

EATING AWAY FROM HOME AND EXCESS WEIGHT: AN ANALYSIS OF EXPLANATORY MECHANISMS

Alimentação fora de casa e excesso de peso: uma análise dos mecanismos explicativos

Alimentación en la calle y el exceso de peso: un análisis de los mecanismos explicativos

Review Article

ABSTRACT

Objective: To discuss the possible mechanisms of the relationship between eating away from home and excessive weight gain. **Methods:** A literature search was conducted to find scientific articles that described the characteristics of the foods consumed outside the home and articles that investigated the relationship between these characteristics and excessive weight gain published in the following databases: MEDLINE, Latin America and Caribbean Center on Health Sciences Information (LILACS) and Scientific Electronic Library Online (SciELO). **Results:** It was found that several characteristics of away-from-home foods such as high energy density, high fat and sugar content, poor fiber and calcium content, large portions of highly palatable foods available in great variety and high consumption of soft drinks and sweets contribute to excessive weight gain. **Conclusion:** After determining the importance of the influence of eating away from home on weight gain, several proposals are suggested to improve the availability of healthy foods in away-from-home meals; however, further studies are needed to understand which changes in the away-from-home food services are effective to reduce the negative impacts on the population's health.

Descriptors: Collective Feeding; Overweight; Review.

RESUMO

Objetivo: Discutir os possíveis mecanismos da relação entre consumo de alimentos fora do domicílio e ganho excessivo de peso. **Métodos:** Realizou-se um levantamento bibliográfico de artigos científicos que descrevessem as características dos alimentos consumidos fora do domicílio e de artigos que investigassem a relação entre essas características e o ganho excessivo de peso, publicados nas bases de dados: MEDLINE, Biblioteca Latino-Americana e do Caribe (LILACS) e Scientific Eletronic Library Online (SciELO). **Resultados:** Constatou-se que diversas características da alimentação fora do domicílio como a elevada densidade energética, o elevado teor de gorduras e açúcares, baixo conteúdo de fibras e cálcio, grandes porções de alimentos altamente palatáveis e ofertados em grande variedade e o consumo elevado de refrigerantes e doces contribuem para o ganho excessivo de peso. **Conclusão:** Constatada a importância da influência da alimentação fora do domicílio no ganho de peso, várias propostas são sugeridas para melhorar a oferta de alimentos saudáveis nas refeições realizadas fora de casa, no entanto, mais estudos são necessários para compreender quais mudanças no setor de alimentação fora de casa são efetivas para reduzir os impactos negativos na saúde da população.

Descritores: Alimentação Coletiva; Sobrepeso; Revisão.

Ilana Nogueira Bezerra⁽¹⁾
Jessica Brito Cavalcante⁽¹⁾
Tyciane Maria Vieira Moreira⁽¹⁾
Caroline da Costa Mota⁽¹⁾
Rosely Sicheiri⁽²⁾

1) University of Fortaleza (*Universidade de Fortaleza - UNIFOR*) - Fortaleza (CE) - Brazil

2) Rio de Janeiro State University (*Universidade do Estado do Rio de Janeiro - UERJ*) - Rio de Janeiro (RJ) - Brazil

Received on: 06/05/2016

Revised on: 07/27/2016

Accepted on: 09/30/2016

RESUMEN

Objetivo: Discutir los posibles mecanismos de la relación entre el consumo de alimentos fuera del domicilio y la ganancia excesiva de peso. **Métodos:** Se realizó una búsqueda bibliográfica de los artículos científicos que describiesen las características de los alimentos consumidos fuera del domicilio y de artículos que investigasen la relación entre esas características y la ganancia excesiva de peso publicados en las bases de datos: MEDLINE, Biblioteca Latino-Americana e do Caribe (LILACS) e Scientific Electronic Library Online (SciELO). **Resultados:** Se constató que las diversas características de la alimentación fuera del domicilio como la elevada densidad de energía, la elevada proporción de grasas y azúcares, el bajo contenido de fibras y calcio, las grandes proporciones de alimentos muy agradables al paladar y ofrecidos en gran variedad y el consumo elevado de refrescos y dulces contribuyen para la ganancia excesiva de peso. **Conclusión:** Al constatar la importancia de la influencia de la alimentación fuera del domicilio para la ganancia de peso, varias propuestas son sugeridas para la mejora de la oferta de alimentos saludables en las comidas realizadas fuera de casa, sin embargo, más estudios son necesarios para la comprensión de cuales cambios en el sector de alimentación fuera de casa son efectivas para la reducción de los impactos negativos para la salud de la población.

