PERSPECTIVE

Perspective: Public Health Nutrition Policies Should Focus on Healthy Eating, Not on Calorie Counting, Even to Decrease Obesity

Ana C Fernandes,[1,2] Débora K Rieger,[1] and Rossana PC Proença[1,2]

[1] Nutrition Postgraduate Program (Programa de Pós-graduação em Nutrição); and [2] Nutrition in Foodservice Research Centre (Núcleo de Pesquisa de Nutrição em Produção de Refeições, NUPPRE), Federal University of Santa Catarina (UFSC), Florianópolis, SC, Brazil

ABSTRACT

Calorie-focused policies, such as calorie menu labeling, seem to result in minor shifts toward healthier choices and public health improvement. This paper discusses the (lack of) relations between energy intake and healthy eating and the rationale for shifting the focus of public health nutrition policies to healthier foods and meals. We argue that the benefits of reducing caloric intake from low-quality foods might not result from the calorie reduction but rather from the reduced consumption of low-quality foods. It is better to consume a given number of calories from high-quality foods than a smaller number of calories from low-quality foods. It is not possible to choose a healthy diet solely based on the caloric value of foods because calories are not equal; they differ in nutritional quality according to their source. Foods are more than just a collection of calories and nutrients, and nutrients interact differently when presented as foods. Different subtypes of a macronutrient, although they have the same caloric value, are metabolized and influence health in different ways. For instance, industrial *trans* fats increase lipogenesis and the risk of heart diseases, whereas monounsaturated fats have the opposite effect. Food processing and cooking methods also influence the nutritional value of foods. Thus, public health nutrition policies should stop encouraging people to focus mainly on calorie counting to fight noncommunicable diseases. Instead, policies should focus on ingredients, dietary sources, and food processing and cooking methods. *Adv Nutr* 2019;10:549–556.

Keywords: calories, energy, joules, processed food, food quality, healthy food, obesity, chronic diseases, menu labeling, food guidelines

Introduction

Calorie-focused policies, such as calorie labeling, and dietary guidelines that emphasize calorie counting might not be enough to improve public health, such as to prevent obesity and related diseases (1, 2). For instance, studies have shown that menu calorie labeling has little or no effect on the consumer's choice of dish (3–7). A study (8) exploring demographic patterns on the use of calorie information in restaurants in the United States showed that only 53% of consumers notice calorie information, and less than half of these use the information. Calorie labeling was associated with binge eating, increase in weight-related concerns, dieting, and unhealthy weight-control practices (8). Thus, highlighting calorie information on food labels or disclosing only this information on menus can complicate eating disorders.

Public nutrition policies are not based solely on caloric consumption, but they emphasize it as the main problem and solution for obesity and other chronic diseases. Although some actions might promote a reduction in caloric intake, it is relevant to debate whether calorie reduction is able to improve health simply because it can result in weight loss. The relation between calorie reduction and health improvement has been contested by other authors (2, 9) and is discussed in this study with the aim of answering the fol-

Perspective articles allow authors to take a position on a topic of current major importance or controversy in the field of nutrition. As such, these articles could include statements based on author opinions or point of view. Opinions expressed in Perspective articles are those of the author and are not attributable to the funder(s) or the sponsor(s) or the publisher, Editor, or Editorial Board of *Advances in Nutrition*. Individuals with different positions on the topic of a Perspective are invited to submit their comments in the form of a Perspectives article or in a Letter to the Editor.

This paper was based on discussions from a PhD thesis that was supported by a scholarship and funding from the Brazilian National Council for Scientific and Technological Development, CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) (grant number 485004/2012-7), and by scholarships from the Brazilian Federal Agency for Support and Evaluation of Graduate Education, CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior).

Author disclosures: ACF, DKR, and RPCP, no conflicts of interest.

Address correspondence to ACF (e-mail: ana.fernandes@ufsc.br).

Abbreviations used: CAPES, Brazilian Federal Agency for Support and Evaluation of Graduate Education; CNCDs, chronic noncommunicable diseases; CNPq, Brazilian National Council for Scientific and Technological Development; NUPPRE, Nutrition in Foodservice Research Centre; UFSC, Federal University of Santa Catarina.

lowing question: Should public health policies focus mainly on calories rather than on the quality and composition of foods?

Some studies claim that nutrition information policies that stress the importance of a food's caloric value stimulate the reformulation of foods and culinary preparations (10, 11). However, we question whether reformulations are directed to healthier options. A study analyzed 11,737 menu items in 37 fast-food restaurants in the USA and observed a mean reduction of 22 kcal in food items from 2012 to 2014. However, the macronutrient composition of the new items did not shift toward a healthier profile (12).

In light of these considerations on calorie-focused policies, we aim to discuss the relation between calories and healthy eating, and propose a shift in the main focus of public policies from calorie counting toward healthier foods and meals.

Current status of knowledge

Concept of calorie and its use in the field of nutrition

We begin by discussing the transposition of a term used in physics to the field of nutrition. Calorie is a unit of energy, also used to express the energy value of foods. The first definition of Calorie (capitalized, referring to kilocalorie or kcal) entered the English language through translation of a French text, which defined Calorie as "the heat needed to raise the temperature of 1 kg of water from 0 to 1°C," that is equivalent to 4,186 kJ (13). In this paper, the term calorie (lowercase) is used as a synonym for Calorie to refer to the concept of a food's energy value.

