlled by the distance and run time, occurring at least five times a week. The two groups were advised to limit calorie intake. 50% of adherence to practicing the high volume of training, increased fitness of the response and postprandial blood glucose and maintaining the weight loss effects were found.

Castello et al.<sup>3</sup> with 21 subjects divided randomly were evaluated one week before surgery and four months later. The program consisted of 36 sessions of one hour of exercise for three months (three sessions per week). The warm-up was done by stretching, diaphragmatic breathing and walking speed of three km / h, was followed by 40 minutes of treadmill exercise divided into four parts, which ranged between 50% and 70% of heart rate. At the end, were performed the same warm-up exercises. Heart rate and blood pressure were measured at the beginning and end of each part of the exercise. The experimental group showed improvement in modulating autonomous cardiac functional capacity and reduced diastolic blood pressure.

The Marcon et al.<sup>17</sup> study was conducted with patients who were awaiting for the bariatric surgery. They were divided into a group that joined the training and others who did not join. Were performed 30 minutes of low intensity walking and stretching for six months, once a week in the hospital with guidance and incentives to perform more often at home. Were observed improvement in lipid profile, functional capacity, fasting glucose, blood pressure and BMI in the group that joined the training.

In the study of Berggren et al.<sup>2</sup> sample was divided into groups of morbid obese, the same

obese group after they get thin (one year after the operation) and lean individuals were compared after being submitted to ten consecutive days of endurance training (activities on the cycle ergometer with 70% of heart rate). The impairment of fatty acid oxidation in obese individuals can be corrected with exercise.

## DISCUSSION

### Relationship between the exercise programs used, slimming and health of the morbid obese

After observing the exercise programs used in the 13 selected studies, it was found that aerobic activities are used in all interventions through outdoor walks and treadmills, bikes and arm ergometers, water activities and simulation of rowing. Resistance training also attended by isotonic and calisthenics exercises in six studies. Stretches were used in two studies to assist in warm-up and diaphragmatic breaths were also used in a study with the aim of working body posture.

In respect to the clinical treatment for weight loss, among the selected studies, the methodology used in the Goodpaster et al.<sup>10</sup> is offering the intervention for a longer period of time, and may define the effects of exercise programs during one year. In this study, the methodology allowed to observe the importance of physical exercise program for weight loss, including greater efficiency in reducing abdominal fat and cardiometabolic risk factors. It is noteworthy that the results of some studies seleccionados<sup>8,14,25,26</sup> even being conducted with interventions with shorter periods of time, also showed favorable results with weight loss.

In respect to the exercise programs used, the predominance of aerobic exercise corroborate the proposal provided by Okay et al.<sup>21</sup> which indicates that this type of exercise worked with large muscle groups in continuous rhythmic activity and the most suitable for the increased energy expenditure and consequent seeking for a negative energy balance, and Fogelholm<sup>9</sup> and Sukata et al.<sup>30</sup>, which associates with higher aerobic fitness, improved health conditions and reduced cardiovascular morbidity and mortality.

Furthermore, when analyzing physical exercise programs recommended by various committees specializing in severe obesity, Okay et al.<sup>21</sup>, in a literature review, reports the importance of the program to generate deficit 500-1000 kcal to conduct weight loss of about 0, 45 to 0.90 kg per week, and weight loss of 10% in six months. Also notes that after six months due to decreased metabolism caused by weight loss for greater difficulty in losing weight.

The proposal of physical exercise for a healthier

life in the general population can be observed in all studies selected with morbid obese. In addition, the search for Randall et al.<sup>24</sup>, which describes data from a clinical treatment for obese individuals which involving diet and physical exercise, showed favorable results for reducing risk factors for morbidity and mortality. In other words, even if medical treatment through exercise does not bring the desired effect in relation to weight loss, should be kept as a guarantee of better health.

After observing resistance exercises used in the selected studies, there was an emphasis on those involving simple movements and a larger number of muscle groups. According to Guttierrez Marins<sup>11</sup> resistance training can effectively contribute to the reduction of risk factors related to metabolic syndrome, which is common in the morbid obese. The ACSM<sup>12</sup>, although recommend certain restrictions during resistance training, indorse that could be an important adjuvant of aerobic exercise, increasing the strength, muscular endurance, functional autonomy and increased skeletal muscle metabolism.

Among the studies that used strength exercises in the intervention, conducted by Sartorius et al.<sup>25</sup> was the only one selected to investigate men and women separately. This approach has brought important contributions to show different results regarding body composition, showing men having greater difficulties in maintaining fat-free mass. However, the muscular strength was maintained in both sexes. The study of Stegen et al.<sup>29</sup> also showed maintenance of strength, while the LaFortuna et al.<sup>14</sup> showed improvement in this variable, seeming to be necessary further investigation on training methods that generate positive results.

The improvement of functional autonomy was observed in some studies conducted in selected periods after surgery with the use of both strength training exercises as aeróbicos<sup>16,17,19</sup>. However, the study conducted by Marcon et al.<sup>17</sup> also observed an increase in the functional capacity using an intervention that consisted only in aerobic activities in the pre-surgical period, showing that the improvement of this variable is not solely dependent on strength training.