Descriptor: Alimentación Colectiva; Sobrepeso; Revisión.

INTRODUCTION

Changes in the lifestyle of the population have led to significant changes in people's eating habits, such as increased consumption of ready-to-eat foods and meals outside the home. In developed countries, eating away from home accounts for up to 39% of the calories consumed⁽¹⁾. In urban areas of Brazil, 18% of calories come from foods prepared and consumed outside the home⁽²⁾.

Foods prepared or consumed outside the home have been reported to have a negative influence on the quality of the diet⁽¹⁾. A study from the São Paulo Health Survey (*Inquérito de Saúde de São Paulo – ISA*) conducted in 2008 found a lower quality of food in the lunch consumed outside the home compared to that consumed at home⁽³⁾. Thus, the consumption of foods outside the home is one of the factors associated with diet that seems to have a considerable contribution to the increased prevalence of excess weight.

This possible relationship between eating away from home and weight gain has become a public health problem

and several studies have suggested a negative impact of this habit on body weight^(4,5). Although other authors have also pointed out possible explanations for the association between eating away from home and excess weight, such as portion sizes and high energy density of foods prepared outside the home, the discussion of the mechanisms that relate the consumption of these foods to body weight gain is still insufficient and little is known about the plausibility of this relationship.

The present study aimed to discuss the possible mechanisms of the relationship between eating away from home and excessive weight gain.

METHODS

The research was carried out using the MEDLINE, the Latin American and Caribbean Library (LILACS) and the Scientific Electronic Library Online (SciELO) databases. First, the characteristics of foods consumed/prepared outside the home were investigated using the following keywords: away-from-home food, eating out, out-of-home eating, fast food, takeaway food, restaurant food combined with nutrient quality, diet quality, characteristics.

After identifying the main characteristics of the foods consumed/prepared outside the home, a new search was made in order to investigate the relationship between the characteristics identified and excessive weight gain. The following keywords were used: energy density, fat, saturated fat, fatty acids, sugar, soft drinks, sweetened beverages, sodium, iron, calcium, vitamin D, vitamin C, fiber, fruits, vegetables, whole cereals, food portion, variety and palatability combined with excessive weight, weight gain, obesity, overweight and body mass index. Articles in English and Portuguese published until March 2016 were included. They were selected after analysis of title, abstract and full text, respectively.

RESULTS

Characteristics related to nutritional content, the way the foods are offered and the type of food offered outside the home were identified in the scientific literature review. Figure 1 illustrates a scheme of the possible relationship between these characteristics and weight gain.

Out-of-home meals were also associated with lower diet quality, including low intakes of fruits, vegetables and whole grains⁽¹⁾.