In 1887, Atwater (14) defined calorie as "the amount of heat which would raise the temperature of 1 kg of water 1°C," and according to Hargrove (13), in 1896, a scientific committee proposed that a temperature range between 0 and 20°C should be chosen.

The concept of food calorie as originated from thermodynamics was not adequate to transfer to the human condition because the human body is not a 100% efficient thermal system (15, 16). Therefore, Atwater, using whole body calorimetry, created and validated in humans the concept of metabolizable energy—the amount of heat that is generated from food by the human organism when in thermodynamic equilibrium (balance of intake, excretion, and expenditure of energy and protein) (17).

Since then, the term "calorie" has been widely used to express the energy value of foods and applied in the elaboration of dietary recommendations, diets, and menus as well as in food labeling (18) and menu labeling (19). In all cases, the energy value of foods is considered to adjust an individual's caloric intake to his/her caloric expenditure. Faced with the high global rates of obesity (20, 21), public health policymakers have focused on the caloric value of foods as a strategy to promote weight reduction.

Calorie counting and obesity

Dietary guidelines recommend healthy eating as a means to promote health and prevent diseases, but when it comes to obesity, the premise is that imbalance of energy is the main cause of the condition (16, 19).

According to the WHO (22), "overweight and obesity are defined as the abnormal or excessive accumulation of fat that may impair health." Still according to WHO (22), the fundamental cause of overweight and obesity is the imbalance between calories consumed and expended as a result of increased ingestion of high-energy foods that are rich in fat and reduced physical activity. Furthermore, they explain that changes in food patterns and physical activity are often the result of environmental and social changes associated with the lack of supportive policies in health, agriculture, transport, urban planning, environment, food processing, distribution, marketing, and education (22). However, the WHO bulletin (22) does not specify foods or food patterns that might be involved in the causes of obesity. In the document, the WHO (22) does not present other causes of obesity, yet, contradictorily, it proposes dietary recommendations to reduce overweight and obesity, for instance, through a reduction in fats, sugar, and sodium. In addition, the consumption of oilseeds (rich in fats and calories) and of foods rich in fibers and minerals are recommended.

When the imbalance between caloric intake and expenditure is considered to be the fundamental cause of obesity, it is assumed that a decrease in caloric intake reduces the energy imbalance and might automatically revert obesity. Even though high caloric intake might be associated with a high BMI, calorie reduction should be associated with an improvement in the nutritional quality of the diet for long-term weight-loss maintenance (23–26).

According to the 2013 American Heart Association/American College of Cardiology Task Force on Practice Guideline for the Management of Overweight and Obesity in Adults (27), an energy deficit is required to achieve weight loss. However, energy deficit is a consequence of changes in diet, physical activity, and metabolism. A variety of dietary approaches can produce weight loss in overweight and obese adults, and even those that suggest a reduction in caloric intake associate calorie reduction with changes in food types (27). Only 1 type of the cited diet is based solely on energy intake reduction (27). Thus, we question whether it is possible to achieve healthy weight loss by only reducing caloric intake from convenience and fast foods, as this behavior can reduce satiety. Following guidelines focused on foods and healthy eating consequently leads to a reduction in caloric intake. On the other hand, reducing caloric intake does not necessarily lead to a healthy diet.

The imbalance between calories consumed and expended cannot explain the entire nutrition factor in the etiology of obesity, as certain foods, food patterns, and behaviors influence cellular metabolism and lipogenesis (25, 26).

Caloric intake is not only influenced by the caloric value of foods, but also by their nutritional composition and by the metabolic singularity of individuals. More specifically, the metabolization and physiological consequences of calories that come from different macronutrients and even of different subtypes of a macronutrient, such as simple and complex carbohydrates, and different types of fats, also differ within the human body (28–30). As each type of nutrient is metabolized via specific pathways by distinct physiological means, their excess can lead to different consequences.

For instance, carbohydrates are stored as glycogen in cells, but after reaching the maximum storage capacity, they are transformed mainly into fat. Simple carbohydrates and sugars are more rapidly absorbed, transported, and taken up by cells than complex carbohydrates (31, 32), and metabolization depends on the excretion and insulin resistance of each individual (33). Complex carbohydrates, on the other hand, are more slowly digested and absorbed. Some complex carbohydrates, such as resistant starch, have similar structures to that of fibers, which cannot be used as energy sources (31, 32).

A randomized, controlled, parallel-arm controlled-feeding trial was conducted with 81 adults randomly assigned to weight-maintenance diets for 6 wk (34). Diets differed only in whole-grain and fiber contents but were otherwise similar (including in energy value). The whole-grain diet led to a loss of nearly 100 kcal/d as a result of the increase in resting metabolic rate and stool energy content and the decrease in digestibility of other nutrients. These findings show the positive effects of whole-grains on reducing body weight and adiposity without altering the energy value of diets (34).

