Original article (short paper)

Emotional eating is related to carbohydrate intake in active women

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Abstract — Background: Physical exercise may contribute to changes in eating behavior. Aims: to investigate eating behavior and reported energy intake in physically active individuals. Methods: Thirty-nine healthy adults of both sexes, who were involved in physical fitness training, were enrolled to participate in the study. A food diary and the TFEQ-21 was used for energy intake measurement and eating behaviors identification. Results: All participants showed acceptable levels of all evaluated behaviors: Cognitive restraint (46.58 ± 16.4 and 49.5 ± 20.0), Emotional eating (8.12 ± 12.5 and 40.8 ± 26.7), and Uncontrolled eating (21.6 ± 15.1 and 35.6 ± 20.9) in men and women, respectively. Uncontrolled eating was associated with increased carbohydate intake for women, and fat-free mass content was associated with less Emotional eating only in men. There were no differences in energy and macronutrient consumption between training and non-training days. Conclusion: Regular physical exercise is associate to better eating behaviors, but women may find it harder to maintain or lose weight due to higher levels of emotional eating.

Keywords: eating behavior, physical exercise, energy intake

Background

Eating behavior (EB) is defined as every practice related to food: its selection, acquisition, preservation, preparation, and intake[1]. Several factors influence EB: physiological factors, such as hunger and satiety sensations, and emotional states, such as cognition and social behavior[2]. Thus, the food choices of each individual are determined by a combination of these factors[3].

The alarming increase in obesity incidence and prevalence is due, at least in part, to the highly obesogenic environment we face in society[4]. Conversely, because of the current social perception of beauty, many people are continuously trying to lose weight.

EB can be distinguished by three different behaviors: cognitive restraint (CR), characterized by several dietary prohibitions and restrictions usually associated with losing weight desire[2,5]; uncontrolled eating (UE), described as the loss of self-control when the individual is exposed to diverse non-healthy food[6]; and emotional eating (EE), which is directly related to mood and stress levels[7]. These behaviors present their own etiology and are derived from theories such as externality theory, psychosomatic theory and restraint theory[8].

All these behaviors are components of EB, however, success in body weight maintenance might be related to an imbalance in these behaviors[9,10], which also appear to be influenced by components such as sex and obesity severity[11]. Lifestyle counseling for weight loss can contribute to changes in these behaviors and weight maintenance[12].

In the search for a healthier lifestyle, physical exercise is an important ally: as well as the metabolic effects, exercise can also contribute to behavioral changes that, in turn, result in better eating habits[13]. Also, is well established that lifestyle changes promote health benefits, such as reductions in total cholesterol, LDL lipoprotein fraction, blood pressure, and glucose maintenance[14].

A simple question, widely discussed in the scientific literature, but so-far proved difficult to answer is: Can physical

exercise alone lead to significant reductions in body weight? In a meta-analysis study, Johns *et al.*[15] concluded that physical exercise alone is of low effectiveness in weight reduction, whereas, in the long term, the best-described intervention comprises both physical exercise practice and dietary control. In 2010, Sweet *et al.*[16] suggested that interventions that do not propose changes in eating habits are ineffective for weight loss, and increased energy intake in workout days might be a compensatory effect due the elevated energy expenditure.

Therefore, it is clear that food choices are regulated by several factors and daily physical exercise might be an important contributing factor. It is believed that people engaged in regular physical exercise practices have more favorable EB and healthier habits, which lead to reductions in food intake and better body weight control. Thus, the aim of this study was to evaluate the EB components (cognitive restraint, emotional eating, and Uncontrolled eating) and food intake of physical exercise practitioners to verify if there is a compensatory food intake on training days compared to non-training days.

Methods

This study was approved by the Ethics Committee for Human Beings of the Federal University of São Paulo (UNIFESP), under number 0155/11. All participants signed an informed consent form.

