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F&V AND ENERGY DENSITY

Editorial

In recent years, policy statements related to obesity have acknowledged the utility of dietary energy density as a guide to food choices. The World Health Organization recommends reducing the energy density of the diet as a strategy to stem the global obesity epidemic. Reductions in energy density can be achieved by increasing intake of vegetables and fruits. Their high water content allows people to eat satisfying amounts of food with few calories per bite. Filling up at the start of a meal with vegetables or fruit and increasing the proportion of vegetables in a main course have been found to control hunger and moderate energy intake. Thus, a number of studies show that eating vegetables and fruits can lower the energy density of a meal and this in turn can reduce energy intake.

Can we extrapolate from these short-term studies and promote increased consumption of vegetables and fruits for weight loss? While several recent studies support this suggestion, the current body of evidence is small and the results have been inconsistent. Most studies of the relationship between vegetable and fruit consumption and weight status have not assessed the impact on dietary energy density, and have not controlled for critical variables that could affect intake such as preparation method, type of fruit or vegetable, timing of consumption, or whether they are added to the diet or substituted for other ingredients.

Eating more vegetables and fruits could provide consumers with a powerful tool to control their weight while improving the quality of their diets. However, additional strategic investigations of how to use vegetables and fruits to lower dietary energy density, to enhance satiety, and to influence energy balance are needed for the development of effective, evidence-based consumer messages.

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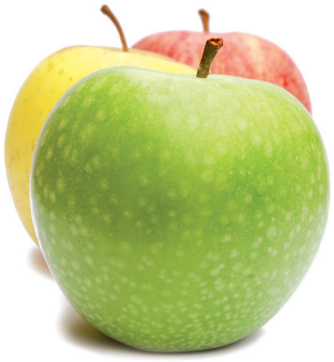

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Diet quality, lifestyle and low energy density

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Healthy dietary habits are of paramount importance for physical and mental health. The identification of properties of foods or dietary patterns related to positive health outcomes helps policymakers to develop strategies for the promotion of healthy diets.

The energy density of a diet, defined as the amount of available dietary energy per unit of weight consumed, seems to play a role in regulating food intake[1]. Lower energy density is associated with lower energy consumption: individuals consuming a greater amount of energy are more likely to meet their nutrient needs. However, although restricting energy intake could, theoretically, lead to nutrient imbalance, several recent reports have suggested that low energy density diets are associated with higher diet quality[2, 3] and favourable health outcomes such as prevention of obesity and diabetes in the general population[4, 5].

Association of energy density with diet quality and other lifestyle variables

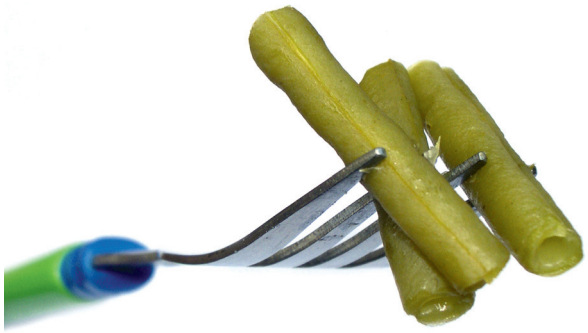
We analyzed dietary data, obtained through a food frequency questionnaire, and other lifestyle variables from a random sample of the 25- to 74-year-old population of Gerona, Spain[6]. Low energy density diets were associated with a healthier lifestyle: participants who adhered to a low energy density diet spent more time in leisure physical activity, drank less alcohol, and were more likely to be non-smokers than those following a high energy density diet.

In recent years, a holistic approach based on food consumption has been developed to quantify overall diet quality, including the creation of composite indices of dietary behaviours[7]. These indices combine a large amount of information about dietary behaviours into a single indicator of diet quality. Although based on different concepts, the Mediterranean Diet Score and the Healthy Eating Index are measurement tools that rank adherence to a healthy diet. Most importantly, high adherence to these diet quality indices has been associated with lower risks of cardiovascular heart disease, obesity, diabetes type 2, hypertension, and mortality[8, 9]. In our study, adherence to low energy density diets showed a high correlation to both diet quality indices in men and women. In contrast, those reporting high-energy density diets exhibited poor diet quality. Furthermore, compliance with dietary recommendations proposed by the Spanish Society for Community Nutrition was higher among participants following a low energy density diet as compared with their peers following a high energy density diet. Hence, a high consumption of low energy density foods can be considered an important factor for diet quality. An interesting model for a healthy diet would be rich in low energy density foods, contain modest amounts of foods of moderate energy density such as fish and pulses, and include only a low to moderate amount of vegetable-based high energy density foods.

