



## ORIGINAL ARTICLE

# Effects of a psychological intervention on the quality of life of obese adolescents under a multidisciplinary treatment<sup>☆</sup>

Camila R.M. Freitas<sup>a</sup>, Thrudur Gunnarsdottir<sup>b</sup>, Yara L. Fidelix<sup>a</sup>,  
Thiago R.S. Tenório<sup>a,c</sup>, Mara C. Lofrano-Prado<sup>d</sup>, James O. Hill<sup>e</sup>, Wagner L. Prado<sup>f,\*</sup>

<sup>a</sup> Universidade de Pernambuco, Programa de Pós-Graduação em Educação de Física, Recife, PE, Brazil

<sup>b</sup> University of Akureyri, Akureyri, Iceland

<sup>c</sup> Instituto Federal de Educação, Ciência e Tecnologia do Sertão Pernambucano, Serra Talhada, PE, Brazil

<sup>d</sup> Universidade de São Paulo, Instituto de Psicologia, São Paulo, SP, Brazil

<sup>e</sup> University of Colorado, Anschutz Center for Health & Wellness, Denver, United States

<sup>f</sup> Universidade Federal de São Paulo (UNIFESP), Departamento de Ciências do Movimento Humano, Santos, SP, Brazil

Received 27 January 2016; accepted 24 May 2016

**KEYWORDS**

Multidisciplinary  
intervention;  
Obese adolescents;  
Psychological  
counseling

**Abstract**

**Objective:** To investigate the effects of multidisciplinary treatment with and without psychological counseling on obese adolescents' self-reported quality of life.

**Methods:** Seventy-six obese adolescents ( $15.87 \pm 1.53$  y) were allocated into psychological counseling group (PCG;  $n=36$ ) or control group (CG;  $n=40$ ) for 12 weeks. All participants received the same supervised exercise training, nutritional and clinical counseling. Participants in PCG also received psychological counseling. QOL was measured before and after 12 weeks of intervention by Generic Questionnaire for the Evaluation of Quality of Life (SF-36).

**Results:** The dropout rate was higher in GC (22.5%) when compared with PCG (0.0%) ( $p < 0.001$ ). After 12 weeks, participants from PCG presents lower body weight, relative fat mass and higher free fat mass ( $p < 0.001$  for all) compared to GC. QOL improved among adolescents from both groups ( $p < 0.05$ ), however, a better QOL was reported from those adolescents enrolled in PCG.

<sup>☆</sup> Please cite this article as: Freitas CR, Gunnarsdottir T, Fidelix YL, Tenório TR, Lofrano-Prado MC, Hill JO, et al. Effects of a psychological intervention on the quality of life of obese adolescents under a multidisciplinary treatment. J Pediatr (Rio J). 2016. <http://dx.doi.org/10.1016/j.jpmed.2016.05.009>

\* Corresponding author.

E-mail: [wagner.prado@pq.cnpq.br](mailto:wagner.prado@pq.cnpq.br) (W.L. Prado).

<http://dx.doi.org/10.1016/j.jpmed.2016.05.009>

0021-7557/© 2016 Sociedade Brasileira de Pediatria. Published by Elsevier Editora Ltda. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**PALAVRAS-CHAVE**

Intervenção multidisciplinar; Adolescentes obesos; Aconselhamento psicológico

**Conclusion:** The inclusion of a psychological counseling component in multidisciplinary treatment for adolescent obesity appears to provide benefits observed for improved QOL as compared with treatment without psychological counseling.

© 2016 Sociedade Brasileira de Pediatria. Published by Elsevier Editora Ltda. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

### Efeitos de uma intervenção psicológica sobre a qualidade de vida de adolescentes obesos em tratamento multidisciplinar

#### Resumo

**Objetivo:** Para investigar os efeitos do tratamento multidisciplinar com e sem aconselhamento psicológico voltado à qualidade de vida de adolescentes obesos.

**Métodos:** 76 adolescentes obesos ( $15,87 \pm 1,53$  ano) foram alocados em um grupo de aconselhamento psicológico e (GAP;  $n = 36$ ) ou grupo de controle (GC;  $n = 40$ ) por 12 semanas. Todos os participantes receberam o mesmo treinamento físico supervisionado e aconselhamento nutricional e clínico. Os participantes no GAP também receberam aconselhamento psicológico. A qualidade de vida foi avaliada antes e depois das 12 semanas de intervenção por meio de um Questionário Genérico de Avaliação da Qualidade de Vida (SF-36).