The sample consisted of 39 individuals of both sexes, aged from 21 to 59 years. All participants were healthy, with no abnormalities shown in clinical parameters or in electrocardiograms at rest and effort. The subjects had no current or past cardiovascular, respiratory, neurological or psychiatric disease and had all undertaken physical training in the last six months. The participants were committed to training under the supervision of researchers for one year, three times a week, and each training session lasting an hour.

Physical exercise training

The physical exercise training was perfomed at the Centro de Estudos em Psicobiologia e Exercício (CEPE-UNIFESP). The climate of the training room was standardized throughout the whole training session. Aerobic training was performed on a treadmill (Life Fitness® 9500; Schiller Park, United States), continuously, with each session varying from 30 to 50 minutes. The intensity of training corresponded to the ventilatory threshold 1 (VT-1), determined by an incremental testing protocol with speed and 1% of inclination increments each minute until maximum voluntary exhaustion[17]. The test was performed every three months from the start of the training sessions.

In resistance training, the following physical exercises were performed: chest press, leg press, lat machine, leg curl, shoulder press, leg extension, arm extension, arm curl, and abdominal crunch (Selection, Technogym®, Italy). The subjects were instructed to perform the exercises, alternating each segment[18]. The intensity of exercise was defined from the loads obtained in a multiple repetitions test, using a pre-defined number of repetitions[19]. Training intensity was made up of 75% of one maximum repetition[18]. The resistance training was designed to have five distinct phases, with number of sets varying between two (phase 1) and four (phase 5), repetitions totaling from 10–12 (phase 1) down to 6–8 (phase 5), and with rest intervals between 60 and 90 seconds.

Eating behavior assessment

The Three-Factor Eating Questionnaire R21 (TFEQ-R21) was used to EB evaluations[20]. The Three-Factor Eating Questionnaire (TFEQ) was first used in 1985 to determine different types of EBs, and comprised 51 items[22]. This was later simplified in an 18-question version[23] and finally, in 2005, was expanded to 21 questions[24]. In 2011, the questionnaire was translated into Portuguese and validated in adult women[20]. The three types of behavior evaluated were Cognitive restraint, Emotional eating, and Uncontrolled eating. The Cognitive restraint scale includes six items and measures the avoidance of certain items and control of food intake to influence body weight. The Emotional eating scale includes six items and measures the propensity to eat excessively in response to negative emotional states such as anxiety, depression and loneliness, and the Uncontrolled eating scale includes nine items and analyzes the tendency of individuals to lose control of food intake in response to the presence of hunger and external stimuli[21].

Energy intake

Dietary intake was assessed by a three-day food diary. All food and beverage intake was recorded on a training session day, a non-training day and a weekend day. AvaNutri® software was used to calculate daily macronutrient intake.

Body composition assessment

Body composition assessment was performed by plethysmography (Bod POD®, Life Measurement Inc., CA, USA), which consists of an electronic scale, a plethysmograph, a cylinder for calibration, and computer software.

Data analysis

First, data normality was tested by Shapiro-Wilk test. Student's *t* test for an unpaired sample was used to compare anthropometric variables between sexes. One Way ANOVA with Tukey post hoc was performed for comparisons between EBs and sex. Pearson correlations were also performed between anthropometric, EB, and energy and macronutrient intake parameters. SPSS software was used for data analysis and statistical significance was defined as $p < 0.05$.

Results

Our sample consisted of 39 men and women with a mean age of 38 ± 10 years. Among these, 26 were women and 13 men, ranging in body mass index (BMI) classification between normal weight, overweight, and obese (Table 1). Our characterization data depicts a normal weight population, with a tendency to overweight for females according to BMI classification and fat mass and a minor increase in BMI in male population with a normal range of fat mass. No significant differences were found between age, anthropometric, and body composition parameters measured (see Table 1).

Table 1**.** Age, anthropometric, and body composition parameters of physically active men and women.