Lucan and DiNicolantonio (2) argue that calorie counting is inherently biased against fat, as 1 g of fat has twice as many kcal as 1 g of other macronutrients. They highlight that many food sources of fat might be protective against obesity and related diseases (2), corroborating the results of other studies (35, 36). Calorie-focused thinking is also supportive of starchy and sugary replacements, which can be detrimental to health (2). Monteiro and Cannon (9) discussed some sources of rapidly absorbable carbohydrates, such as white rice and potatoes, which are staple foods in several Asian and Latin American countries where they are usually consumed with vegetables and/or legumes as part of freshly cooked meals and often enjoyed mindfully and in company. In this context, the metabolic effect of a meal is quite different from that of individual food items, which together influence the glycemic index of a meal (37).

Therefore, food patterns and food composition seem to perform more important roles in the etiology of obesity than the caloric value of foods. Although not discussed in this paper, cultural, environmental, economic, and social issues might also play an important role. Mozaffarian and Forouhi (38) remind us that there is much to be discovered about the influences of fatty acid metabolites, flavonoids, gut–brain metabolic communication, brown and beige fat, microbiome, and early life experiences on eating behaviors. Healthy eating should be regarded as an important means of health promotion that goes beyond calorie counting, even to lose weight.

Healthy food choices

Healthy eating may have several meanings depending on the country, region, period, and culture concerned. According to the WHO bulletin, "Diet evolves over time, being influenced by many factors (…). Therefore, promoting a healthy food environment, including healthy food systems, requires involvement across multiple sectors and stakeholders" (18).

More specifically, the WHO (18) stated that a healthy diet for adults should include fruits, vegetables, legumes, nuts, and whole-grains; at least 5 portions of fruits and vegetables/d; <10% of total energy intake from free sugars, but ideally <5% of total energy intake for additional health benefits; <30% of total energy intake from fats, considering that unsaturated fats are preferable to saturated fats and that industrial *trans* fats should be entirely avoided; and <5 g salt/d (6).

We highlight that dietary advice to limit consumption of saturated and *trans* fats should consider differences between nutrient sources, as is commonly done in relation to carbohydrates. *Trans* fats that are naturally produced by gut bacteria in ruminant animals do not seem to have deleterious effects on health and might, in fact, help protect against some diseases (39). In contrast, industrial *trans* fats do not have any beneficial effect on the organism, do not have a safe intake limit, and are associated with several diseases. Thus, artificial *trans* fats should be eliminated from the diet (40–42). Different fat types exert different regulatory effects on metabolism, either increasing or decreasing adipose tissue accumulation (43). Saturated fats also have different health effects depending on the type of food consumed. For instance, plain yogurts and oilseeds are considered healthy sources of saturated fats (44). A recent study emphasized the confounding nature of nutrients substituted for saturated fats in diets, giving broader recognition to the effect of food patterns as a whole (45).

According to studies in mice (46) and humans (47), macronutrient distribution plays a role in energy homeostasis in a manner that goes beyond energy content. A study analyzing data from the 1960–2011 NHANES concluded that the increase observed in the average BMI of the US population over the years was not caused by changes in total caloric intake but by the shift in macronutrient intake from fat to carbohydrate (47).

The recommendation to limit the intake of free sugars (18) is clearly not based on caloric value but on the physiological consequences of their consumption, as free sugars provide the same 4 kcal/g as complex carbohydrates. The consumption of sugars, especially added sugars, is associated with an increased risk of chronic noncommunicable diseases (CNCDs), such as diabetes mellitus type 2 (48), and cardiovascular diseases (49), as well as an increased risk of mortality (50). Kearns et al. (51) analyzed internal documents

from the sugar industry and found that companies sponsored a research program that successfully promoted fats as the dietary culprit in cardiovascular disease. In another paper (52), the authors discussed the findings of a project financed by the sugar industry, revealing that the industry withheld information that sucrose intake is associated with a greater cardiovascular disease risk than that of starch intake.

According to the WHO (53), there is good scientific evidence that nutrients interact differently when presented as foods, and methods of food processing and cooking influence the nutritional value of foods. Taking into account these considerations, the WHO recommends that dietary guidelines should be elaborated on foods, not on nutrients (53).

This approach has been adopted in the new food- and meal-based Dietary Guidelines for the Brazilian Population (54). The document provides no recommendation on caloric intake, nor does it on macronutrient consumption. Its golden rule is "always prefer natural or minimally processed foods and freshly made dishes and meals to ultraprocessed products" (54). The Brazilian Dietary Guidelines (54) also include the WHO recommendation to encourage culinary and cooking skills. In this framework, we highlight the importance of using cooking methods that preserve the nutritional quality of foods (55) and reduce the formation of potentially toxic compounds (56). According to the healthy dietary diversity classification system developed by Bernardo et al. (57), healthier foods include those that are grilled, baked, or broiled as opposed to fried. However, the use of dry heat for long periods, as in grilled or baked culinary preparations, may lead to the formation of toxins. It occurs especially in culinary preparations that are rich in proteins, such as meat and fish (56). Thus, special attention should be paid when grilling or baking foods because, under the aforementioned conditions, these are not the healthiest cooking methods. Many commercially processed foods contain toxic compounds as a result of heat processing, especially products with large amounts of proteins or carbohydrates, such as canned soups. At high concentrations, these harmful compounds can contribute to diabetes and other diseases (58).

In addition to these factors, healthy eating addresses not only issues related to food composition but also those related to food safety, genetically modified organisms, pesticides, and hormones, among others. Considering the WHO recommendations (18) and the health issues in food production and consumption in a comprehensive manner, we underscore the importance of eating unprocessed and, especially, agroecologically produced organic foods for a healthy diet.