**Resultados:** O abandono do tratamento foi maior no GC (22,5%), em comparação ao GAP (0,0%) ( $p < 0,001$ ). Após 12 semanas, os participantes do GAP apresentam menor peso corporal, massa gorda relativa e maior massa livre de gordura ( $p < 0,001$  para todos) em comparação ao GC. A qualidade de vida melhorou entre os adolescentes de ambos os grupos ( $p < 0,05$ ); contudo, uma melhor qualidade de vida foi relatada pelos adolescentes incluídos no GAP.

**Conclusão:** A inclusão de aconselhamento psicológico no tratamento multidisciplinar dos adolescentes obesos parece proporcionar benefícios observados na melhoria da qualidade de vida, em comparação ao tratamento sem aconselhamento psicológico.

© 2016 Sociedade Brasileira de Pediatria. Publicado por Elsevier Editora Ltda. Este é um artigo Open Access sob uma licença CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Introduction

Obesity and its associated risk factors have become a major public health concern.<sup>1-4</sup> The worldwide prevalence of overweight among children and adolescents (aged 5–17 years) is estimated at 21.4% for girls and 22.9% for boys.<sup>5</sup> In Brazil, the prevalence of childhood and adolescent overweight/obesity ranges from 4% to 37% in the different regions of the country.<sup>6</sup>

Studies show that adolescence obesity is associated with an increased likelihood of depression, anxiety, and eating disorders, which may affect quality of life (QOL).<sup>7-9</sup> Studies have demonstrated lower QOL in the physical, psychosocial, emotional, and school functioning domains among obese children and adolescents when compared with their normal weight peers<sup>10-12</sup>; a multidisciplinary behavioral treatment positively impacts QOL in this population.<sup>13</sup> In fact, multidisciplinary behavioral interventions composed by regular physical activity, nutrition, and psychological counseling have been widely acclaimed as the most effective approach for treating obesity.<sup>14,15</sup> Moreover, such interventions appear to be more effective with children/adolescents than adults.<sup>16</sup>

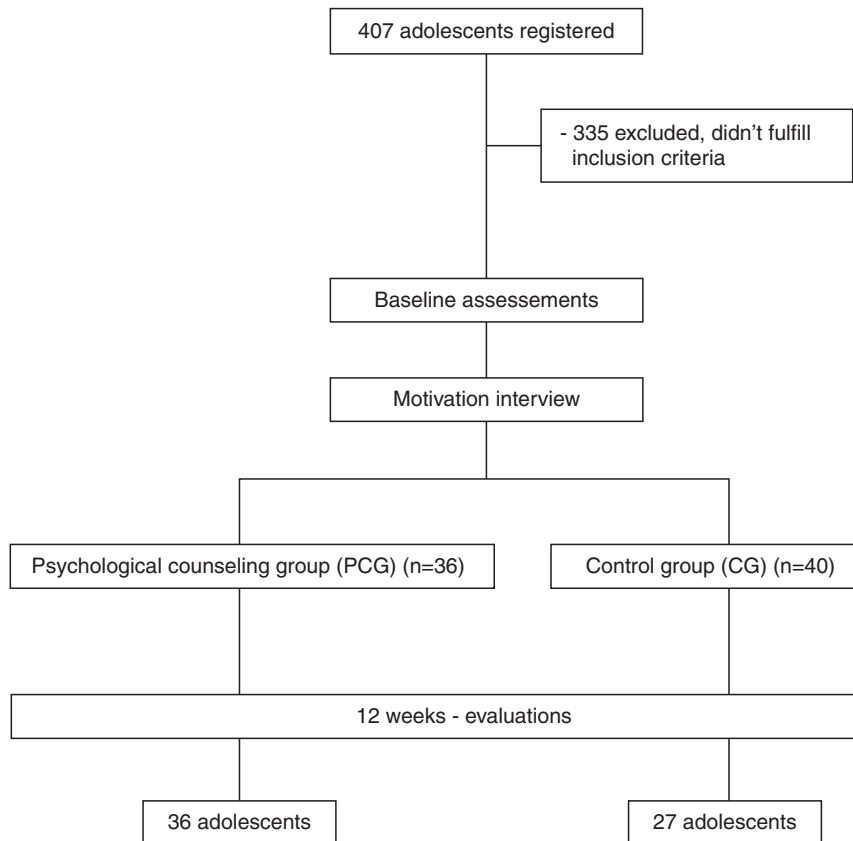
Improvements in weight and body composition are common as a result of a multidisciplinary behavioral treatment for obesity.<sup>10</sup> Improvements in psychological well-being and quality of life are common as well.<sup>8,9,17-19</sup> Better psychological outcomes may result from changes in weight status