Variables	All participants (N = 39)	Women (N = 26)	Men (N = 13)
Age (years)	37.9±10.4	37.7±11.3	38.5±8.9
Body mass (kg)	69.4±14.5	63.8±11.7	80.8± 13.0
Height (m)	165.1±8.9	160.9± 6.9	173.7± 5.9
BMI (kg/m²)	25.3±4.0	24.6± 3.7	26.8± 4.3
Fat mass (kg)	21.3±8.7	23.1±8.1	17.6±9.0
Fat mass (%)	32.7±13.6	35.2±7.2	21.1± 8.3
Fat-free mass (kg)	48.7±12.5	41.6±7.1	63.0±7.4
Fat-free mass (%)	69.7±9.3	64.7±7.2	76.7±7.8

Variables presented in mean ± standard deviation. BMI, body mass index.

Figure 1 shows the prevalence of each EB component among participants. Higher scores of UE were found among women (men, 21.6 ± 15.1; women, 35.6 ± 20.9; $p < 0.05$) and EE (men, 8.12 ± 12.5; women, 40.8 ± 26.7; $p < 0.05$). No significant difference was found in CR behavior between sexes (men, 46.58 ± 16.4; women, 49.5 ± 20.0).

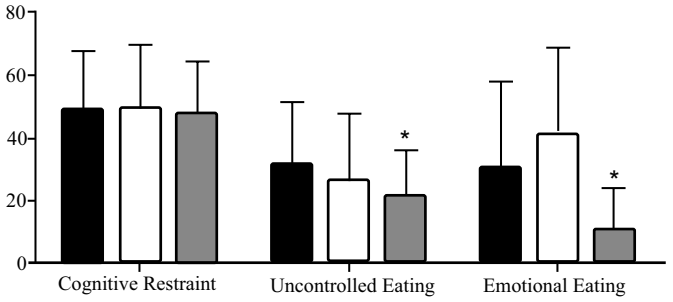

Figure 1. Eating behaviors evaluated by TFEQ-21 in physically active men and women. Variables showed in mean ± standard deviation; Black bars, all participants; White bars, female participants; Gray bars, male participants. *Significant difference between men and women (ANOVA one way, post hoc Tukey; $p < 0.05$).

In this sample, there was no significant difference in energy and macronutrient consumption between the evaluated days (training day, non-training day, and weekend). When stratified by sex, still no significant difference is observed in energy and macronutrient intake between the different days in men and women. As expected, in the average of the three evaluated days, higher energy intake was observed in men (Table 2).

When analysed all participants, Pearson correlations showed a significant negative correlation between fat-free mass (kg) and EE (r: -0.514; $p < 0.05$) and a positive correlation between UE and percentage of carbohydrate intake (r: 0.488; $p < 0.05$). For men, the only significant correlation was between UE and fat intake in the percentage of total kcal consumed (r:-0.566, $p < 0.05$). For women, a positive correlation was found between UE and the percentage of carbohydrate intake (r: 0.519, $p < 0.05$).

Discussion

The present study aimed to describe aspects related to EB and food intake in men and women regularly engaged in physical exercise. Our main finding was that physically active people show good control of their EB, with appropriate levels of all three types of assessed behaviors: CR, EE, and UE. Another important finding is that men and women demonstrate different EB patterns, and higher levels of EE in women is associated to enhanced intake of carbohydrates.

Our initial hypothesis was that individuals engaged in physical exercises have elevated levels of CR due to their constant search for the desired body weight. Among the analyzed behaviors, CR proved to be an important contributor factor to EB in this study, which confirms our hypothesis and highlights that this population have concerns about body weight maintenance. It is important to note that although TFEQ-R21 was initially developed for EB analysis of obese individuals, recent studies validated it also in normal weight populations[22,25,26].

