Clinical Nutrition ESPEN 34 (2019) 110–115

Contents lists available at ScienceDirect

Clinical Nutrition ESPEN

journal homepage: http://www.clinicalnutritionespen.com

Original article

Dietary quality differences between women with and without weight loss in nutritional treatment

Ana Carolina Aguiar-Bloemer [a], Camila Cremonezi Japur [a, b], Lucas Vieira Francisco [a], Rosa Wanda Diez-Garcia [a, b, *]

[a] Laboratory of Food Practices and Behavior - PrátiCA, Division of Nutrition and Metabolism, Department of Health Sciences, Ribeirão Preto Medical School, University of São Paulo, São Paulo, SP, Brazil
[b] Division of Nutrition and Metabolism, Department of Health Sciences, Ribeirão Preto Medical School, University of São Paulo, São Paulo, SP, Brazil

ARTICLE INFO

Article history:
Received 19 December 2018
Accepted 5 August 2019

Keywords:
Obesity
Diet quality
Nutritional treatment
Sweet
Weight loss

SUMMARY

Background & aims: The obesity nutritional treatment is structured to weight loss and diet is considered an important indicator of treatment effectiveness. The purpose of this study is to compare the diet quality among women who lost weight to women who maintained or gained weight during the nutritional treatment.

Methods: This is a retrospective study that included 66 obese women in nutritional treatment for weight loss, over six months, divided in tercile according to their weight loss. The diet quality was evaluated by score, which was obtained with a food frequency questionnaire.

Results: The diet quality comparison was made among the group with weight loss (GL; n = 22) and the group that maintained or gained weight during the nutritional treatment (GG; n = 22) showed that both groups had improvement in their diet quality scores from pre-treatment to post-treatment. Nevertheless, the GG had higher sugar consumption than the GL in the pre-treatment (p = 0.02) and in the post-treatment (p 0.01) periods. In the post-treatment, GL increased their scores for leafy vegetables (0.013), fruit (0.004), sweets (p 0.03), and soft drinks (p 0.02). GL improved their scores for fried food (p 0.01) and sweets (p 0.008).

Conclusion: This indicates that in the weight loss treatment special attention should be given to the incentive to the fruit and leafy vegetables consumption and, to reduce the consumption of sweets.

1. Introduction

The treatment for obesity is complex and involves long-term lifestyle changes [1]. Several studies point to the difficulty and low efficacy of the treatment for obesity, regarded as unsuccessful and inefficient by health professionals [2].

Usually, weight loss treatment is related to diet quality [3–6] and metabolic improvement, such as reducing risk of diabetes, heart diseases and arterial hypertension [7]. Studies that evaluated the replacement of food with high energy content for food with high fiber content, like fruit, vegetables and whole grain showed reduction on the obesity risk and chronic diseases in their patients [8]. Wolongevicz et al. (2010) showed that women with poor diet quality are more likely to become overweight and obese compared to women with better diet quality [9]. In a review about weight keeping, the authors showed strong evidence that a diet with high consumption of whole cereals is associated with a lower BMI, smaller abdominal circumference (AC), and smaller risk of becoming overweight. Moreover, a considerable weight loss can be reached with a diet rich in cereals and vegetables plus controlled energy ingestion [10].

Besides weight loss, diet quality improvement is also related to metabolic benefits as the reduction of risk for developing chronic diseases [11,12] and even depression [13]. Boeing et al. (2012) concluded that higher fruit and vegetable consumption decreases the risk for hypertension, coronary diseases, heart attack, cancer, dementia, osteoporosis, and some eye diseases. Some data also

* Corresponding author. Ribeirão Preto Medical School, University of São Paulo, Av. Bandeirantes, 3900, Ribeirão Preto, SP, Brazil.
E-mail addresses: carolinabloemer@gmail.com (A.C. Aguiar-Bloemer), camilajapur@usp.br (C.C. Japur), l.vieira.francisco@gmail.com (L.V. Francisco), wanda@fmrp.usp.br (R.W. Diez-Garcia).

https://doi.org/10.1016/j.clnesp.2019.08.003
2405-4577/

point to prevention of asthma, chronic obstructive lung disease, and rheumatoid arthritis. Likewise, there is evidence that high fruit and vegetable consumption can possibly prevent weight gain [14].