and body composition following an increase in participants' physical activity levels and improvements in eating behavior. These psychological outcomes may also be directly related to a treatment including psychological counseling; however, to the best of the authors' knowledge, none of the previous researches were conducted to verify the contribution of psychological counseling on QOL in obese adolescents submitted to a multidisciplinary therapy. Psychological counseling targets a broad variety of factors, such as physical, psychosocial, emotional, and school functioning in the context of changing health-related behaviors. As such, psychological counseling per se could be affecting changes in psychological outcomes and adolescents' QOL beyond the effects observed as a result of changes in weight status or body composition. Thus, the main purpose of this study was to investigate the effects of a multidisciplinary treatment for adolescent obesity with and without psychological counseling on participants' self-reported quality of life. Secondary outcomes included therapy adherence, and anthropometric and body composition measures.

## Methods

### Sample

Study participants from both genders were recruited between 2011 and 2012 through advertisements in local



**Figure 1** Flow of participants through the study process.

media (newspaper, radio, and television) in the urban area of Recife, Brazil. The study was approved by the Ethics Committee of the University of Pernambuco (No. 154/09); parents or guardians signed an informed consent, and participants signed an assent form. The inclusion criteria were: age range 13–18 years; pubertal stage: Tanner 3–4<sup>20,21</sup>; obesity: BMI > 95th percentile<sup>22</sup>; and no pre-existing conditions that would restrict participation in an exercise program. Additional exclusion criteria included pregnancy, presence of hypertension and/or another metabolic condition (such as diabetes type II diabetes and hyperlipidemia), and use of weight loss medications.

### Study protocol

A total of 407 adolescents were screened for the study. During the first laboratory visit, potential participants were instructed to self-assess and report their perceived pubertal stage; height and weight was measured. At the second visit, an individual, semi-structured interview containing eight questions was conducted by a psychologist. The interview assessed motives for seeking weight loss treatment and barriers to losing weight. During a third visit, the adolescents underwent a medical screening and resting ECG's were performed. Three hundred thirty-two adolescents did not meet inclusion criteria based on the screening results. A total of 76 obese adolescents (27 boys and 49 girls) who met all inclusion criteria were enrolled in the study. Following baseline

testing, participants were allocated into either psychological counseling group (PCG;  $n=36$ ) or control group (CG;  $n=40$ ) for 12 weeks of a multidisciplinary intervention that included supervised exercise training sessions, nutritional, and clinical counseling (Fig. 1). Participants enrolled in PCG also received psychological counseling. Fig. 1 presents the flow of participants through the study process.

### Multidisciplinary treatment

#### Clinical counseling

Medical follow-up was performed once a month by an endocrinologist. This included a physical examination to monitor clinical parameters and to facilitate overall compliance with the study.

#### Nutrition education

Nutritional counseling was conducted by a trained dietitian for one hour each week in small groups (approximately nine participants). Lessons focused on healthy eating behavior, weight loss diets, diet vs. light products, macro and micronutrients function, and nutritional facts. Although no specific prescription for energy intake was recommended, the participants were encouraged to reduce overall calorie intake and to follow a balanced diet as recommended by the Brazilian Ministry of Health. The dietitian was blinded for group allocation.

### Supervised aerobic exercise training

The adolescents underwent an exercise program administered on a treadmill and supervised by physical educators three times per week (36 sessions total). The intensity of the exercise training (50–60% of the maximum oxygen uptake [ $VO_{2max}$ ]) was individualized, based on each adolescents' ventilatory threshold 1 (VT1) obtained from an incremental test on a treadmill with a fixed inclination of 1%.<sup>23</sup> All exercise sessions had a set caloric expenditure at 350 kcal ( $1050 \text{ kcal week}^{-1}$ ) and duration was determined as:

Exercise session time(min)

$$= 350 \text{ kcal}/(\text{VO}_2 \text{ on target intensity} \times 1\text{MET})$$

### Psychological counseling

Psychological counseling was conducted for one hour each week in small groups (approximately nine adolescents) by a clinical psychologist. Along with the psychological motivation for compliance, themes related to body image, eating disorders (symptoms and consequences), the relationship between food and feelings, family and social problems, mood, anxiety, and depression were included.