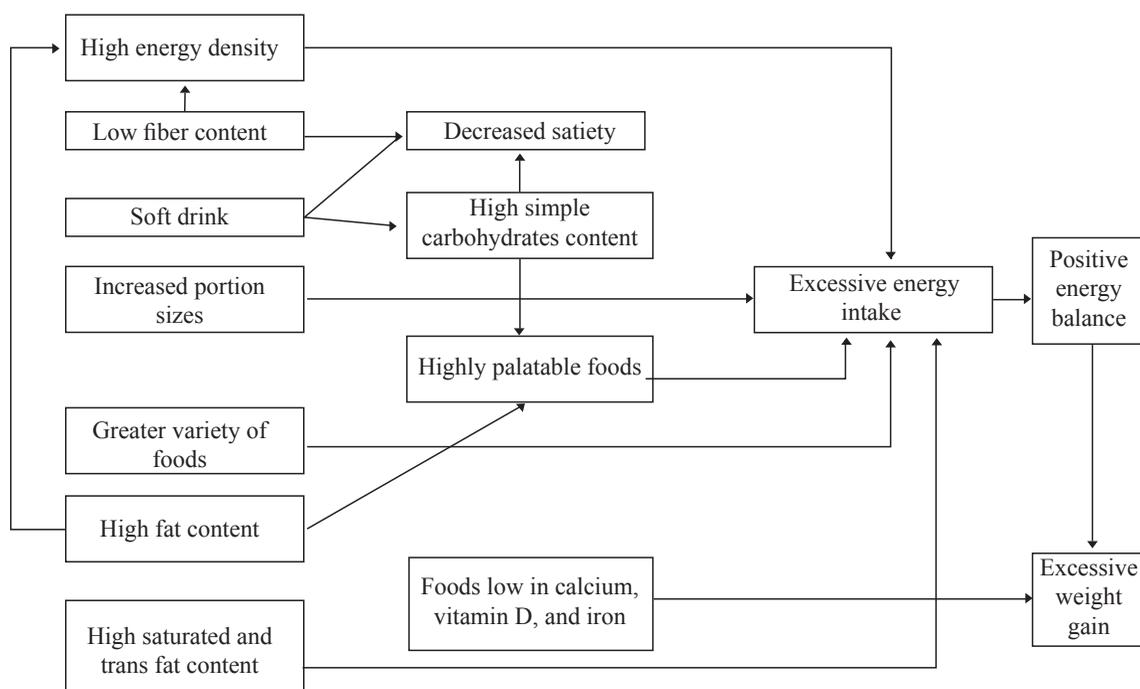


Figure 1 - Model of the relationship between eating away from home and weight gain. Fortaleza, CE, 2016.

DISCUSSION

Energy density and weight gain

The relationship between energy density (kcal-to-weight ratio of a ready-to-eat food) and weight gain can be explained by individuals' limited ability to distinguish foods with high energy content and to adequately adjust food intake to maintain energy homeostasis. Normally, the amount of food consumed is kept constant, regardless of the variation in energy density. Thus, the consumption of high energy density foods may favor increased passive energy intake and contribute to weight gain⁽⁶⁾.

Fat, saturated fat and trans fat content and weight gain

The role of fat in weight gain is a subject of debate in the literature and there is evidence that consumption of high-fat diets favors weight gain, regardless of total caloric intake, and that fat has a minimal effect on adiposity.

Some mechanisms are proposed to explain the relationship between fat intake and weight gain. The increase in fat consumption does not proportionally stimulate its oxidation, and the efficiency with which dietary lipids are stored as body fat is high. In addition, diet induced thermogenesis after fat intake is lower compared to carbohydrate and protein intake. It is also emphasized

that fats are absorbed more efficiently in the gastrointestinal tract when compared to carbohydrates⁽⁷⁾.

It is also believed that hyperlipidic diets favor hyperphagy due to increased palatability caused by the presence of fat^(8,9). The relationship between fat consumption and weight gain can also be explained by its lower satiety effect when compared to carbohydrates or proteins, possibly due to its low ability to stimulate insulin and leptin production⁽⁹⁾.

Although a low-fat diet is recommended for obesity prevention, the effect of reducing weight loss by reducing fat intake is still small, suggesting that total caloric intake is more important than diet composition for body weight⁽¹⁰⁾.

As for saturated fats, there is evidence that this type of fat has a different impact on energy balance and, consequently, on body weight⁽¹¹⁾. One study conducted with 810 individuals aged over 25 found that saturated fat intake after 6-month intervention was positively associated with body weight at 18 months⁽¹¹⁾.