Associated to weight loss, although cohort studies [15] and clinic studies [16] suggest that high fruit and vegetable consumption can reduce the incidence of obesity, there are controversial studies about the subject. Some point to weight loss [17,18], to weight maintenance [19,20] and even weight gain [21]. The purpose of this study was to compare the diet quality between obese women in nutritional treatment who lost weight to women who gained weight.

2. Materials and methods

2.1. Sample

This is a retrospective analysis of the records of treatment regimens for weight loss of 66 obese women treated in the Endocrinology Gynecological Ambulatory at the Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto, from 2008 to 2013. This project was approved by the ethics and research committee of Hospital das Clinicas da Faculdade de Medicina de Ribeirão Preto, São Paulo University (protocol 101372010). For sampling characterization, we used a questionnaire, which collects social and demographic data (age, income, marital status, number of children and education) and the diagnosis of polycystic ovary syndrome (PCOS) by the Rotterdam standard.

2.2. Study procedure

Before the treatment initiation, nutritional status, body composition, and food consumption for each patient were evaluated. After the initial evaluation, patients attended an appointment every two months for a total of four appointments in six months of nutritional treatment. The intervention was individualized by nutritional counselling based on the qualitative food consumption evaluation and diagnosis. The main topics addressed were the reduction of energy consumption and ultra-processed foods, especially those rich in simple carbohydrate (sweets such as chocolate, cake, candy and biscuits), saturated fat, and also increase the consumption of foods rich in fiber, vitamins and minerals. The parameters measured initially were reassessed after six months of treatment. By the end of the treatment, the women were divided into two groups: those who lost weight and those who gained or maintained their weight.

2.3. Nutritional status evaluation

Nutritional status was evaluated by the difference between observations taken before and after nutritional treatment of the following parameters: body mass index (BMI = weight/height^2) as classified by World Health Organization (WHO) [22]; neck [23], abdominal, and hip circumferences; and body composition evaluated by the bioelectrical impedance (Biodynamics apparatus model 450) examination with four electrodes. The fat percentage was evaluated according to the cut points proposed by Sun et al. (2003) [24].

2.4. Food consumption evaluation

Food consumption data was obtained from a food frequency questionnaire, adapted from Medeiros et al. (2007) [25]. In this adaptation, the following food or food groups were analyzed: fruit, leafy vegetables, vegetables, beans, milk, cheese, meat, fried food, sweets (sugar-rich foods, such as cake, biscuit, candy and chocolate), and soft drinks. The highest score [32] corresponds to better diet quality and was assigned to the frequency considered desirable. The lowest score was zero and indicates poorer diet quality (Fig. 1). The analysis of diet quality changes was made by the comparison of the scores obtained by the food frequency questionnaire between the pre and post-treatment.

2.5. Statistical analysis

After analyzing weight differences between pre- and post-treatment for each participant, the results were put in descending order of weight loss and divided in tercile: 1st tercile (n = 22): group with larger weight loss (GL); 2nd tercile (n = 22): middle group (GM); and 3rd tercile (n = 22): group which maintenance or gained weight (GG) during the nutritional treatment. We compared variation in diet quality of the group which lost more weight (GL) with the group which maintenance or gained weight (GG).

We calculated averages, medians, standard deviations and percentages of nutritional data or food information for sample characterization data, socioeconomic data, PCOS and nutritional diagnosis. To compare the differences of nutritional status, anthropometry, body composition, and diet quality by score and food type between the groups, we used a non-parametric Kruskal–Wallis test for independent samples. To analyze the alteration in diet quality by food type and the intra-group nutritional features, we used a T-Test. For statistical analysis, we used SPSS software, version 22 (IBM Corp. NY. USA). The significance level was set at 95% ($p < 0.05$).

3. Results

3.1. Sample characterization

The sociodemographic analysis showed that age, per capita income, number of children, and years of education were statistically similar between GL and GG groups. The groups were also similar concerning marital status. In the GL group, 54% were married and 40% were single, while 59% were married and 41% were single in the GG group. The polycystic ovary syndrome diagnosis predominated in 73% of the GL group and in 77% of the GG group (Table 1).

Initial pre-treatment assessments were similar for GL and GG groups in weight (p 0.67) and BMI (p 0.86). The median weight was of 94.19 kg and 95.94 kg and BMI was 37.11 kg/m^2 and 36.71 kg/m^2, respectively (Table 2).