### Measurements

All participants underwent the same assessment protocol, at the beginning and at the end of the 12-week treatment. Assessments were performed during a similar time of day to avoid circadian influence. The same evaluator conducted the assessments for both cohorts.

### Pubertal maturation

Each participant was given drawings of the five stages of breast, genital, and pubic hair development. They were instructed to look at the drawings, read the accompanying descriptions, think about their own physical development and appearance in comparison to the drawings, and pick the one that most closely resembled their own stage of physical maturity.

### Anthropometry and body composition

Participants were weighed barefoot and wearing light clothing on a Filizola scale (model 160/300, Brazil) to the nearest 0.1 kg. Stature was measured to nearest 0.5 cm using a wall-mounted stadiometer (Filizola scale, model 160/300, Brazil). Body mass index (BMI) was calculated in  $\text{kg m}^{-2}$ .<sup>22</sup> Triceps, subscapular, and medial calf skinfolds were measured in triplicate with a caliper (Lange, CA, USA) with constant pressure ( $10 \text{ g mm}^{-2}$ ) and resolution of 1 mm, on the right hemisphere; the mean value was used. Body composition was estimated by gender-specific equations.<sup>24</sup>

Generic Questionnaire for the Evaluation of Quality of Life: 'Medical Outcomes Study SF-36'.

The SF-36, translated into Portuguese and validated for the Brazilian population,<sup>25</sup> was used to assess the adolescents' quality of life (QOL). The instrument is multidimensional. It consists of 36 items, and is intended to generically evaluate QOL. The questionnaire has eight multi-item subscales: physical functioning, role-physical, pain, general health perception, vitality, social functioning, role-emotional, mental health, plus a

one-item measure of self-evaluated change in health status over the past year.

### Statistical procedures

All analyses were performed using the software Statistica® 7.0 for Windows®. Normality was verified by the Shapiro–Wilk test and data were presented as means  $\pm$  SD; differences in outcomes between times (baseline and 12 weeks) and groups were analyzed using two-way ANOVA with a Duncan post hoc test. Due to baseline differences between groups for %FM, physical functioning, general health perception, and mean of dimensions of QOL, additional analyses were performed with ANCOVA, where the baseline values were included as covariates. The significance level was set at  $p < 0.05$ .

### Results

Of the 76 adolescents who participated in the study, 100% from PCG ( $n = 36$ ) and 67.5% from GC ( $n = 27$ ) completed the 12-week of multidisciplinary therapy ( $p < 0.001$ ). At baseline, differences in height and relative fat mass (%FM) were observed between groups ( $p < 0.05$  for both).

Multidisciplinary therapy was effective in reducing BMI (PCG = 2.6% and CG = 0.5%;  $F_{1,61} = 37.05$ ;  $p < 0.001$ ), fat mass (PCG = 24% and CG = 10.3%;  $F_{1,59} = 12.78$ ;  $p < 0.001$ ) and to increase FFM (PCG = 21.2% and CG = 13.5%;  $F_{1,60} = 55.34$ ;  $p < 0.001$ ). At the end of 12 weeks, participants from PCG presented lower body weight (2.3%,  $F_{1,61} = 7.03$ ;  $p < 0.001$ ), %FM (PCG = 13.7%,  $F_{1,59} = 12.78$ ;  $p < 0.001$ ) and higher FFM (PCG = 7.7%,  $F_{1,60} = 55.34$ ;  $p < 0.001$ ) when compared GC (Table 1).

As shown in Table 2, adolescents from both PCG and CG presented an overall improvement on the dimensions of QOL, such as physical functioning, general health perception, vitality, and mean of dimensions. However, high values of self-reported QOL were observed in adolescents enrolled in the PCG.

### Discussion

The data from the present study provided evidence that including psychological counseling in a multidisciplinary treatment is more effective for improving QOL when compared with a treatment that does not include it. Furthermore, psychological counseling may reduce dropout rate.