We question whether the choice of low-calorie foods necessarily leads to the consumption of healthier foods. Burton et al. (59) hypothesized that, when only calorie information is available, consumers that comprehend and use this information tend to choose products that have fewer calories, as they are perceived as healthier. Because of the complexity of food composition, however, such a relation is not always true (7). It is preferable to consume a given amount of higher-quality food than a smaller amount of lower-quality food. As a result, health benefits stem from calorie reduction as well as from a general improvement in food quality. When calorie reduction is achieved by the consumption of smaller portions without changes to ingredients and cooking methods, although some health benefits may follow, there is no improvement in the nutritional quality of the diet.

We also cast doubt on the effectiveness of calorie labeling as a public policy action to promote healthy eating choices. Although dietary recommendations depend on individual preferences, philosophies, and health conditions, the concept of healthy eating should be appropriate for everybody and should lay the foundation for public policies, which requires going well beyond calorie counting.

Calories and healthy food choices

A multiplicity of parameters can be used to define healthy eating and focusing only on the energy value of foods or culinary preparations means reducing the universe of possibilities to only 1. According to Cappuccio and Pravst (60), media communications have a great effect on health-sensitive consumers and can be used as a strong marketing instrument. In search of healthy foods, consumers often opt for products that are reduced in, or free of, nutrients or calories, especially "diet" or "light" products (61–64).

However, the changes made to create diet or light versions of products do not necessarily make them healthier. Nishida et al. (65) evaluated the labels of 3,449 packaged foods and observed that diet and light products had an average sodium content 43% higher than that of similar conventional products. Also, to create diet or light versions, companies commonly replace sugar with noncaloric sweeteners, frequent consumption of which has been associated with increased risk of excessive weight gain (66, 67), metabolic syndrome (66), cardiovascular disease (66), type 2 diabetes (66, 68), and glucose intolerance (69). Moreover, foods containing sweeteners retain their sweet flavor, which may affect neuronal signaling pathways responsible for satiety and thereby induce a compensatory increase in food intake (70).

The food environment has changed radically with the increase in the supply of hyperpalatable foods, which contain high amounts of fat, sugar, salt, flavorings, and other food additives. A recent study concluded that obesity is the result of a "food addiction" for hyperpalatable foods (71). Satiety signals to the brain about gastric volume begin in the gastrointestinal tract and are enhanced by nutrient absorption, gastrointestinal and adipose tissue hormones, and signals from the cerebral cortex. These physiological mechanisms influence feeding behavior (72). Food activates the reward system in the brain and induces the release of peptides that modulate dopaminergic activity (i.e., insulin and leptin) depending on its palatability. In vulnerable individuals, repeated exposure to hyperpalatable foods can result in low control of food intake, compulsive consumption,

TABLE 1 Nutritional composition of 2 foods with calculated portions providing the same number of calories[1]

Food / Composition	Chewy fruit-flavored candy (UP) (6 units, 25 g)	Almond (MP) (14 units, 15 g)
Energy	97 kcal	97 kcal
Carbohydrate	21.2 g (76% sugar)	3.6 g (80% complex carbohydrates)
Protein	0 g	3.5 g
Fat	1.5 g (58% *trans* and saturated fats)	8.4 g (88% mono- and polyunsaturated fats)
Fiber	0 g	2.1 g
Sodium	17.5 mg	0 mg
Other minerals	No	Potassium, phosphorus, calcium, magnesium, iron, and zinc
Vitamins	No	E, folate, niacin, riboflavin, thiamin, and B-6
Additives	Acidulant, emulsifiers (including transgenic soy lecithin), and flavorings	No

[1] MP, minimally processed food; UP, ultraprocessed food. Sources: product label (candy) and USDA, Agricultural Research Service, Nutrient Data Laboratory (almond) (77).

and weight gain (71). Borges et al. (73) analyzed the role of artificially sweetened beverages in preventing weight gain and promoting health, and concluded that such drinks should not be considered part of a healthy diet.

Restriction of caloric intake for the purpose of weight loss might contribute to eating disorders, such as bulimia nervosa, anorexia nervosa, and binge eating (74–76). Theories on the subject suggest that caloric restriction precedes the emergence of pathological eating patterns, including compulsive overeating and purging. Thus, the recommendation is that diets that promote healthy eating behaviors should be encouraged, and conversely, that caloric restriction should be discouraged (76).

Individuals that choose healthy foods based on caloric value alone are likely to fall into error. In **Table 1** we present a comparison between the nutritional characteristics and components of 97 kcal portions of a minimally processed food and an ultraprocessed food.

According to the concepts of healthy eating choices explored in this paper, the consumption of 14 almonds is considered healthier than the consumption of 6 chewy fruit-flavored candies, even though both portions provide the same number of calories. The 2 foods induce different metabolic, hormonal, and neuronal responses and have different consequences in terms of satiety and weight gain. In this example, a consumer using only calorie information to evaluate the 2 food items might conclude that they are equally healthy (or unhealthy). Public health policies in nutrition, like most important initiatives and food and menu labeling legislations, do not define healthy eating as an end goal. They refer to the fight against obesity as an objective, and this leads to completely different actions (19, 78–82).