Every person presents the all the three behaviors evaluated by TFEQ-21, however, an excess of any of these behaviors may contribute to weight changes[9]. It is possible that the difference between success in body weight maintenance or not is in the imbalance between these behaviors[10]. We can speculate that the amount of physical exercise practiced in this study (three times a week, one hour duration) is effective in promoting healthier EB without causing excessive, usually unhealthy, concerns about body weight.

Table 2. Energy and macronutrient intake in physically active men and women.

Variables	Three days mean (Mean ± SD)	Training day (Mean ± SD)	Non-training day (Mean ± SD)	Weekend day (Mean ± SD)
		All participants		
Kcal	2003.8±736.7	2003.8±736.7	2009.7±523.7	2251.4±1016.8
Carbohydrates (%)	50.7±8.7	50.73±8.7	53.26±9.2	50.29±8.8
Proteins (%)	18.6±6.3	18.57±6.3	16.7±4.5	20.65±21.3
Lipids (%)	30.3±8.3	30.3±8.3	30.1±7.9	31.9±7.3
		Women		
Kcal	1884.9±530.1	1884.9±530.1	1967.1±463.5	1998.8±850.3
Carbohydrates (%)	51.2±9.0	51.25±8.9	51.5±9.6	49.7±7.6
Proteins (%)	17.3±6.6	17.2±6.6	16.8±4.9	17.3±4.5
Lipids (%)	30.7±7.7	30.73±7.7	31.38±7.9	32.9±6.5
		Men		
Kcal	2232.4±1012.7*	2232.5±1012.75	2102.0±648.6	2737.3±1163.5
Carbohydrates (%)	49.7±8.4	49.75±8.4	57.03±9.4	51.44±11.1
Proteins (%)	21.1±5.2	21.09±5.2	16.7±3.4	27.05±35.9
Lipids (%)	29.4±9.6	29.39±9.6	27.36±7.3	29.99±8.6

Variables presented in mean ± standard deviation. * Significant difference between men and women in the mean of three-day food diary (*Student T test for unpaired sample*; $p < 0.05$)