The discussions of topics such as social acceptance and self-motivation may have encouraged adolescents to further modify their lifestyle, making them more aware of the importance of physical activity and nutrition,<sup>10,11,26–29</sup> leading to positive changes on body composition, as observed in the present study, which has been identified as a protective factor against disease development (e.g., hypertension, diabetes, dyslipidemia, and cardiovascular problems)<sup>1,2,4,26–29</sup> and as such may also improve the QOL of individuals.<sup>30</sup>

On average, published studies from programs addressing lifestyle changes report that 50% of patients dropout early or do not complete the treatment. In the current study, psychological counseling appeared to have been important for treatment completion; the reasons for early dropout or treatment completion were not investigated, but future

**Table 1** Effects of multidisciplinary therapy with and without psychological counseling on anthropometry and body composition in obese adolescents.

	Baseline	12 weeks	Group effect	Time effect	Interaction effect
<i>BM (kg)</i>					
PCG	91.26 ± 11.22	89.16 ± 11.98 <sup>b</sup>	0.022	0.001	0.010
CG	95.87 ± 10.33	96.72 ± 10.98 <sup>c</sup>			
<i>BMI (kg<sup>-1</sup> m<sup>2</sup>)</i>					
PCG	34.48 ± 3.88	33.61 ± 3.92 <sup>b</sup>	0.505	<0.001	0.222
CG	34.55 ± 3.36	34.40 ± 3.73 <sup>b</sup>			
<i>FFM (kg)</i>					
PCG	44.14 ± 7.50	53.51 ± 8.72 <sup>b</sup>	<0.015	<0.001	0.029
CG	42.03 ± 5.20	47.73 ± 4.56 <sup>b,c</sup>			
<i>FM<sup>a</sup></i>					
PCG	51.61 ± 8.39	39.23 ± 8.46 <sup>b</sup>	<0.001	<0.001	0.002
CG	56.04 ± 5.89	50.28 ± 4.76 <sup>b,c</sup>			

BM, body mass; BMI, body mass index; FFM, fat free mass; %FM, relative fat mass; PCG, psychological counseling group; CG, control group.

$p \leq 0.05$ .

<sup>a</sup> ANCOVA.

<sup>b</sup> vs. basal.

<sup>c</sup> vs. PCG.

**Table 2** Effects of multidisciplinary therapy with and without psychological counseling on quality of life in obese adolescents.

	Basal	12 weeks	Group effect	Time effect	Interaction effect
<i>Physical functioning<sup>a</sup></i>					
PCG	82.50 ± 15.18	91.80 ± 11.22 <sup>c</sup>	0.781	<0.001	0.881
CG	72.00 ± 23.19 <sup>b</sup>	80.55 ± 18.51 <sup>b,c</sup>			
<i>Role physical</i>					
PCG	79.16 ± 27.05	87.50 ± 21.12	0.021	0.705	0.062
CG	74.62 ± 28.51	67.59 ± 29.26 <sup>b</sup>			
<i>Pain</i>					
PCG	78.86 ± 19.18	78.83 ± 18.85	0.044	0.665	0.658
CG	70.12 ± 19.26	72.03 ± 21.05			
<i>General health perception<sup>a</sup></i>					
PCG	66.13 ± 22.40	74.63 ± 19.93 <sup>c</sup>	0.162	<0.001	0.454
CG	51.22 ± 25.57 <sup>b</sup>	62.56 ± 17.71 <sup>b,c</sup>			
<i>Vitality</i>					
PCG	66.25 ± 20.54	77.50 ± 13.54 <sup>c</sup>	0.008	<0.001	0.410
CG	56.50 ± 24.13	68.33 ± 16.40 <sup>c</sup>			
<i>Social functioning</i>					
PCG	81.59 ± 20.59	86.11 ± 19.31	0.545	0.071	0.733
CG	76.25 ± 21.52	83.79 ± 22.68			
<i>Role emotional</i>					
PCG	77.77 ± 32.85	87.96 ± 19.76	0.002	0.368	0.252
CG	68.33 ± 38.45	62.96 ± 31.12 <sup>b</sup>			
<i>Mental health</i>					
PCG	75.88 ± 20.47	81.44 ± 16.89	0.480	0.003	0.430
CG	71.80 ± 25.17	80.37 ± 13.58 <sup>c</sup>			
<i>Mean of dimensions<sup>a</sup></i>					
PCG	76.36 ± 15.54	83.22 ± 11.53 <sup>c</sup>	0.091	<0.001	0.839
CG	67.97 ± 16.57 <sup>b</sup>	72.22 ± 14.53 <sup>b,c</sup>			

PCG, Psychological Counseling Group; CG, Control Group.