Healthy eating and public health nutrition policies

Nutritional information policies do not necessarily represent a solution to reduce obesity or promote healthy choices. It is not enough to make nutrition information available and focus on calorie counting if healthy foods and meals are difficult to find or expensive, if portion sizes are larger than recommended, or if culinary preparations are not culturally and sensorially adequate. Nutritional information should be considered primarily as a part of an individual's right to information about food. Consumers can choose to make healthy choices if they have access to information, if they comprehend nutritional information, and if healthy food preparation is available. Healthy eating concepts are closely related to food quality. Therefore, it seems that information on ingredients, food origin, processing level, and cooking methods may be more important for public health nutrition policies than calorie information, although the 2 are not mutually exclusive.

In this way, authors from a *Lancet Commission* report reinforce that undernutrition and obesity both result from poor diet quality and a low variety of healthy foods, and that recognizing this is a more helpful perspective to resolve nutrition problems than the perception that undernutrition and obesity are simply a consequence of too few or too many calories (83).

According to Levine (84), a calorie is simply an energy unit and has a neutral meaning, whereas foods and portions have powerful cultural, social, medical, scientific, and political meanings. US history shows that this discrepancy has resulted in more than a century of disconnection between policy aims, personal behaviors, and public health outcomes (84). Thus, policymakers may need to think beyond calories to promote healthy eating and to reduce obesity. For example, food labeling policies can focus on nutrient/ingredient-based warning labels, which seem to help consumers make healthy choices (85). In restaurants, it is important to improve menu quality and introduce other interventions, such as providing price incentives (7). Menu labeling should focus on qualitative information, such as healthy food signs, and criteria to classify foods based on healthy eating parameters (e.g., added sugars, types of fats, whole-grains, culinary techniques), and not only on energy value or total fat (7).

Thus, the shift of focus from calorie counting to healthy eating is justified, even in the fight against obesity. As

discussed throughout the manuscript, encouraging consumption of foods of high nutritional quality invariably leads to increased consumption of less processed foods and balanced intake of macronutrients and bioactive compounds that help prevent CNCDs and chronic inflammation, which is both a cause and consequence of overweight. In addition, healthy foods promote satiety, affecting meal size and caloric intake. Calorie counting, in contrast, does not necessarily lead to healthy eating habits or increased satiety. Both factors are necessary for a substantial reduction in caloric intake and for weight loss, as demonstrated in population studies.

Conclusions

Food and menu labels should be analyzed differently. Calorie and fat information may be of importance when comparing similar products of different brands. In these cases, fats are usually responsible for differences in caloric value. As a rule, packaged products that are low in fat are preferable to those high in fat because fats present in ultraprocessed foods are generally industrial *trans* fats. Nonetheless, it is necessary to read the ingredients list to have information on the sources of nutrients. In addition to fats, other nutrients should be evaluated, such as fibers, added sugars, and sodium. When analyzing meals (not packaged products), calories and fats are not the key point of evaluation. Similar culinary preparations can use different ingredients and be prepared in distinct ways.

Calorie focusing is an approach that reduces food to a single aspect that, in most cases, is not the most important for health promotion. Researchers and policymakers should stop discussing whether actions can decrease "calorie intake" (people eat food, not calories) and should start focusing on food and healthy eating patterns to reduce obesity. We also suggest adoption of nutrient/ingredient-based warning labels as part of food and menu labeling policies that consider factors associated with healthy eating besides energy value and total fat, as well as the implementation of dietary guidelines that recognize and value food patterns.

Acknowledgments

The authors' responsibilities were as follows—ACF, DKV, and RPCP: read and approved the final manuscript.