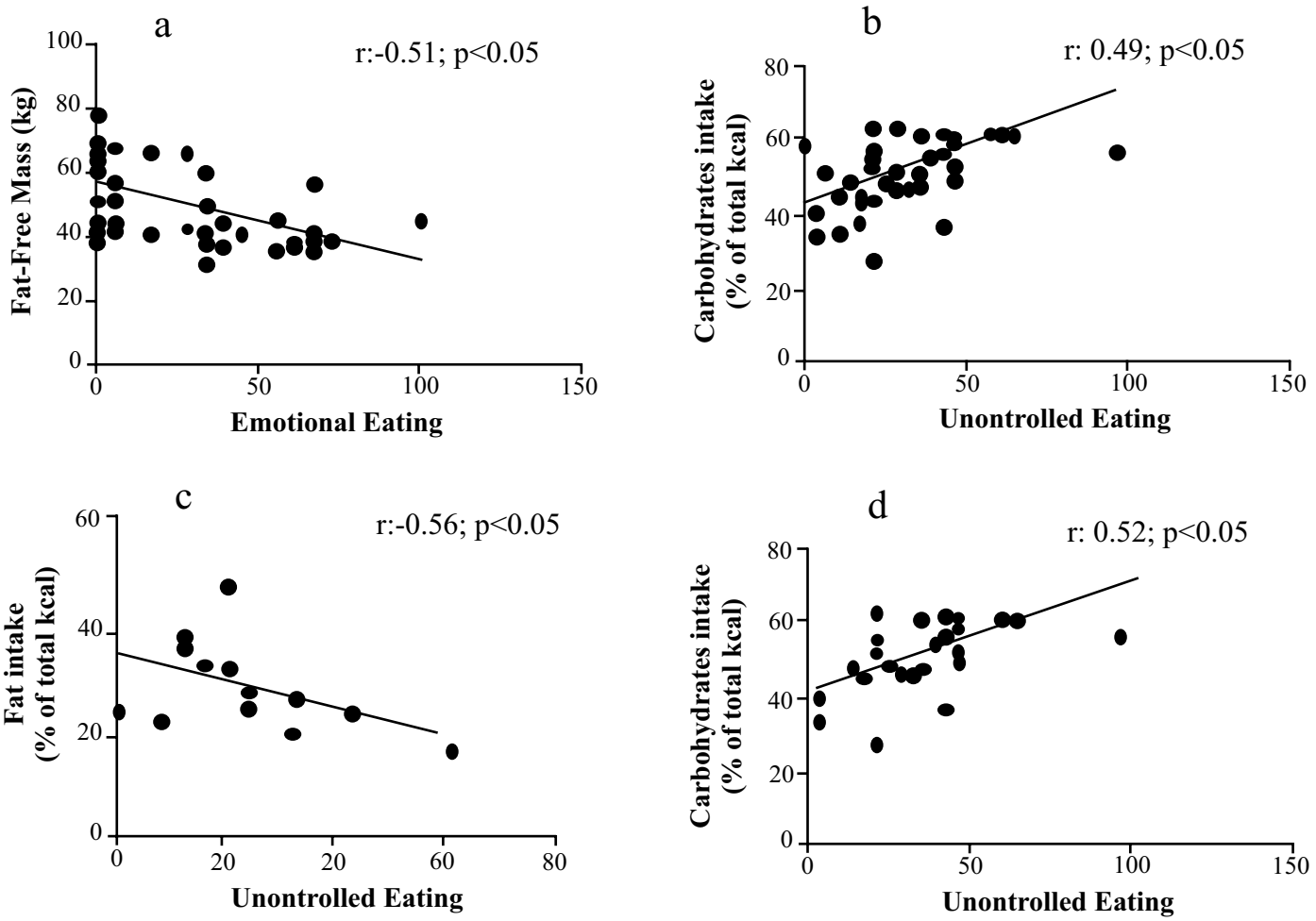

Figure 2. Pearson correlations between eating behaviors components and parameters of body composition and macronutrient intake. (a, b) Significant correlations in all participants; (c) Significant correlation in male participants; (d) Significant correlation in women participants.

In agreement with others studies[27,28], in the present study women had higher scores of EE behavior compared to men. According to Gattellari and Huon[28] and Krawczyk and Thompson[29], women who adhere to dietary restrictions mainly have general concerns about their body image and the type of food they eat. The current literature suggests that inappropriate feeding practices to improve body composition are common in women[30].

The higher scores of EE and UE support the theory that women have more difficulties in maintain body weight compared to men. Some individuals tend to use food to alleviate anxiety and depression, which results in excessive food intake[31]. In addition, women with eating disorders also use physical exercise as a compensatory factor for excessive eating, probably because of their behaviors of anxiety, depression, obsession, and perfectionism associated with a slimmer body[32]. However, there is no consensus about the mechanisms related to these attitudes. Some authors suggest a difficulty in distinguishing the feeling of hunger from physiological hunger with other behaviors that promote increased appetite[33].

The relationship between negative emotional stimuli and increased food consumption, especially of foods with high energy density, high fat and sugars, has been extensively studied[34]. A significant association between stress, emotional stimulation, and weight gain was previously described[35]. Our results suggest that there is a relationship between the UE behavior and carbohydrate consumption in women and an inverse relationship between this behavior and fat consumption in men. When compared between sexes, some aspects related to EE, consumption of sweets, and energy rich foods, the current literature shows conflicting results[25]. According to Elfhag *et al.*[35] women tend to prefer sugar-rich foods, justifying psychological aspects and comfort feelings. Anxiety, one of the most common feelings in society, contributes significantly to increased EE behavior. Reports show that around 50% of women have some type of eating disorder, which is mainly related to symptoms of anxiety[36].