Initial diet quality scores between groups were similar (p 0.54) with an average score of 17.97 ± 4.40 for the GL group and 17.39 ± 5.33 for the GG group. However, when analyzing the scores for consumption frequency of each food type separately, we found that the GL group presented a significantly higher score (p 0.02) for sweets when compared to the GG group. In other words, the GL group had lower sweets consumption.

3.2. Intervention effect on the weight loss group (GL)

The nutritional intervention resulted in an average weight loss of 6.70 ± 2.82 kg (3.2% of the initial GL participants weight; $p < 0.001$) and a BMI reduction of 2.53 ± 0.84 kg/m^2 ($p < 0.001$). This loss is also directly reflected in the reduction of body fat mass (1.7 ± 1.87%) and the circumferences of the neck (2.9 ± 1.44 cm), torso (4.66 ± 3.25 cm), abdomen (4.76 ± 2.36 cm) and hips (5.51 ± 3.77 cm).

The diet quality score of the GL group improved by a median of 18.3% through a significant increase in fruit consumption (p 0.004) and leafy vegetables (p 0.013) and a significant reduction on the consumption of sweets (p 0.03) and soft drinks (p 0.02).

Food/Score	0 point	1 point	2 points	3 points	4 points
Fruit	Never	Sometimes	1 time per day	2 times per day	3 or more times
Leafy vegetables	Never	Sometimes	1 time per day	2 times per day	-
Vegetables	Never	Sometimes	1 time per day	2 times per day	-
Beans	Never	Sometimes	1 time per day	2 times per day	-
Milk	Never	Sometimes	1–2 times per day	3 or more times per day	-
Cheese	Never	Eventually	Often	Always	-
Meat	Never	Sometimes	1–2 times per day	-	-
Fried food	Everyday	4-5 times per week	2–3 times per day	<1 time per week	<1 time per month
Sweets	Several times per day	1 time per day	Not everyday	Not often	-
Soft drinks	Several times per day	1 time per day	Only on weekends	Never	-

Fig. 1. Food group and scores for diet quality analysis.

3.3. Intervention effect on the maintenance or gained weight group (GG)

After the nutritional intervention, the GG group gained an average of 2.65 ± 1.47 kg ($p < 0.001$), resulting in an increase of 2.52 ± 0.36% of the average BMI. Percentual body fat mass, lean mass and circumferences of the neck, arms, torso and abdomen all remained stable for this group, while hip circumference increased significantly. The GG group had an improvement of 19.49 ± 4.06% in the diet quality general score as a consequence of the higher score in fried food (p-0.01) and sweets (p-0.008) consumption after the intervention.

Table 1
Sample characterization.

Variables	GL (average ± SD)	GG (average ± SD)	p-value
Age (years)	30.6 ± 8.17	32.0 ± 5.44	0.60
Per capita income (R$)	632.22 ± 491.73	413.48 ± 225.58	0.17
Marital status	Married: 54% Single: 40% Other: 4.54%	Married: 59% Single: 41%	
Number of children	0.73 ± 1.12	1.03 ± 0.78	0.75
Education (years)	9.13 ± 3.94	9.45 ± 2.65	0.84
PCOS diagnosis	73.0%	77%	

PCOS: Polycystic Ovary Syndrome.

3.4. Comparing the intervention effect on body and diet quality aspects of both groups

Comparing the body aspects between GL and GG groups, participants in the GG group weighed a median of 10.58 kg more than those in the GL group, and 3.08 kg/m^2 in the median BMI. As shown in Fig. 2, there was a significant difference for all anthropometric measurements between groups, as in the circumferences of the neck (2.35 cm), arms (2.65 cm), torso (7.64 cm), abdomen (8.38 cm) and hips (7.58 cm). There was no statistical difference for body fat mass (p 0.11) or lean mass (p 0.21) after the intervention between groups.

The diet quality score post-intervention varied between 9 and 28, according to the food frequency of the 11 food group items evaluated. Both groups improved their scores after the intervention. In Fig. 3, when comparing the diet quality scores of the two

Table 2
Anthropometric and diet quality factors analyzed in GL and GG groups after the intervention and pre- and post-treatment comparison among groups.