Another type of exercise that has not been much explored in the studies were aquatic ones. Only Annesi et al.<sup>1</sup> and Christiansen et al.<sup>4</sup> used such activities, but in conjunction with aerobic training or other types of exercise, also cannot draw conclusions about its real effect for the morbidly obese. In addition, Poston et al.<sup>23</sup> cites that the water could promote calorie expenditure without causing articular overload, but there is no scientific evidence to confirm this theory.

The results observed in general, are not yet sufficient to indicate a specific type of exercise that is best, requiring further studies comparing different

exercise programs, or to examine new proposals for physical exercise and their health benefits.

### **The volume-intensity of the physical exercises**

Moderate aerobic physical activities, an hour a day, five times a week or vigorous-intensity, 20 minutes a day, three times a week are the ACSM recommendations for healthy individuals 18-65 years of age to promote and maintain health. On the strength exercises, it is recommended the realization of 8-10 resistance exercises for the major muscle groups on two or more nonconsecutive days each week, not allowing to do more than 8-12 repetitions for the full development of strength<sup>12</sup>. However, to prevent the increase in weight is recommended accumulation of 250 minutes per week of aerobic exercise, moderate intensity, the loss or prevention of weight regain suggest accumulation over 250 minutes of moderate aerobic exercise<sup>6</sup>.

However, such volumes and intensities proposed may not be suitable for people who have locomotion limitations. Interventions in selected studies were varied in relation to the volume and intensity. In studies in morbidly obese patients in the pre-surgical or medical treatment was observed aerobic activity at low and moderate intensity, not exceeding 60% of VO<sub>2</sub>max, reaching a maximum of 85% of heart rate reserve or maximum, ranging from three to five times per week, daily practice time ranged 30 to 120 minutes.

In the postoperative period was also observed moderate-intensity activities, reaching 70% of VO<sub>2</sub>max, reaching a maximum of 75% of heart rate reserve or 70% of maximum. The intervention of Berggren et al.<sup>2</sup> the volume of exercise was considered high, but held in only 10 consecutive days of training. In the study by Shah et al.<sup>28</sup> there was concern about controlling energy expenditure, with the experimental group individuals are recommended to spend more than 2000 kcal per week in aerobic exercise. The other studies using selected range of three to five times per week with activities from 30 to 60 minutes.

Knowing that the morbid obese deserve special care when prescribing exercise and are not so motivated to its practice, comes the importance of choosing activities that are enjoyable and volume - intensity gradually increase according to biological individuality. The study conducted by Marcon et al.<sup>17</sup>, even with less intensity than the others studies selected, the adherence to the program had only 34 among 61 patients waiting for bariatric surgery and participated in multidisciplinary treatment. However, while not imposing an appropriate volume - intensity ACSM 's proposal, we observed positive effects in reducing BMI and cardiometabolic risk factors . Perhaps the most important is to prescribe exercises that satisfy the obese without major concerns about

the volume-intensity, seeking greater adherence. In this sense, the study of LaFortuna et al.<sup>14</sup> showed that individualized exercise programs provide greater adherence, and this may be an important strategy.

### **Exercise programs in post-surgical period**

With the increasing quantity of bariatric operations in the world it became necessary to know the effects of exercise during treatment multidisciplinary postoperative period. A literature review of Egberts et al.<sup>10</sup> identified 17 studies that investigated the physical exercise in individuals post-surgical, whereas in all exercise programs the adherence were identified through questionnaires, because, in search procedures, was not possible to find studies with exercise programs interventions. Due to the limitation of the studies did not perform experimental approach, it was not possible to identify the ideal type and volume- intensity of exercise suited for weight loss.

In general, the studies without exercise intervention showed important results in groups that reported their practice as weight loss<sup>16,19</sup>, maintenance of weight lost<sup>5</sup>, and also increasing the fat free mass<sup>19</sup>, which usually is reduced in the postoperative period, resulting in lower resting metabolism. In addition, even during exercise was observed lower metabolism due to weight loss<sup>20</sup>, seems to be a need to increase the intensity in the exercises to generate higher energy expenditure and achievement of resistance exercises to stimulate hypertrophy or maintaining muscle mass.

By analyzing the selected studies were unable to verify satisfactory results with exercise programs in post-bariatric. However, it is worth mentioning the study of Stegen et al.<sup>41</sup>, although used some resistance exercises, decreased fat-free mass in both groups, experimental and control ones, showing the need for further research to examine types of exercises that can positively affect this variable.

It can be noticed that the volume-intensity exercise programs in post-bariatric studies are higher than in other obese. The Egberts et al.<sup>7</sup> study even suggested that the ACSM recommendations for healthy individuals, already mentioned, are applied in these patients. However, when analyzing studies investigating adherence to exercise programs such patients, it is observed that although increased, still occurs nonadherence, even knowing the importance of the exercise at this stage of treatment<sup>13,16</sup>. In this sense, the study of LaFortuna et al.<sup>14</sup> showed that individualized exercise programs provide greater adherence, and this may be an important strategy.

## **CONCLUSIONS**

The reviewed studies showed the importance of

physical exercise programs for weight loss and health in clinical treatment and after the bariatric surgery. Aerobic exercises are the most recommended, however, the addition of resistance exercise can be helpful in increasing strength and preventing the loss of fat-free mass, especially in the postoperative period. Special care when determining the volume-intensity exercise are important because morbidly obese are not very susceptible to physical exercise, being valid a proposed individualized exercise programs.

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