References

1. Camacho S, Ruppel A. Is the calorie concept a real solution to the obesity epidemic? Glob Health Action 2017;10(1):1289650.
2. Lucan SC, DiNicolantonio JJ. How calorie-focused thinking about obesity and related diseases may mislead and harm public health. An alternative. Public Health Nutr 2015;18(4):571–81.
3. Sinclair SE, Cooper M, Mansfield ED. The influence of menu labeling on calories selected or consumed: a systematic review and meta-analysis. J Acad Nutr Diet 2014;114(9):1375–88.
4. Swartz JJ, Braxton D, Viera AJ. Calorie menu labeling on quick-service restaurant menus: an updated systematic review of the literature. Int J Behav Nutr Phys Act 2011;8:135.
5. Kiszko KM, Martinez OD, Abrams C, Elbel B. The influence of calorie labeling on food orders and consumption: a review of the literature. J Community Health 2014;39(6):1248–69.
6. Long MW, Deirdre K, Tobias Cradock AL, Batchelder H, Gortmaker SL. Systematic review and meta-analysis of the impact of restaurant menu calorie labeling. Am J Public Health 2015;105(5):e11–24.
7. Fernandes AC, Oliveira RC, Proença RP, Curioni CC, Rodrigues VM, Fiates GM. Influence of menu labeling on food choices in real-life settings: a systematic review. Nutr Rev 2016;74(8):534–48.
8. Larson N, Haynos AF, Roberto CA, Loth KA, Neumark-Sztainer D. Calorie labels on the restaurant menu: is the use of weight-control behaviors related to ordering decisions? J Acad Nutr Diet 2018;118(3):399–408.
9. Monteiro CA, Cannon G. Calories do not add up. Public Health Nutr 2015;18(4):569–70.
10. VanEpps EM, Roberto CA, Park S, Economos CD, Bleich SN. Restaurant menu labeling policy: review of evidence and controversies. Curr Obes Rep 2016;5(1):72–80.
11. Roberto CA, Schwartz MB, Brownell KD. Rationale and evidence for menu-labeling legislation. Am J Prev Med 2009;37(6):546–51.
12. Jarlenski MP, Wolfson JA, Bleich SN. Macronutrient composition of menu offerings in fast food restaurants in the U.S. Am J Prev Med 2016;51(4):e91–7.
13. Hargrove JL. History of the calorie in nutrition. J Nutr 2006;136(12):2957–61.
14. Atwater WO. The potential energy of food: the chemistry and economy of food III. Century 1887;(34):397–405.
15. Feinman RD, Fine EJ. "A calorie is a calorie" violates the second law of thermodynamics. Nutr J 2004;3:9.
16. Hall KD, Heymsfield SB, Kemnitz JW, Klein S, Schoeller DA, Speakman JR. Energy balance and its components: implications for body weight regulation. Am J Clin Nutr 2012;95(4):989–94.
17. Livesey G, Buss D, Coussement P, Edwards DG, Howlett J, Jonas DA, Kleiner JE, Müller D, Sentko A. Suitability of traditional energy values for novel foods and food ingredients. Food Control 2000;11(4):249–89.
18. WHO. World Health Organization. Healthy diet. [Internet]. Fact sheet N°394. 2015 [cited 13 Aug, 2015]. Available from: http://www.who.int/mediacentre/factsheets/fs394/en/.
19. Disclosure of nutrient content information for standard menu items offered for sale at chain restaurants or similar retail food establishments and for articles of food sold from vending machines, FDA-2011-F-0172 (2014). [Internet]. Available from: https://www.fda.gov/downloads/food/ingredientspackaginglabeling/labelingnutrition/ucm423985.pdf
20. Malik VS, Willett WC, Hu FB. Global obesity: trends, risk factors and policy implications. Nat Rev Endocrinol 2013;9(1):13–27.
21. Morgen CS, Sorensen TI. Obesity: global trends in the prevalence of overweight and obesity. Nat Rev Endocrinol 2014;10(9):513–4.
22. WHO. Obesity and overweight. [Internet]. World Health Organization; 2018 [cited 25 Nov, 2018]. Available from: http://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight.
23. Howarth NC, Huang TT, Roberts SB, Lin BH, McCrory MA. Eating patterns and dietary composition in relation to BMI in younger and older adults. Int J Obes (Lond) 2007;31(4):675–84.
24. Challem J. Current controversies in nutrition: the calorie myth—why some calories "weigh" more than others. Alternative and Complementary Therapies 2012;18(1):31–4.
25. Wells JC. Obesity as malnutrition: the dimensions beyond energy balance. Eur J Clin Nutr 2013;67(5):507–12.
26. Mattes RD. Eating patterns, diet quality and energy balance: an introduction to an international conference. Physiol Behav 2014;134:1–4.
27. Jensen MD, Ryan DH, Apovian CM, Ard JD, Comuzzie AG, Donato KA, Hu FB, Hubbard VS, Jakicic JM, Kushner RF, et al. 2013 AHA/ACC/TOS Guideline for the management of overweight and obesity in adults. Circulation 2014;129(25 Suppl 2):S102–S38.
28. Swinburn BA, Ravussin E. Energy and macronutrient metabolism. Baillieres Clin Endocrinol Metab 1994;8(3):527–48.
29. Jenkins DJ, Popovich DG, Kendall CW, Rao AV, Wolever TM, Tarig N, Thompson LU, Cunnane SC. Metabolic effects of non-absorbable carbohydrates. Scand J Gastroenterol 1997;32:10–3.