Characters	GL			GG			Pre-intervention GL X GL (p-value)	Post-intervention GL X GL (p-value)
	Pre-intervention (average ± SD)	Post-intervention (average ± SD)	p-value	Pre-intervention (average ± SD)	Post-intervention (average ± SD)	p-value		
Body weight (kg)	94.19 ± 16.09	87.91 ± 16.93	p < 0.001	95.94 ± 14.33	98.49 ± 15.45	p < 0.001	0.67	0.04
BMI (kg/m^2)	37.11 ± 5.57	34.58 ± 5.77	p < 0.001	36.71 ± 4.49	37.66 ± 4.75	p < 0.001	0.86	0.03
Body fat mass (%)	40.03 ± 3.81	38.33 ± 4.65	0.007	40.30 ± 3.57	39.32 ± 9.35	0.66	0.79	0.11
Lean mass (kg)	54.88 ± 6.26	50.87 ± 13.23	0.083	56.12 ± 7.62	54.65 ± 14.80	0.59	0.44	0.21
Neck circumference (cm)	38.36 ± 3.03	36.64 ± 3.01	p < 0.001	38.67 ± 3.60	38.99 ± 3.47	0.47	0.54	0.01
Arm circumference (cm)	37.74 ± 4.45	35.46 ± 4.11	0.99	37.39 ± 4.28	38.11 ± 3.72	0.12	0.71	0.04
Torso circumference (cm)	107.43 ± 7.36	102.77 ± 6.76	p < 0.001	109.31 ± 8.38	110.41 ± 8.30	0.18	0.95	0.01
Abdominal circumference (cm)	109.87 ± 11.03	105.11 ± 11.34	0.008	111.00 ± 11.01	113.49 ± 9.76	0.10	0.92	0.04
Hip circumference (cm)	119.34 ± 10.42	113.83 ± 9.50	p < 0.001	119.46 ± 12.06	121.41 ± 11.94	0.02	0.72	0.03
Diet quality score	17.97	21.27	0.004	17.39	20.78	0.006	0.54	0.08
Fruit score	1.54	2.40	0.004	1.86	2.30	0.12	0.25	0.70
Leafy vegetables score	1.90	2.40	0.013	1.73	1.69	0.68	0.54	0.02
Vegetables score	1.81	2.00	0.35	1.78	2.13	0.17	0.19	0.20
Beans score	2.04	2.18	0.41	2.00	2.17	0.44	0.99	0.37
Milk score	1.33	1.27	0.57	1.21	1.39	0.29	0.45	0.92
Cheese score	1.72	2.09	0.18	1.65	1.95	0.23	0.47	0.20
Meat score	1.81	1.81	1.00	1.91	1.95	0.57	0.63	0.59
Fried food score	2.40	2.77	0.14	2.17	2.95	0.01	0.66	0.42
Sweets score	2.45	2.95	0.03	1.34	2.04	0.008	0.02	0.01
Soft drinks score	1.50	2.13	0.02	1.73	2.17	0.06	0.17	0.16

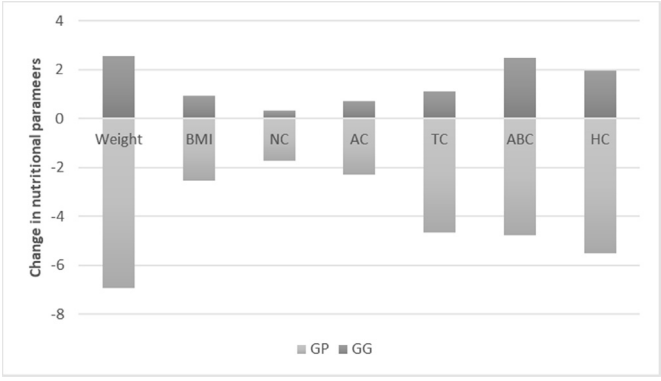

Fig. 2. Anthropometric differences between weight loss group (GL, dark gray bars) and weight maintenance or gained group (GG, light gray bars). Abbreviations: body mass index (BMI), neck circumference (NC), arm circumference (AC), torso circumference (TC), abdominal circumference (ABC) and hip circumference (HC).

groups, there were significant differences only for leafy vegetables (p 0.02) and sweets (p 0.01) consumption, in which the GL group presented a higher score than the GG group. In Fig. 3 is observed a similarity in the frequency of the consumption of most food types evaluated after intervention.