Foods prepared outside the home also have a higher amount of trans fat than those prepared at home, especially when they are fried foods, such as those served in fast food restaurants⁽¹²⁾.

Trans fats have been strongly associated with weight gain, abdominal fat deposition and cardiovascular diseases.

Strong evidence has been found on the association between trans fat intake and body weight gain⁽¹³⁾.

Consumption of sugary beverages and foods high in sugar and excess weight

The mechanisms of weight gain through the consumption of sugary beverages are not yet fully elucidated, but there are indications that calories from liquids provide less satiety compared to solid foods, leading to the consumption of higher amounts⁽¹⁴⁾.

The amount of refined sugars in these beverages provides a high glycemic load which, coupled with its low satiety effect, favors the consumption of higher amounts and increases the intake of other foods. A recent study⁽¹⁵⁾ found that body weight gain is related to the consumption of sugary beverages in both children and adults.

On the other hand, the absence of added sugar in beverages, which is substituted by artificial sweeteners for low calorie beverages, has also been shown to be positively associated with extra calories from solid meals, low fruit and vegetable intake, and higher consumption of fast food and hypercaloric snacks⁽¹⁶⁾.

Fiber content and body weight

Dietary fibers have several functions and their effect on diet is directly related to their activity in the gastrointestinal tract, affecting the physiology of appetite and energy intake. It is known that foods with higher amounts of fiber decrease energy intake because the fibers are not absorbed in the intestine. Therefore, high-fiber meals may provide greater volume without generating an increase in calories⁽¹⁷⁾.

In addition, high-fiber foods are low in calories and palatable when compared to high-fat foods⁽¹⁷⁾. Another effect of dietary fiber in controlling food intake is related to its physicochemical characteristics. The capacity of water absorption and formation of gels in the stomach cause a delayed gastric emptying and a sensation of fullness that prolongs satiety⁽¹⁸⁾. The longer contact time of the nutrients with the intestinal mucosa stimulates the release of hormones that regulate appetite. Thus, fiber intake can prolong the digestion and absorption of carbohydrates by reducing postprandial glucose response. In the long term, this may improve insulin sensitivity and stimulate lipolysis, assisting in the control of body weight⁽¹⁸⁾.

It is believed that dietary fibers can also affect satiety due to its fermentative properties. The effect of intestinal bacteria on fibers produces short-chain fatty acids. The increase of these fatty acids could stimulate colon cells to produce hormones, such as GLP-1 and PYY, which increase satiety after a meal and decrease the intake of food, contributing to the maintenance of energy homeostasis.

However, the cause and effect relationship has not yet been fully elucidated^(17,18).

Micronutrients and body weight

Foods prepared outside the home have been characterized as low-nutritional-quality foods, with low vitamin C, calcium and iron, and high amounts of sodium⁽¹⁾.

The association of these micronutrients with nutritional status has been widely studied in the literature, and a possible relationship between micronutrient intake and excess weight has been described. In addition, it has been found that some vitamins (A, C, E and D) and calcium and zinc are involved in the metabolic and endocrine processes of the genesis and/or control of excess weight; therefore, the adequate intake of these nutrients is important to avoid the development of obesity and other noncommunicable diseases⁽¹⁹⁾.

Regarding calcium, some studies have shown a negative association of this mineral with excessive weight gain. It is believed that calcium binds to fatty acids in the gastrointestinal tract, preventing their absorption in addition to increasing lipid oxidation and promoting fat excretion⁽²⁰⁾.

Like calcium, vitamin D deficiency is an independent risk factor for the development of abdominal fat. Matrix metalloproteinases (MMPs) are proteolytic enzymes that play an important role in infectious and inflammatory processes. They are responsible for remodeling the extracellular matrix and regulating leukocyte migration through the matrix. The adipose tissue releases MMPs, which confirms the important role in the pathogenesis of obesity⁽²¹⁾.