$p \leq 0.05$ .

<sup>a</sup> ANCOVA.

<sup>b</sup> vs. PGC.

<sup>c</sup> vs. basal.

studies should consider the reasons for early dropout and factors contributing to treatment completion.

Although it is known that engaging in regular physical exercise improves QOL,<sup>7,9,27</sup> recent studies have suggested that the addition of a behavioral component and a nutritional intervention provides the most changes in QOL among obese individuals.<sup>3,10,12,13</sup> In those studies, overweight adolescents reported lower QOL when compared with their normal weight peers. This was observed not only on their total score, but also on the physical, social, psychosocial, and school domains as assessed by the PedsQL 4.0, suggesting that lower QOL affects adolescents on a daily basis.<sup>8</sup> Obese individuals are more vulnerable to social injustices (e.g., bullying, discrimination in school, social isolation) and are likely to face prejudice, which may result in poorer QOL.

Behavioral interventions that aim to promote lifestyle changes (increasing physical activity and improving diet quality) are identified as effective for improving QOL, among both adolescents and adults. It is noteworthy that, while comparing the groups of this study, those who received psychological counseling reported a higher QOL on some domains (physical functioning, role physical, general health perception, mean of dimensions). The results from the present study are consistent with other studies that demonstrated that obesity treatment should focus on changes in lifestyle and be conducted by a multidisciplinary team.<sup>7-9</sup> However, to date, this was the first study to evaluate the effect of adding psychological counseling in such a multidisciplinary intervention.

A limitation of this study was the use of a generic QOL questionnaire, which may be less sensitive than a specific questionnaire. Another limitation is the fact that, of the participants who started out in CG, only 67.5% completed the intervention, which reduced the generalizability of the conclusions drawn from this study. However, the dropout rate observed in this study was not any higher than what is expected in intervention studies.

In conclusion, multidisciplinary treatment improves quality of life among obese adolescents; the outcomes are improved when psychological counseling is included. Moreover, the inclusion of a psychological counseling component may reduce the dropout ratio commonly observed in the obesity treatment in adolescents.

## Funding

All phases of this study were supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPQ). Data collection was performed at the University of Pernambuco.

## Conflicts of interest

The authors declare no conflicts of interest.

## Acknowledgements

All phases of this study were supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico

[CNPQ]. Data collection was performed by the Grupo de Estudos em Nutrição e Exercício (GENE).