4. Discussion

Our study results showed that the main difference in diet quality between women who lost weight and women that did not lose weight during the nutritional treatment was sweets consumption. That is, when comparing pre-treatment diet quality between the two groups, we noted that both groups presented the same fruit, leafy vegetables, vegetables, beans, milk, cheese, meat, fried food and soft drinks consumption. However, that group which lost weight presented less sweets consumption when compared to the group which did not lose weight. When comparing the diet quality before and after the nutritional treatment, this study showed that the GL group improved more aspects of their diet quality (leafy vegetables, fruit, sweets, and soft drinks) than the GG group (sweets and fried food). Although the GG group improved their sweets consumption after the nutritional treatment, the results showed that this group consumed a larger quantity of sweets after the nutritional treatment when compared to the GL group (p 0.01).

Interestingly, epidemiological studies in Brazil showed that the nutritional status transition of Brazilian people (the increasing obesity prevalence) is concomitantly the alteration of the food consumption standards. Furthermore, there was an increase of ultra-processed food consumption (source of sugar and saturated fat) and a decrease of raw and minimally processed food consumption (source of vitamins and minerals) [26–31]. Therefore, this nutritional change generates an increase in sugar and saturated fat intake and a decrease in vitamins and minerals consumption for the Brazilian population. Considering all the above, it seems that the increase of sweets consumption not only can raise the risk of weight gain and metabolic changes [32].

A meta-analysis showed that most studies presented positive associations between the quantity of consumed sugar and body weight, weight gain, and adiposity in adults, and that sugar consumption reduction was associated with a decrease in body weight [33]. In a systematic literature review, Fogelhol et al. (2012) showed evidences that high refined grain, sweets and desserts consumption are the main weight-gain predictors, while high consumption of high density energy is a predictor of increased waist circumference [34]. Moreover, this same study showed the proportion of macronutrients is not important for obesity prevention, meaning that the association between nutritional standards and weight gain is stronger than the association between macronutrients ingestion and weight gain. The consumption of foods rich in fiber and reduced consumption of more refined grains and sugar-rich foods are associated with smaller weight gain [34].

The mechanism of gaining weight by high consumption of sugar is frequently explained by an energy imbalance. In other words, the consumption of high sugar content food usually presents a high energy density, and the energy consumption over that which is necessary promotes weight gain and adiposity increase. It is important to emphasize that there is also risk of hyperinsulinemia (predictor of obesity and metabolic syndrome), depending on the type of sugar ingested (sucrose, glucose and corn syrup) [33].

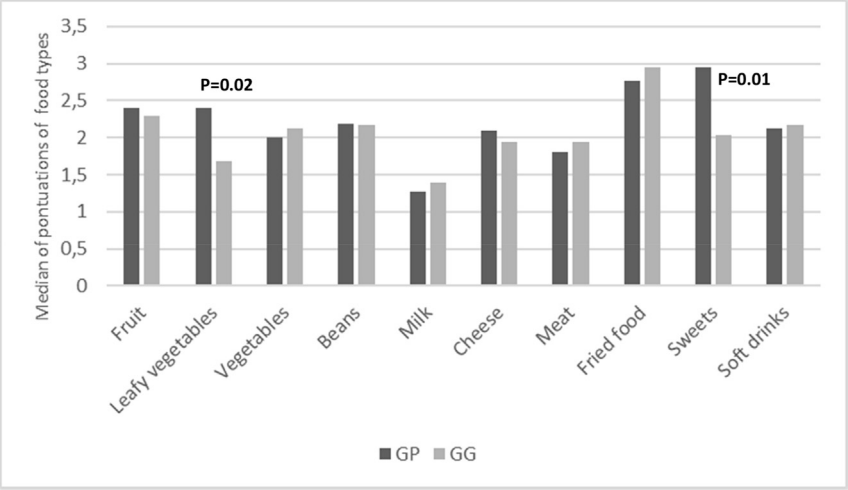

Fig. 3. Diet quality score by food type after the intervention of weight loss group (GL, dark gray bars) and weight maintenance or gained group (GG, light gray bars).

It is known there is an innate preference for sweet food [35] and the consumption of this type of food can exceed the biological aspects. Sweet food is frequently associated with comfort food (food that relieves negative emotions and/or can bring pleasure) [36–38]. Accordingly, the consumption of this type of food can be bound to the patient's psychological state, making the orientation for reduction on consumption of this type of food more complicated in the nutritional treatment, especially when this consumption is a common practice. In this study, it is seen the women group which had a positive result on the nutritional treatment (GL) showed sweet food consumption significantly smaller than the group which did not have success in this treatment (GG), which points to a minor sweets consumption habit and, consequently, they are capable of getting a better score on sweets consumption after the nutritional treatment.