In a randomized study conducted with Chinese students with low calcium intake, calcium and vitamin D3 supplementation resulted in significant loss of body and visceral fat⁽²²⁾. The loss of adipose tissue found in the calcium + D3 group could result from some dietary factors related to a high intake of calcium, such as the promotion of fat oxidation, promotion of fat cell apoptosis, reduced lipid absorption due to the formation of insoluble soaps in the intestine, which are excreted in the feces, and suppression of 1,25-dihydroxyvitamin D (1,25-(OH)₂D), which is responsible for decreasing the intracellular influx of calcium. Such changes stimulate lipolysis and suppress lipogenesis in adipocytes^(20,22).

There is also evidence that calcitriol (active vitamin D) plays an important role in the pathological processes of obesity by regulating the level of MMPs and the level of tissue inhibitor of metalloproteinase (TIMP)⁽²²⁾.

The relationship between iron and obesity is still not well-established in the literature. Some authors suggest an inverse relationship between iron levels and BMI, waist

circumference, and fat mass, describing an association between obesity and low iron levels or iron deficiency⁽²³⁾. This relationship can be explained by the low intake or reduced absorption of the nutrient or increased nutritional need in obese individuals due to iron sequestration resulting from an inflammatory condition. A review on the subject described that obese individuals, despite having higher levels of hemoglobin and ferritin, present decreased transferrin saturation, which favors the inflammatory process associated with obesity⁽²⁴⁾. However, the cause and effect mechanisms of this relationship have not yet been fully elucidated. One possible explanation would be the role of the hormone hepcidin, which regulates iron homeostasis by inhibiting its absorption by enterocytes and favoring the sequestration of the nutrient by macrophages. Expression of the hormone is increased in the inflammatory state of obesity due to the increased production of proinflammatory cytokines, such as interleukin 6 (IL-6) and tumor necrosis factor (TNF- α), which stimulate expression of hepcidin⁽²⁴⁾.

Vitamin C is a potent soluble antioxidant that is also involved in the synthesis of collagen and in the immune system. Its relationship with obesity may be mediated by its participation in the synthesis of catecholamines, a major regulatory source of adipose tissue lipolysis, and its role as a cofactor in the synthesis of carnitine, which is involved in the transport of fatty acids and lipid oxidation. Thus, vitamin C deficiency may contribute to adipogenesis⁽¹⁹⁾.

Obese individuals have lower plasma vitamin C concentrations than non-obese individuals. A study carried out with adults and older people from different European countries showed that lower plasma ascorbic acid concentration is related to increased waist circumference, regardless of the body mass index⁽²⁵⁾.

Portion sizes and calorie intake

The increase in the portion sizes of foods consumed outside the home has been considered an important factor contributing to the high intake of calories. The mechanisms favoring higher energy intake due to increase in portion sizes are still not well understood⁽²⁶⁾. It is suggested that individuals override or ignore the signals of hunger and satiety when consuming large portions and there is no compensation in the subsequent meals for this increased energy intake⁽²⁷⁾.

Inconsistency in the portion sizes (large-medium-small) offered also contributes to increased food intake. A portion that was once identified as “large” and is now categorized as “medium” produces the false sense that the amount consumed is adequate. A study⁽²⁷⁾ that assessed the perception of portion size and actual and perceived consumption found that consumers can consume large

quantities of foods that are offered as small portions and do not realize that they consumed a lot. In addition, people felt less guilty when consuming smaller portions, which the authors called “guiltless gluttony”.

Palatability and variety

The palatability of foods derives from sensory characteristics such as taste, smell, texture, temperature, and visual appearance, and the addition of sugar, salt and fat is what mostly contributes to the palatability of foods. Besides the pleasant taste, these nutrients activate the reward pathways of the brain that improve the sensitivity and palatability to the food, stimulating exaggerated consumption. It is believed that tasting such tastier foods produces a rise in brain dopamine, which may explain, in most cases, the hyperphagia that leads to obesity⁽²⁸⁾.