However, food choice is influenced by a large number of factors, including taste, cost, convenience and, to a lesser extent, health and variety[10]. It has been shown that economic constraints lead to the consumption of less healthy diets characterized by high energy density and palatability[11]. The consumption of vegetables and fruit accounted for more than one third of the total costs of the average diet in our study population[12]. Furthermore, low energy density diets were directly associated with monetary costs. In an effort to identify and promote healthy diets, monetary costs should be considered. Otherwise, promotion of this new model will run the risk of being in vain, particularly in low income groups.

Diet quality and energy density in the elderly

Due to the amorphous nature of energy density, freely selected low energy density diets might differ considerably in food and nutrient composition across populations. Because ingestion of most nutrients increases with increasing energy consumption, and energy density increases with energy intake, low energy density diets are, theoretically, more prone to nutrient inadequacy than are high energy density diets. Aging has been associated with altered sensations of thirst, hunger, and satiety, and a loss of appetite is generally observed in the elderly. Data from a study performed in free living elderly men and women indicate that following a low energy density diet had a generally favourable micronutrient intake pattern[13]. Furthermore, diet adequacy, measured as compliance with RDA for 19 nutrients, was remarkably higher among elderly men and women on low energy density diets as compared with their peers following a high energy density diet.



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Reductions in entrée energy density increase children's vegetable intake and reduce energy intake

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To prevent childhood overweight, major heath organizations recommend changes in eating behavior such as limiting the consumption of energy-dense foods[1] and consuming diets with recommended amounts of fruits and vegetables[2]. These recommendations are supported by studies in adults, which have demonstrated that consumption of a diet low in energy density (ED; kcal/g) can moderate energy intake[3] and improve diet quality[4]. It is not clear however, that these dietary changes have a similar impact on children. We will review recent studies that have tested the effect of reducing the energy density of foods on preschool children's energy intake.

Several studies have demonstrated that reducing the energy density of food can be an effective approach to moderate children's energy intake[5, 6] because, like adults, children tend to consume a consistent weight of a food even when it is reduced in energy density[5]. In these studies, the energy density of a main dish was reduced by decreasing the proportion of fat in the recipe. Another way to reduce the energy density of a recipe is to increase the proportion of water-rich ingredients, such as vegetables. Increasing the proportion of vegetables in a dish has been shown to reduce energy intake in adults[7]. The aim of our recent study[8] was to determine the effect on preschool children's energy intake of decreasing the energy density of a main dish by reducing the proportion of fat and incorporating extra vegetables. Another aim of our study was to assess whether vegetable intake would be influenced by the vegetable content of the dish.

Reducing dietary energy density decreased energy entake and increased vegetable intake

Preschool children (30 boys, 31 girls) were served a standard breakfast and a test lunch one day per week for four weeks. The lunch consisted of applesauce, carrots, milk, and a pasta dish with a vegetable-based tomato sauce. Two versions of the pasta dish were formulated to be similar in taste and appearance while differing in energy density: the higher-ED dish had 1.6 kcal/g and the lower-ED dish was reduced in energy density by 25% (1.2 kcal/g). The reduction in the energy density of the pasta was achieved by decreasing the amount of cheese and substituting low-fat cheeses (thus decreasing fat content) and increasing the amount of puréed broccoli and cauliflower (thus increasing water content). Children's taste ratings for both versions of the pasta were assessed at the end of the study.

The results showed that children consumed a consistent weight of food and milk across experimental conditions, and therefore, the energy density of the pasta had significant effects on children's energy intake from the dish and from the meal. Decreasing the energy density of the pasta by 25% led to a 25% reduction in children's energy intake of the dish and a 17% decrease in their energy intake at lunch.