Another difference between the two groups after the nutritional treatment was a larger consumption of leafy vegetables by the GL group when compared to the GG group. Only the GL group improved their fruit consumption scores after the nutritional treatment. The ingestion of low energy density food (ratio between energy and weight of food: kcal/g), such as whole grains and vegetables, promotes increases in satiety and prevents energy overconsumption [39]. Other studies also showed the benefits of low energy density food consumption for weight loss treatment [39–42]. Moreover, low energy density food consumption is related to a lower BMI [43] and higher maintenance of weight loss [44].

It is important to highlight that both groups presented improvement in their diet quality compared to your own initial diet quality (diet quality score in pre-intervention x pos-intervention). Study showed that only the diet quality improvement has already beneficial effects on the metabolism [45], indicating the importance of nutritional treatment, even when the weight goals were not reached. On the other hand, the results of this study showed differences in diet quality among women who lost weight with the women who did not.

The group that did not lose weight (GG) improved their score for fried food but did not have a significant difference on the consumption of this type of food when compared to the GL group post-treatment. Further, the GG group improved their sweets consumption score, but had a significantly lower score than the GL group post-treatment. Although their diet quality improved, it is necessary that the GG group participants continue to decrease sweets consumption and increase vegetables consumption to reach their weight loss goals.

The analysis of food intake by food frequency questionnaires bring some limitations to the study, because of the nature of this evaluation, that demands memory and attention for the consumption of all food types analyzed.

5. Conclusions and implications

Considering our results, we suggest that diet quality should be considered a criterion for defining the nutritional treatment success. In nutritional treatments, sugar consumption should be carefully monitored, and the increase of vegetables consumption should be a priority for weight loss. Future studies should be develop in order to evaluate targeted interventions for this food consumption profile.

Role of funding sources

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001 and by productivity grant of the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) given to RW Diez-Garcia.

Author contribuitions

AGUIAR-BLOEMER, AC contributed to development of the study, interpretation of the results, drafting of the manuscript, and submission process. JAPUR. C.C contributed to the design and implementation of the data collection. FRANCISCO. L.V contributed to the implementation, data collection, and development of the study. DIEZ-GARCIA, RW contributed to the design and implementation of the study, interpretation of the results, drafting of the manuscript, and submission process. All authors read, revised, and approved the final version of the manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

Acknowledgements

This study was part of the research of Laboratory of Food Practices and Behavior-PrátiCA.

References

[1] Associação Brasileira para o Estudo da Obesidade e da Síndrome Metabólica (Abeso), Godoy-Matos A, Oliveira J, Guedes E, Carraro L, Lopes A, et al. Diretrizes Brasileiras de Obesidade. 3rd ed. Itapevi, SP: AC Farmacêutica; 2009.

[2] Teixeira FV, Pais-Ribeiro JL, Maia ÂRP da C. Beliefs and practices of healthcare providers regarding obesity: a systematic review. Rev Assoc Med Bras 2012;58(2):254–62.

[3] Grafenauer SJ, Tapsell LC, Beck EJ, Batterham MJ. Changes in food choice patterns in a weight loss intervention. Nutr Diet 2015;72(4):309–15.

[4] Lassale C, Fezeu L, Andreeva VA, Hercberg S, Kengne A-P, Czernichow S, et al. Association between dietary scores and 13-year weight change and obesity risk in a French prospective cohort. Int J Obes (Lond) 2012;36(11):1455–62.

[5] Nazare J-A, Smith J, Borel A-L, Alméras N, Tremblay A, Bergeron J, et al. Changes in both global diet quality and physical activity level synergistically reduce visceral adiposity in men with features of metabolic syndrome. J Nutr 2013;143(7):1074–83.

[6] Tapsell LC, Batterham MJ, Thorne RL, O'Shea JE, Grafenauer SJ, Probst YC. Weight loss effects from vegetable intake: a 12-month randomised controlled trial. Eur J Clin Nutr 2014;68(7):778–85.