As for the variety of foods, studies have shown that the greater the variety of foods offered at a meal the greater the energy intake. Individuals tend to consume more foods when greater variety (number of foods with different sensory properties) is available at the same time of consumption.

This is probably due to the fact that the greater the number of foods with different flavors, colors and forms of presentation the greater the individual intake of each of them until their full appreciation. However, one study highlights that the role of dietary variety in controlling body weight is not well defined and that increased variety in some food categories (energy-poor and nutrient-rich) and decreased variety in categories of foods with high energy density and low nutrient density may be a strategy to promote adherence to healthy eating patterns and body weight control⁽²⁹⁾.

A Brazilian study has shown that ‘pay what you weigh’ restaurants, which sell a wide variety of ready-to-eat food options, are a good option for those who choose healthier meals, indicating that it is possible to eat healthy meals outside the home⁽³⁰⁾.

CONCLUSION

Food plays an important role in both the development and prevention of diseases, and changes in eating habits, such as frequent out-of-home meals, affect the quality of the diet and consequently the public health of many countries. Many evidences suggest that the characteristics of foods consumed outside the home directly contribute to excessive weight gain.

These characteristics require attention and deserve to be the focus of future studies given that the incorporation of the habit of eating outside the home is increasing in the daily life of the population and that the influence of foods prepared and consumed outside the home is increasingly

more relevant to consumer's health. Although it is possible to eat healthy foods outside the home, it is important to carry out studies to point out strategies to improve the nutritional quality of these foods.

REFERENCES

1. Lachat C, Nago E, Verstraeten R, Roberfroid D, Van Camp J, Kolsteren P. Eating out of home and its association with dietary intake: a systematic review of the evidence. *Obes Rev.* 2012;13(4):329-46.
2. Bezerra IN, Moura Sousa A, Pereira RA, Sicheiri R. Contribution of foods consumed away from home to energy intake in Brazilian urban areas: the 2008-9 Nationwide Dietary Survey. *Br J Nutr.* 2013;109(7):1276-83.
3. Gorgulho BM, Fisberg RM, Marchioni DM. Nutritional quality of major meals consumed away from home in Brazil and its association with the overall diet quality. *Prev Med.* 2013;57(2):98-101.
4. Bezerra IN, Curioni C, Sicheiri R. Association between eating out of home and body weight. *Nutr Rev.* 2012;70(2):65-79.
5. Nago ES, Lachat CK, Dossa RA, Kolsteren PW. Association of out-of-home eating with anthropometric changes: a systematic review of prospective studies. *Crit Rev Food Sci Nutr.* 2014;54(9):1103-16.
6. Perez-Escamilla R, Obbagy JE, Altman JM, Essery EV, McGrane MM, Wong YP, et al. Dietary energy density and body weight in adults and children: a systematic review. *J Acad Nutr Diet.* 2012;112(5):671-84.
7. Jaworowska A, Blackham T, Davies IG, Stevenson L. Nutritional challenges and health implications of takeaway and fast food. *Nutr Rev.* 2013;71(5):310-8.
8. Prentice AM, Jebb SA. Fast foods, energy density and obesity: a possible mechanistic link. *Obes Rev.* 2003;4(4):187-94.
9. Pereira-Lancha LO, Coelho DF, Campos-Ferraz PL, Lancha AH Jr. Body fat regulation: is it a result of a simple energy balance or a high fat intake? *J Am Coll Nutr.* 2010;29(4):343-51.
10. Hooper L, Abdelhamid A, Bunn D, Brown T, Summerbell CD, Skeaff CM. Effects of total fat intake on body weight. *Cochrane Database Syst Rev.* 2015;8:CD011834.
11. Lin PH, Wang Y, Grambow SC, Goggins W, Almirall D. Dietary saturated fat intake is negatively associated with weight maintenance among the PREMIER participants. *Obesity (Silver Spring).* 2012;20(3):571-5.
12. Stender S, Dyerberg J, Astrup A. Fast food: unfriendly and unhealthy. *Int J Obes (Lond).* 2007;31(6):887-90.
13. Thompson AK, Minhane AM, Williams CM. Trans fatty acids and weight gain. *Int J Obes (Lond).* 2011;35(3):315-24.
14. 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:e7492.
15. Malik VS, Pan A, Willett WC, Hu FB. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. *Am J Clin Nutr.* 2013;98(4):1084-102.
16. Piernas C, Mendez MA, Ng SW, Gordon-Larsen P, Popkin BM. Low-calorie- and calorie-sweetened beverages: diet quality, food intake, and purchase patterns of US household consumers. *Am J Clin Nutr.* 2014;99(3):567-77.
17. Kristensen M, Jensen MG. Dietary fibres in the regulation of appetite and food intake. Importance of viscosity. *Appetite.* 2011;56(1):65-70.
18. Pereira MA, Ludwig DS. Dietary fiber and body-weight regulation. Observations and mechanisms. *Pediatr Clin North Am.* 2001;48(4):969-80.
19. Leao AL, Santos LC. Micronutrient consumption and overweight: is there a relationship?. *Rev Bras Epidemiol.* 2012;15(1):85-95.
20. Soares MJ, Murhadi LL, Kurpad AV, Chan She Ping-Delfos WL, Piers LS. Mechanistic roles for calcium and vitamin D in the regulation of body weight. *Obes Rev.* 2012;13(7):592-605.
21. Lương KVQ, Nguyễn LTH. The beneficial role of vitamin D in obesity: possible genetic and cell signaling mechanisms. *Nutr J.* 2013;12:89.
22. Zhu W, Cai D, Wang Y, Lin N, Hu Q, Qi Y, et al. Calcium plus vitamin D3 supplementation facilitated fat loss in overweight and obese college students with very-low calcium consumption: a randomized controlled trial. *Nut J.* 2013;12:8.
23. Chambers EC, Heshka S, Gallagher D, Wang J, Pi-Sunyer FX, Pierson RN Jr. Serum iron and body fat distribution in a multiethnic cohort of adults living in New York City. *J Am Diet Assoc.* 2006;106(5):680-4.