Despite not being our main objective, in this study the training did not modulate the food intake of individuals. Thus, there were no differences in total energy or macronutrients consumption on the different days. Several studies show that physical exercise is an essential component of a healthy lifestyle. However, it is known that it can lead to unhealthy behaviors and, sometimes, the development of eating disorders[37,38] when done incorrectly and is associated to excessive worries about body image.

Although the main association between physical exercise and weight loss is related to the increased energy expenditure, several studies show that physical exercise or physical activity can significantly modulate the EB, feelings of hunger or satiety and energy consumption[39,40]. In 2012, Cormier *et al.*[40], aiming to evaluate the effects of physical training on neuronal response to food intake and EB in obese individuals, failed to observe effects of exercise on appetite, hunger, and satiety feelings. However, these authors found an association between chronic physical exercise and reduced visual response to food in important brain regions.

No differences were found between energy and macronutrient consumption in the different evaluated days, which means that no compensation in energy intake happened on training days. The effects of physical exercise on food intake are still controversial. However, women seem to have greater variations in EB when compared to men. It was observed that acute physical exercise has no effect on energy consumption in men[41], whereas, in women, there was an increase in energy intake[42]. In 2009, Hagobian *et al.*[42] observed higher levels of acylated ghrelin in women compared to men after moderate exercise, suggesting that exercise can modulate this hormone (hunger stimulator). Thus, women may have greater feelings of hunger after physical exercise.

Our findings suggest the existence of higher CR behavior rates in both sexes compared to the other behaviors evaluated. Also, our study population presents no large fluctuations in food consumption when analyzing non-training days and weekends, which is in agreement with the higher levels of CR behavior and success in maintaining body weight, considering that this is a normal weight population.

Although the neural and hormonal mechanisms related to hunger and satiety regulation are well described in the literature, the effects of physical exercise on the different types of EB is not so clear. Better understanding of these variables are needed for more accurate adjustments in clinical practice.

Importantly, this study presents a number of limitations: this is cross-sectional study with a small sample size; the evaluation of only one day of food for every situation (with training, without training, and weekend), which does not always represent the habits in all individuals; and it was not possible to verify more sensitive markers related to hunger and satiety.

In summary, this study showed that people engaged in regular physical exercise have better control over EB, and that women are more influenced by emotional factors than men and, therefore, find it more difficult to maintain body weight. In addition, this study showed that there is no compensation in food consumption due to the increased energy expenditure from exercise. This study highlights a common problem, frequently experienced in nutrition clinical practice, in which women experience great difficulty in body weight loss or maintenance. This difficulty is related to specific EBs and this should be considered when planning strategies for weight loss in this population.

References

1. Poulain JP. The contemporary diet in France: "de-structuration" or from commensalism to "vagabond feeding". Appetite. 2002; 39(1): 43-55.
2. Apfeldorfer G, Zermati JP. Cognitive restraint in obesity. History of ideas, clinical description. Presse medicale. 2001; 30(32): 1575-80. http://dx.doi.org/10.1590/S1415-52732011000300002.
3. Barker ME, Thompson KA, McClean SI. Attitudinal dimensions of food choice and nutrient intake. Br J Nutr. 1995; 74(5): 649-59.
4. Flier JS. Obesity wars: molecular progress confronts an expanding epidemic. Cell. 2004; 116(2): 337-50.
5. Lowe MR, Timko CA. What a difference a diet makes: towards an understanding of differences between restrained dieters and restrained nondieters. Eat Behav. 2004: 5(3): 199-208.
6. Gilhooly CH, Das SK, Golden JK, McCrory MA, Dallal GE, Saltzman E, et al. Food cravings and energy regulation: the characteristics of craved foods and their relationship with eating