[7] Van Horn L, McCoin M, Kris-Etherton PM, Burke F, Carson JAS, Champagne CM, et al. The evidence for dietary prevention and treatment of cardiovascular disease. J Am Diet Assoc 2008;108(2):287–331.

[8] Rolls BJ, Ello-Martin JA, Tohill BC. What can intervention studies tell us about the relationship between fruit and vegetable consumption and weight management? Nutr Rev 2004;62(1):1–17.

[9] Wolongevicz DM, Zhu L, Pencina MJ, Kimokoti RW, Newby PK, D'Agostino RB, et al. Diet quality and obesity in women: the framingham nutrition studies. Br J Nutr 2009;103(8):1.

[10] Williams PG, Grafenauer SJ, O'Shea JE. Cereal grains, legumes, and weight management: a comprehensive review of the scientific evidence. Nutr Rev 2008;66(4):171–82.

[11] Nicklas TA, O'Neil CE, Fulgoni VL. Diet quality is inversely related to cardiovascular risk factors in adults. J Nutr 2012;142(12):2112–8.

[12] Ye EQ, Chacko SA, Chou EL, Kugizaki M, Liu S. Greater whole-grain intake is associated with lower risk of type 2 diabetes, cardiovascular disease, and weight gain. J Nutr 2012;142(7):1304–13.

[13] Appelhans B, Whited M, Schneider K, Ma Y, Oleski J, Merriam P, et al. Depression severity, diet quality, and physical activity in women with obesity and depression. J Acad Nutr Diet 2012;112(5):693–8.

[14] Boeing H, Bechthold A, Bub A, Ellinger S, Haller D, Kroke A, et al. Critical review: vegetables and fruit in the prevention of chronic diseases. Eur J Nutr 2012;51(6):637–63.

[15] He K, Hu FB, Colditz GA, Manson JE, Willett WC, Liu S. Changes in intake of fruits and vegetables in relation to risk of obesity and weight gain among middle-aged women. Int J Obes 2004;28(12):1569–74.

[16] Champagne CM, Broyles ST, Moran LD, Cash KC, Levy EJ, Lin P-H, et al. Dietary intakes associated with successful weight loss and maintenance during the Weight Loss Maintenance trial. J Am Diet Assoc 2011;111(12):1826–35.

[17] Howard BV, Manson JE, Stefanick ML, Beresford SA, Frank G, Jones B, et al. Low-fat dietary pattern and weight change over 7 years. JAMA 2006;295(1):39–49.

[18] Lanza E, Schatzkin A, Daston C, Corle D, Freedman L, Ballard-Barbash R, et al. Implementation of a 4-y, high-fiber, high-fruit-and-vegetable, low-fat dietary intervention: results of dietary changes in the Polyp Prevention Trial. Am J Clin Nutr 2001;74(3):387–401.

[19] Mytton OT, Nnoaham K, Eyles H, Scarborough P, Ni Mhurchu C. Systematic review and meta-analysis of the effect of increased vegetable and fruit consumption on body weight and energy intake. BMC Public Health 2014;14(1):886.

[20] Saquib N, Rock CL, Natarajan L, Flatt SW, Newman VA, Thomson CA, et al. Does a healthy diet help weight management among overweight and obese people? Allegrante JP, Barry MM, editors. Health Educ Behav 2009;36(3):518–31.

[21] Djuric Z, Poore KM, Depper JB, Uhley VE, Lababidi S, Covington C, et al. Methods to increase fruit and vegetable intake with and without a decrease in fat intake: compliance and effects on body weight in the nutrition and Breast health study. Nutr Cancer 2002;43(2):141–51.

[22] World Health Organization. Obesity : preventing and managing the global epidemic : report of a WHO consultation. World Health Organization; 2000. p. 253.

[23] Penaforte FRO, Japur CC, Diez-Garcia RW, Chiarello PG. Upper trunk fat assessment and its relationship with metabolic and biochemical variables and body fat in polycystic ovary syndrome. J Hum Nutr Diet 2011;24(1):39–46.

[24] Sun SS, Chumlea WC, Heymsfield SB, Lukaski HC, Schoeller D, Friedl K, et al. Development of bioelectrical impedance analysis prediction equations for body composition with the use of a multicomponent model for use in epidemiologic surveys. Am J Clin Nutr 2003 Feb 1;77(2):331–40.