-
24. Cheng HL, Bryant C, Cook R, O'Connor H, Rooney K, Steinbeck K. The relationship between obesity and hypoferraemia in adults: a systematic review. *Obes Rev.* 2012;13(2):150-61.
 25. Canoy D, Wareham N, Welch A, Bingham S, Luben R, Day N, et al. Plasma ascorbic acid concentrations and fat distribution in 19,068 British men and women in the European Prospective Investigation into Cancer and Nutrition Norfolk cohort study. *Am J Clin Nutr.* 2005;82(6):1203-9.
 26. English L, Lasschuijt M, Keller KL. Mechanisms of the portion size effect. What is known and where do we go from here? *Appetite.* 2015;88:39-49.
 27. Aydinoglu NZ, Krishna A. Guiltless Gluttony: The Asymmetric Effect of Size Labels on Size Perceptions and Consumption. *J Consum Res.* 2011;37:105-112.
 28. Fortuna JL. The obesity epidemic and food addiction: clinical similarities to drug dependence. *J Psychoactive Drugs.* 2012;44(1):56-63.
 29. Vadiveloo MK, Parekh N. Dietary variety: an overlooked strategy for obesity and chronic disease control. *Am J Prev Med.* 2015;49(6):974-9.
 30. Santos MV, Proença RPC, Fiates GMR, Calvo MCM. Os restaurantes por peso no contexto de alimentação saudável fora de casa. *Rev Nutr.* 2011;24(4):641-9.

First author's address:

Ilana Nogueira Bezerra
Universidade de Fortaleza - UNIFOR
Programa de Pós-Graduação em Saúde Coletiva - PPGSC
Avenida Washington Soares, 1321
Bairro: Edson Queiroz
CEP: 60811-905 - Fortaleza - CE - Brasil
E-mail: ilana.bezerra@yahoo.com.br