Because the lower-ED version of the pasta had a higher vegetable content (three times the amount of broccoli and cauliflower), children consumed significantly more puréed broccoli and cauliflower when served this dish than when served the higher-ED version. The mean increase in intake of broccoli and cauliflower was more than half a serving of vegetables, where an age-appropriate serving is equivalent to 3 tablespoons[9]. A majority of children (79%) rated the taste of the lower-ED version of the pasta as the same or better than that of the higher-ED version of the dish.

Implications

This study extends the current literature on the effects of dietary energy density in children. It shows that the addition of vegetables to a food in order to lower the energy density could provide an effective strategy to both increase vegetable intake and decrease energy intake. Adding puréed vegetables to a pasta sauce did not affect acceptability, but when combined with a modest reduction in fat content, it significantly reduced energy intake. This effect is similar to the results of studies in which fat reduction alone was used to reduce the energy density of a dish/recipe[5, 6]. Although the studies that we have described focus on the effects of energy density at a single meal, we have found that reductions in energy density can have persistent effects on energy intake in young children. In a recent study, reducing energy density using a combination of strategies led to a decrease in energy intake over the two days of the intervention[10].

In addition to providing an approach to reducing the energy density of children's diets, increasing the vegetable content of foods could improve young children's vegetable intake. Increasing vegetable intake is vital considering many children are not meeting dietary recommendations[11]. In the present study, vegetable intake increased by half of a serving of vegetables, but larger increases in vegetable intake may be possible if greater amounts of vegetables are incorporated into dishes or if multiple recipes are adjusted using this approach. While it is important for children to be offered vegetables in a variety of forms, incorporating vegetables into foods is a strategy that can be used to increase children's vegetable intake and to moderate energy intake.

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Fruits reduces weight and energy intake of Brazilian women

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Description of the study

We conducted a randomized clinical trial with three arms to evaluate the effect of adding either three apples, three pears, or three oat cookies on serum lipids of overweight midlife women. The amount of fiber was similar in the apples, pears and oat cookies. Secondary outcome was weight change[1].

Overweight (body mass index >25 kg/m2) women, between 30 to 50 years who were nonsmokers, with cholesterol level greater than 240 mg/dL, were invited to the study. Of 411 eligible women, 49 were randomly assigned to the three treatment groups after signing written consent form. The Ethical Committee of Rio de Janeiro State University – UERJ, Brazil, approved the protocol.

The participants were instructed by a dietician to eat a standardized hypocaloric diet, (55% energy from carbohydrates, 15% from protein, and 30% from fat) aiming at a small weight reduction that corresponded to an energy restriction of 250 kcal/day based on the baseline energy intakes and estimated expenditure (WHO, 1985)[2].

Participants were instructed to have a diet which includes breakfast, lunch, dinner and three snacks per day for 10 weeks. Women received the fruits or the cookies twice a month in an amount sufficient for their families, and the women were instructed to eat either three apples (300 g), three pears (300 g), or three oat cookies (60 g) per day during the follow-up. Each two weeks, the participants completed dietary records for three consecutive days, including one weekend day to evaluate compliance. Weight, height were measured monthly. Diets were adjusted every two weeks according to changes in body weight. The main staple foods of Brazilian diet: rice and beans were used for energy adjustment. The average intake was 2,401±389 kcal/day, 2,459±464 kcal/day or 2,383±31kcal/day for the apple, pear or oat group respectively.

Study results

Results showed a significant decrease in the energy density during the follow up (- 1.23 kcal/g, $p<0.04$, and -1.29 kcal/g, $p<0.05$) for apples and pears respectively, compared to the oat group.

The energy intake also decreased significantly (-25.17 and -19.81 kcal/day) for the apple and pear group respectively, but showed a small increase (+0.93) for the oat group. Apples and pears were also associated ($p<0.001$) with weight reduction for the apple (-0.93 kg) and the pear (-0.84 kg) groups, whereas weight was unchanged (+0.21 kg; P=0.35) in the oat group.

Conclusion

The energy density of foods is considered a key determinant of energy intake because a large intake of a low-energy-dense diets, such as fruits, makes an excessive energy intake more difficult[3, 4]. Although our study did not directly address the effects of fruits on the energy density, we showed that body weight was reduced by adding fruits to the diet. These results suggest that energy densities of fruits, independent of their fiber amount can reduce energy consumption and body weight over time.

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