30. Misra A, Singhal N, Khurana L. Obesity, the metabolic syndrome, and type 2 diabetes in developing countries. Role of dietary fats and oils. J Am Coll Nutr 2010;29(1):289S–301S.
31. Guyton AC, Hall JE, Schmitt W. Human physiology and mechanisms of disease: Saunders; 1996.
32. Champe PC, Harvey RA, Ferrier DR. Bioquímica ilustrada: Artmed; 2012. 528 pp.
33. McClain AD, Otten JJ, Hekler EB, Gardner CD. Adherence to a low-fat vs. low-carbohydrate diet differs by insulin resistance status. Diabetes Obes Metab 2013;15:87–90.
34. Karl JP, Meydani M, Barnett JB, Vanegas SM, Goldin B, Kane A, Rasmussen H, Saltzman E, Vangay P, Knights D, et al. Substituting whole grains for refined grains in a 6-wk randomized trial favorably affects energy-balance metrics in healthy men and postmenopausal women. Am J Clin Nutr 2017;105(3):589–99.
35. Li H, Li X, Yuan S, Jin Y, Lu J. Nut consumption and risk of metabolic syndrome and overweight/obesity: a meta-analysis of prospective cohort studies and randomized trials. Nutr Metab (Lond) 2018;15:46.
36. Galvao Candido F, Xavier Valente F, da Silva LE, Goncalves Leao Coelho O, Gouveia Peluzio MDC, Goncalves Alfenas RC. Consumption of extra virgin olive oil improves body composition and blood pressure in women with excess body fat: a randomized, double-blinded, placebo-controlled clinical trial. Eur J Nutr 2018;57(7): 2445–55.
37. Mozaffarian D. Dietary and policy priorities for cardiovascular disease, diabetes, and obesity: a comprehensive review. Circulation 2016;133(2):187–225.
38. Mozaffarian D, Forouhi NG. Dietary guidelines and health—is nutrition science up to the task? BMJ 2018;360:k822.
39. Kuhnt K, Degen C, Jahreis G. Evaluation of the impact of ruminant trans fatty acids on human health: important aspects to consider. Crit Rev Food Sci Nutr 2016;56(12):1964–80.
40. Gebauer SK, Chardigny JM, Jakobsen MU, Lamarche B, Lock AL, Proctor SD, Baer DJ. Effects of ruminant trans fatty acids on cardiovascular disease and cancer: a comprehensive review of epidemiological, clinical, and mechanistic studies. Adv Nutr 2011;2(4):332–54.
41. Aldai N, de Renobales M, Barron LJR, Kramer JKG. What are the trans fatty acids issues in foods after discontinuation of industrially produced trans fats? Ruminant products, vegetable oils, and synthetic supplements. Eur J Lipid Sci Technol 2013;115(12): 1378–401.
42. Ganguly R, Pierce GN. The toxicity of dietary trans fats. Food Chem Toxicol 2015;78:170–6.
43. Lottenberg AM, Afonso Mda S, Lavrador MS, Machado RM, Nakandakare ER. The role of dietary fatty acids in the pathology of metabolic syndrome. J Nutr Biochem 2012;23(9):1027–40.
44. Mozaffarian D. Diverging global trends in heart disease and type 2 diabetes: the role of carbohydrates and saturated fats. Lancet North Am Ed 2015;3(8):586–8.
45. Bier DM. Saturated fats and cardiovascular disease: interpretations not as simple as they once were. Crit Rev Food Sci Nutr 2016;56(12): 1943–6.
46. Moretto TL, Benfato ID, de Carvalho FP, Barthichoto M, Le Sueur-Maluf L, de Oliveira CAM. The effects of calorie-matched high-fat diet consumption on spontaneous physical activity and development of obesity. Life Sci 2017;179:30–6.
47. Cohen E, Cragg M, deFonseka J, Hite A, Rosenberg M, Zhou B. Statistical review of US macronutrient consumption data, 1965–2011: Americans have been following dietary guidelines, coincident with the rise in obesity. Nutrition 2015;31(5):727–32.
48. Xi B, Li S, Liu Z, Tian H, Yin X, Huai P, Tang W, Zhou D, Steffen LM. Intake of fruit juice and incidence of type 2 diabetes: a systematic review and meta-analysis. PLoS One 2014;9(3):e93471.
49. Huang C, Huang J, Tian Y, Yang X, Gu D. Sugar sweetened beverages consumption and risk of coronary heart disease: a meta-analysis of prospective studies. Atherosclerosis 2014;234(1): 11–6.
50. Tasevska N, Park Y, Jiao L, Hollenbeck A, Subar AF, Potischman N. Sugars and risk of mortality in the NIH-AARP Diet and Health Study. Am J Clin Nutr 2014;99(5):1077–88.
51. Kearns CE, Schmidt LA, Glantz SA. Sugar industry and coronary heart disease research: a historical analysis of internal industry documents. JAMA Intern Med 2016;176(11):1680–5.
52. Kearns CE, Apollonio D, Glantz SA. Sugar industry sponsorship of germ-free rodent studies linking sucrose to hyperlipidemia and cancer: an historical analysis of internal documents. PLoS Biol 2017;15(11):e2003460.
53. WHO. Preparation and use of food-based dietary guidelines. Geneva: World Health Organization, Food and Agriculture Organization of the United Nations; 1998.
54. Brazil. Dietary Guidelines for the Brazilian Population. Brasília: Ministry of Health of Brazil; 2014. 156 pp.
55. Hering B, Proença RP, Sousa AA, Veiros MB. Evaluation of nutritional and sensorial quality in meal production – NSQE system. J Foodservice 2006;17(4):173–81.
56. Marques AC, Valente TB, Rosa CS. Toxin formation during food processing and possible consequences to the human body. Rev Nutr 2009;22(2):283–93.
57. Bernardo GL, Proença RPC, Calvo MCM, Fiates GMR, Hartwell H. Assessment of the healthy dietary diversity of a main meal in a self-service restaurant: a pilot study. Br Food J 2015;117(1):286–301.
58. Sharma C, Kaur A, Thind SS, Singh B, Raina S. Advanced glycation end-products (AGEs): an emerging concern for processed food industries. J Food Sci Technol 2015;52(12):7561–76.
59. Burton S, Creyer EH, Kees J, Huggins K. Attacking the obesity epidemic: the potential health benefits of providing nutrition information in restaurants. Am J Public Health 2006;96(9):1669–75.
60. Cappuccio FP, Pravst I. Health claims on foods: promoting healthy food choices or high salt intake? Br J Nutr 2011;106(11):1770–1.
61. Chandon P. How package design and packaged-based marketing claims lead to overeating. Appl Econ Perspect Policy 2012;35(1):7–31.
62. Al-Ani HH, Devi A, Eyles H, Swinburn B, Vandevijvere S. Nutrition and health claims on healthy and less-healthy packaged food products in New Zealand. Br J Nutr 2016;116(6):1087–94.
63. Góes FB, Góes FJ, Popolim WD, Tribst AAL, Augusto PED. Knowledge of diet and light food products by its consumers in supermarkets in São Paulo city. Rev Assoc Bras Nutr 2010;3(1):5–7.
64. Oliveira MBC, Enes CC, Sousa CR, Desani DDR, Muniz RP, Salay E. Level of consumer information about diet and light food products in grocery stores in Campinas, SP, Brazil. Rev Ciênc Méd 2005;14(5): 433–40.
65. Nishida W, Fernandes AC, Veiros MB, González Chica DA, Proença RPC. A comparison of sodium contents on nutrition information labels of foods with and without nutrition claims marketed in Brazil. Br Food J 2016;118(7):1594–609.
66. Swithers SE. Artificial sweeteners produce the counterintuitive effect of inducing metabolic derangements. Trends Endocrinol Metab 2013;24(9):431–41.
67. Rogers PJ, Hogenkamp PS, de Graaf C, Higgs S, Lluch A, Ness AR, Penfold C, Perry R, Putz P, Yeomans MR, et al. Does low-energy sweetener consumption affect energy intake and body weight? A systematic review, including meta-analyses, of the evidence from human and animal studies. Int J Obes (Lond) 2016;40(3):381–94.
68. Greenwood DC, Threapleton DE, Evans CE, Cleghorn CL, Nykjaer C, Woodhead C, Burley VJ. Association between sugar-sweetened and artificially sweetened soft drinks and type 2 diabetes: systematic review and dose-response meta-analysis of prospective studies. Br J Nutr 2014;112(5):725–34.
69. Suez J, Korem T, Zeevi D, Zilberman-Schapira G, Thaiss CA, Maza O, Israeli D, Zmora N, Gilad S, Weinberger A, et al. Artificial sweeteners induce glucose intolerance by altering the gut microbiota. Nature 2014;514(7521):181–6.