## References

1. Sinha A, Kling S. A review of adolescent obesity: prevalence, etiology, and treatment. *Obes Surg.* 2009;19:113–20.
2. Hills AP, Andersen LB, Byrne NM. Physical activity and obesity in children. *Br J Sports Med.* 2011;45:866–70.
3. Pulgarón ER. Childhood obesity: a review of increased risk for physical and psychological comorbidities. *Clin Ther.* 2013;35:A18–32.
4. Sparling PB, Franklin BA, Hill JO. Energy balance: the key to a unified message on diet and physical activity. *J Cardiopulm Rehabil Prev.* 2013;33:12–5.
5. Pérez Rodrigo C. Current mapping of obesity. *Nutr Hosp.* 2013;28:21–31.
6. Souza CO, Silva RC. Factors associated with excess weight in Brazilian children and adolescents: review. *J Brazilian Soc Food Nutr.* 2009;34:201–16.
7. Burgić-Radmanović M, Gavrić Z, Strkić D. Eating behavior disorders of female adolescents. *Psychiatr Danub.* 2009;21:297–301.
8. Kunkel N, Oliveira WF, Peres MA. Overweight and health-related quality of life in adolescents of Florianópolis, Southern Brazil. *Rev Saude Publ.* 2009;43:226–35.
9. Poeta LS, Duarte Mde F, Giuliano Ide C. Health-related quality of life of obese children. *Rev Assoc Med Bras (1992).* 2010;56:168–72.
10. Dalle Grave R, Calugi S, Centis E, El Ghoch M, Marchesini G. Cognitive-behavioral strategies to increase the adherence to exercise in the management of obesity. *J Obes.* 2011;2011:348293.
11. Jacob JJ, Isaac R. Behavioral therapy for management of obesity. *Indian J Endocrinol Metab.* 2012;16:28–32.
12. Portela de Santana ML, da Costa Ribeiro Junior H, Mora Giral M, Raich RM. Epidemiology and risk factors of eating disorder in adolescence: a review. *Nutr Hosp.* 2012;27:391–401.
13. Lofrano-Prado MC, Antunes HK, do Prado WL, de Piano A, Caranti DA, Tock L, et al. Quality of life in Brazilian obese adolescents: effects of a long-term multidisciplinary lifestyle therapy. *Health Qual Life Outcomes.* 2009;7:61.
14. Freitas CR, Lofrano-Prado MC, Gomes PP, Almeida NC, Ferreira MN, Prado WL. Efeito da intervenção multidisciplinar sobre a insatisfação da imagem corporal em adolescentes obesos. *Rev Bras Ativ Fis Saude.* 2012;17:449–56.
15. Curioni CC, Lourenço PM. Long-term weight loss after diet and exercise: a systematic review. *Int J Obes (Lond).* 2005;29:1168–74.
16. Snethen JA, Broome ME, Cashin SE. Effective weight loss for overweight children: a meta-analysis of intervention studies. *J Pediatr Nurs.* 2006;21:45–56.
17. Gunnarsdottir T, Njardvik U, Olafsdottir AS, Craighead L, Bjarnason R. Childhood obesity and co-morbid problems: effects of Epstein's family-based behavioural treatment in an Icelandic sample. *J Eval Clin Pract.* 2012;18:465–72.
18. Ho M, Garnett SP, Baur L, Burrows T, Stewart L, Neve M, et al. Effectiveness of lifestyle interventions in child obesity: systematic review with meta-analysis. *Pediatrics.* 2012;130:e1647–71.
19. Zabelina DL, Erickson AL, Kolotkin RL, Crosby RD. The effect of age on weight-related quality of life in overweight and obese individuals. *Obesity (Silver Spring).* 2009;17:1410–3.
20. Marshall WA, Tanner JM. Variations in pattern of pubertal changes in girls. *Arch Dis Child.* 1969;44:291–303.
21. Marshall WA, Tanner JM. Variations in the pattern of pubertal changes in boys. *Arch Dis Child.* 1970;45:13–23.

22. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000;320:1240–3.
23. Porszasz J, Casaburi R, Somfay A, Woodhouse LJ, Whipp BJ. A treadmill ramp protocol using simultaneous changes in speed and grade. *Med Sci Sports Exerc*. 2003;35:1596–603.
24. Slaughter MH, Lohman TG, Boileau RA, Horswill CA, Stillman RJ, Van Loan MD, et al. Skinfold equations for estimation of body fatness in children and youth. *Hum Biol*. 1988;60:709–23.
25. Ciconelli RM. Tradução para o português e validação do questionário genérico de avaliação de qualidade de vida "medical outcomes study 36-item short-form health survey (SF-36)". [Thesis]. São Paulo, Brazil: UNIFESP Escola Paulista de Medicina; 1997.
26. Al-Hazzaa HM, Abahussain NA, Al-Sobayel HI, Qahwaji DM, Musaiger AO. Physical activity, sedentary behaviors and dietary habits among Saudi adolescents relative to age, gender and region. *Int J Behav Nutr Phys Act*. 2011;8:140.
27. Teixeira PJ, Silva MN, Coutinho SR, Palmeira AL, Mata J, Vieira PN, et al. Mediators of weight loss and weight loss maintenance in middle-aged women. *Obesity (Silver Spring)*. 2010;18:725–35.
28. Bianchini JA, da Silva DF, Nardo CC, Carolino ID, Hernandez F, Nardo N Jr. Multidisciplinary therapy reduces risk factors for metabolic syndrome in obese adolescents. *Eur J Pediatr*. 2013;172:215–21.
29. Fortes LS, Morgado FF, Ferreira ME. [Factors associated with inappropriate eating behavior in adolescent students]. *Rev Psiquiatr Clín*. 2013;40:59–64.
30. Vathesatogkit P, Sritara P, Kimman M, Hengprasith B, E-Shyong T, Wee HL, et al. Associations of lifestyle factors, disease history and awareness with health-related quality of life in a Thai population. *PLoS One*. 2012;7:e49921.