behaviors and weight change during 6 months of dietary energy restriction. Int J Obes. 2007; 31(12): 1849-58.
7. Rutters F, Nieuwenhuizen AG, Lemmens SG, Born JM, Westerterp-Plantenga MS. Acute stress-related changes in eating in the absence of hunger. Obesity. 2009; 17(1): 72-7.
8. Cappelleri JC, Bushmakin AG, Gerber RA, Leidy NK, Sexton CC, Lowe MR, Karlsson J. Psychometric analysis of the Three-Factor Eating Questionnaire-R21: results from a large diverse sample of obese and non-obese participants. Int J Obes. 2009 Jun;33(6):611-20.
9. Dalton M, Hollingworth S, Blundell J, Finlayson G. Weak Satiety Responsiveness Is a Reliable Trait Associated with Hedonic Risk Factors for Overeating among Women. Nutrients. 2015; 7(9): 7421-36.
10. Asarian L, Geary N. Sex differences in the physiology of eating. Am J Physiol Regul Integr Comp Physiol. 2013; 305(11): R1215-67.
11. Ernst B, Wilms B, Thurnheer M, Schultes B. Eating behaviour in treatment-seeking obese subjects - Influence of sex and BMI classes. Appetite. 2015 Dec;95:96-100.
12. Nurkkala M, Kaikkonen K, Vanhala ML, Karhunen L, Keränen AM, Korpelainen R. Lifestyle intervention has a beneficial effect on eating behavior and long-term weight loss in obese adults. Eat Behav. 2015 Aug;18:179-85.
13. Volger S, Wadden TA, Sarwer DB, Moore RH, Chittams J, Diewald LK, et al. Changes in eating, physical activity and related behaviors in a primary care-based weight loss intervention. Int J Obes. 2013; 37(Suppl 1): S12-8.
14. Elliott L, Cifu AS. Healthy Lifestyle Counseling in Persons With Cardiovascular Risk Factors. Jama. 2015; 314(4): 398-9.
15. Johns DJ, Hartmann-Boyce J, Jebb SA, Aveyard P. Diet or exercise interventions vs combined behavioral weight management programs: a systematic review and meta-analysis of direct comparisons. J Acad Nutr Diet. 2014; 114(10): 1557-68.
16. Sweet SN, Fortier MS. Improving physical activity and dietary behaviours with single or multiple health behaviour interventions? A synthesis of meta-analyses and reviews. Int J Environ Res Public Health. 2010; 7(4): 1720-43.
17. Jones AM, Doust JH. A 1% treadmill grade most accurately reflects the energetic cost of outdoor running. J Sports Sci. 1996 Aug;14(4):321-7.
18. Kraemer SJFWJ. Fundamentos do treinamento de força muscular. ARTMED BOOKMAN. 2006;1.
19. Knutzen KM, Brilla LR, Caine D. Validity of 1RM prediction equations for older adults. J Strength Cond Res. 1999; 13(3): 242-246.
20. Natacci LC, Ferreira Junior M. The three factor eating questionnaire - R21: tradução para o português e aplicação em mulheres brasileiras. Rev Nutri. 2011; 24(3): 383-94.
21. de Lauzon B, Romon M, Deschamps V, Lafay L, Borys JM, Karlsson J, et al. The Three-Factor Eating Questionnaire-R18 is able to distinguish among different eating patterns in a general population. J Nutr. 2004; 134(9): 2372-80.
22. Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. J Psychosom Res. 1985; 29(1): 71-83.
23. Karlsson J, Persson LO, Sjostrom L, Sullivan M. Psychometric properties and factor structure of the Three-Factor Eating Questionnaire (TFEQ) in obese men and women. Results from the Swedish Obese Subjects (SOS) study. Int J Obes Relat Metab Disord. 2000; 24(12): 1715-25.
24. Tholin S, Rasmussen F, Tynelius P, Karlsson J. Genetic and environmental influences on eating behavior: the Swedish Young Male Twins Study. Am J Clin Nutr. 2005; 81(3): 564-9.