[25] de Medeiros MAT, Cordeiro R, Zangirolani LTO, Garcia RWD. Estado nutricional e práticas alimentares de trabalhadores acidentados. Rev Nutr 2007;20(6):589–602.

[26] Levy RB, Claro RM, Mondini L, Sichieri R, Monteiro CA. Distribuição regional e socioeconômica da disponibilidade domiciliar de alimentos no Brasil em 2008-2009. Rev Saude Publica 2012;46(1):06–15.

[27] Levy RB, Claro RM, Monteiro CA. Sugar and total energy content of household food purchases in Brazil. Public Health Nutr 2009;12(11):2084–91.

[28] da Louzada MLC, Baraldi LG, Steele EM, Martins APB, Canella DS, Moubarac J-C, et al. Consumption of ultra-processed foods and obesity in Brazilian adolescents and adults. Prev Med (Baltim) 2015;81:9–15.

[29] Malta DC, Campos MO, de Oliveira MM, Iser BPM, Bernal RTI, Claro RM, et al. Prevalência de fatores de risco e proteção para doenças crônicas não transmissíveis em adultos residentes em capitais brasileiras, 2013. Epidemiol e Serviços Saúde 2015;24(3):373–87.

[30] Monteiro CA. Nutrition and health. The issue is not food, nor nutrients, so much as processing. Public Health Nutr 2009;12(05):729–31.

[31] Monteiro CA, Levy RB, Claro RM, de Castro IRR, Cannon G. Increasing consumption of ultra-processed foods and likely impact on human health: evidence from Brazil. Public Health Nutr 2011;14(1):5–13.

[32] Macedo DM, Diez-Garcia RW. Sweet craving and ghrelin and leptin levels in women during stress. Appetite 2014;80:264–70.

[33] Te Morenga L, Mallard S, Mann J. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. BMJ 2012;346(Jan15 3):e7492.

[34] Fogelholm M, Anderssen S, Gunnarsdottir I, Lahti-Koski M. Dietary macronutrients and food consumption as determinants of long-term weight change in adult populations: a systematic literature review. Food Nutr Res 2012;56(1):19103.

[35] Birch LL. Development of food preferences. Annu Rev Nutr 1999;19(1):41–62.

[36] LeBel J, Lu J, Dube L. Positive versus negative affect asymmetry and comfort food consumption. ACR North Am Adv 2006;33:263–4.

[37] Tomiyama AJ, Dallman MF, Epel ES. Comfort food is comforting to those most stressed: evidence of the chronic stress response network in high stress women. Psychoneuroendocrinology 2011;36(10):1513–9.

[38] Wansink B, Cheney MM, Chan N. Exploring comfort food preferences across age and gender. Physiol Behav 2003;79(4–5):739–47.

[39] Rolls BJ, Drewnowski A, Ledikwe JH. Changing the energy density of the diet as a strategy for weight management. J Am Diet Assoc 2005;105(5):98–103.

[40] Ello-Martin JA, Roe LS, Ledikwe JH, Beach AM, Rolls BJ. Dietary energy density in the treatment of obesity: a year-long trial comparing 2 weight-loss diets. Am J Clin Nutr 2007;85(6):1465–77.

[41] Flood A, Mitchell N, Jaeb M, Finch EA, Laqua PS, Welsh EM, et al. Energy density and weight change in a long-term weight-loss trial. Int J Behav Nutr Phys Act 2009;6(1):57.

[42] Raynor HA, Looney SM, Steeves EA, Spence M, Gorin AA. The effects of an energy density prescription on diet quality and weight loss: a pilot randomized controlled trial. J Acad Nutr Diet 2012;112(9):1397–402.

[43] Ledikwe JH, Blanck HM, Kettel Khan L, Serdula MK, Seymour JD, Tohill BC, et al. Dietary energy density is associated with energy intake and weight status in US adults. Am J Clin Nutr 2006;83(6):1362–8.

[44] Raynor HA, Van Walleghen EL, Bachman JL, Looney SM, Phelan S, Wing RR. Dietary energy density and successful weight loss maintenance. Eat Behav 2011;12(2):119–25.

[45] dos Rodrigues AMS, Martins LB, Franklin AMT, Candido AL, dos Santos LC, Ferreira AVM. Poor quality diet is associated with overweight status and obesity in patients with polycystic ovary syndrome. J Hum Nutr Diet 2015;28(Suppl. 2):94–101.