70. Mattes RD, Popkin BM. Nonnutritive sweetener consumption in humans: effects on appetite and food intake and their putative mechanisms. Am J Clin Nutr 2009;89(1):1–14.
71. Heisler LK, Lam DD. An appetite for life: brain regulation of hunger and satiety. Curr Opin Pharmacol 2017;37:100–6.
72. Mishra A, Anand M, Umesh S. Neurobiology of eating disorders—an overview. Asian J Psychiatr 2017;25:91–100.
73. Borges MC, Louzada ML, de Sa TH, Laverty AA, Parra DC, Garzillo JM, Monteiro CA, Millett C. Artificially sweetened beverages and the response to the global obesity crisis. PLoS Med 2017;14(1):e1002195.
74. Fairburn CG, Welch SL, Doll HA, Davies BA, O'Connor ME. Risk factors for bulimia nervosa. Arch Gen Psychiatry 1997;54:509–17.
75. Fairburn CG, Shafran R, Cooper Z. A cognitive behavioural theory of anorexia nervosa. Behav Res Ther 1999;37:1–13.
76. Schaumberg K, Anderson D. Dietary restraint and weight loss as risk factors for eating pathology. Eat Behav 2016;23:97–103.
77. USDA National Nutrient Database for Standard Reference . [Internet]. 2015 [cited 13 May, 2018]. Available from: https://ndb.nal.usda.gov/ndb/.
78. UK. Guidance on voluntary calorie labelling for caterers. [Internet]. London: Department of Health; 2011 [cited 2016]. Available from: https://responsibilitydeal.dh.gov.uk/wp-content/uploads/2013/04/Illustrative-guidance-on-voluntary-calorie-labelling-for-caterers-2011.pdf.
79. Stein K. A national approach to restaurant menu labeling: the Patient Protection and Affordable Health Care Act, Section 4205. J Am Diet Assoc 2011;111(5 Suppl):S19–27.
80. Oliveira RC, Proença RPC, Salles RK. The right to food and nutrition information in restaurants: a review. Demetra: Food, Nutrition & Health 2012;7(1):47–58.
81. UK. Public Health Responsibility Deal: sign up and pledge to improve public health in England. [Internet]. United Kingdom: Department of Health; 2011. Available from: http://responsibilitydeal.dh.gov.uk.
82. Kasapila W, Shaarani SM. Legislation-impact and trends in nutrition labeling: a global overview. Crit Rev Food Sci Nutr 2016;56(1):56–64.
83. Swinburn BA, Kraak VI, Allender S, Atkins VJ, Baker PI, Bogard JR, Brinsden H, Calvillo A, De Schutter O, Devarajan R, et al. The global syndemic of obesity, undernutrition, and climate change: the Lancet Commission report. Lancet 2019;393(10173):791–846.
84. Levine DI. The curious history of the calorie in U.S. policy: a tradition of unfulfilled promises. Am J Prev Med 2017;52(1):125–9.
85. Khandpur N, Swinburn B, Monteiro CA. Nutrient-based warning labels may help in the pursuit of healthy diets. Obesity (Silver Spring) 2018;26(11):1670–1.