25. Yeomans MR, Tovey HM, Tinley EM, Haynes CJ. Effects of manipulated palatability on appetite depend on restraint and disinhibition scores from the Three-Factor Eating Questionnaire. Int J Obes Relat Metab Disord. 2004; 28(1): 144-51.
26. Bryant EJ, King NA, Blundell JE. Disinhibition: its effects on appetite and weight regulation. Obes Rev. 2008; 9(5): 409-19.
27. 27. Mazzeo SE, Saunders R, Mitchell KS. Gender and binge eating among bariatric surgery candidates. Eat Behav. 2006; 7(1): 47-52.
28. Gattellari M, Huon GF. Restrained and unrestrained females' positive and negative associations with specific foods and body parts. Int J Eat Disord. 1997; 21(4): 377-83.
29. Krawczyk R, Thompson JK. The effects of advertisements that sexually objectify women on state body dissatisfaction and judgments of women: The moderating roles of gender and internalization. Body image. 2015; 15: 109-19.
30. Epel E, Lapidus R, McEwen B, Brownell K. Stress may add bite to appetite in women: a laboratory study of stress-induced cortisol and eating behavior. Psychoneuroendocrinology. 2001; 26(1): 37-49.
31. Shroff H, Reba L, Thornton LM, Tozzi F, Klump KL, Berrettini WH, et al. Features associated with excessive exercise in women with eating disorders. Int J Eat Disord. 2006; 39(6): 454-61.
32. Spaziani D, Isidori MV, Floridi S, Casacchia M. Physiological and psychopathological aspects of eating behavior. Clin Ter. 1993; 143(5): 389-406.
33. Konttinen H, Silventoinen K, Sarlio-Lahteenkorva S, Mannisto S, Haukkala A. Emotional eating and physical activity self-efficacy as pathways in the association between depressive symptoms and adiposity indicators. Am J Clin Nutr. 2010; 92(5): 1031-9.
34. Nguyen-Rodriguez ST, Chou CP, Unger JB, Spruijt-Metz D. BMI as a moderator of perceived stress and emotional eating in adolescents. Eat Behav. 2008: 9(2): 238-46.
35. Elfhag K, Tholin S, Rasmussen F. Consumption of fruit, vegetables, sweets and soft drinks are associated with psychological dimensions of eating behaviour in parents and their 12-year-old children. Public Health Nutr. 2008; 11(9): 914-23.
36. Lipsey Z, Barton SB, Hulley A, Hill AJ. "After a Workout ..." Beliefs about exercise, eating and appearance in female exercisers with and without eating disorders features. Psychol Sport Exerc. 2006; 7(5): 425-36.
37. Meyer C, Taranis L, Goodwin H, Haycraft E. Compulsive exercise and eating disorders. Eur Eat Disord Rev. 2011; 19(3): 174-89.
38. King NA, Caudwell P, Hopkins M, Byrne NM, Colley R, Hills AP, et al. Metabolic and behavioral compensatory responses to exercise interventions: barriers to weight loss. Obesity. 2007; 15(6): 1373-83.
39. King NA, Horner K, Hills AP, Byrne NM, Wood RE, Bryant E, et al. Exercise, appetite and weight management: understanding

the compensatory responses in eating behaviour and how they contribute to variability in exercise-induced weight loss. Br J Sports Med. 2012; 46(5): 315-22.

40. Cornier MA, Melanson EL, Salzberg AK, Bechtell JL, Tregellas JR. The effects of exercise on the neuronal response to food cues. Physiol Behav. 2012; 105(4): 1028-34.
41. Pomerleau M, Imbeault P, Parker T, Doucet E. Effects of exercise intensity on food intake and appetite in women. Am J Clin Nutr. 2004; 80(5): 1230-6.
42. Hagobian TA, Sharoff CG, Stephens BR, Wade GN, Silva JE, Chipkin SR, et al. Effects of exercise on energy-regulating hormones and appetite in men and women. Am J Physiol Regul Integr Comp Physiol. 2009; 296(2): R233-42.

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