Review Article

The energetics of nut consumption

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Nuts are a nutrient-rich food group. Depending on the type, they may provide substantive concentrations of Vitamin E, magnesium, folate, essential fatty acids, fiber and protein to the diet. They also contain potentially important phytochemicals. By mechanisms yet to be identified, they are reported to improve postprandial lipid profiles and may hold other health benefits. However, they are also energy dense so a theoretical contributor to positive energy balance and weight gain. However, epidemiological studies have consistently revealed an inverse association between the frequency of nut consumption and BMI. Further, intervention trials demonstrate less than predicted weight gain following inclusion of nuts in the diet. The mechanisms for these observations are currently under study. Candidates include strong satiety effects, promotion of energy expenditure and/or inefficient energy utilization. Recent trials have revealed support for each. Inclusion of nuts in the diet results in strong satiety effects as revealed by robust compensatory dietary responses that offset approximately 65-75% of the energy they provide. Several trials note increased energy expenditure that may account for an additional 10% of their energy yield. Limited bioaccessibility results in a loss of 5-15% of energy. Taken together, these findings largely account for the energy provided by nuts and explain the epidemiological and clinical observations. Thus, current knowledge suggests moderate nut consumption does not pose a threat for weight gain.

Key Words: nuts, energy balance, body weight, dietary compensation, appetite

In contrast to the common orientation of the time, i.e. to explore the associations between nutrient intake and health outcomes, the Seventh Day Adventists Health Trial examined the relationships between food intake and health.[1] An inverse association was observed between the frequency of nut consumption and BMI. This initial finding was replicated in a number of subsequent epidemiological studies.[2-6] The consistency of findings prompted intervention trials with a wide array of nuts (e.g., almonds, walnuts, pecans, macadamias, pistachios, hazelnuts). Nearly all revealed the inclusion of nuts in the diet had limited impact on weight gain.[7,8] Most designs entailed provision of large energy contributions by the nuts 1250-2500 kJ to permit detection of treatment effects in relatively short time intervals, typically 4-8 weeks. Less is know about the effects of longer-term intake of smaller amounts, but data to-date suggest the impact on BMI is limited.[9,10] Additional trials are currently underway[11]. The outcome of such trials will reveal critical information regarding the role of nuts in a healthy diet. Complimentary mechanistic studies are also required to establish the veracity of these epidemiological and intervention trials. Knowledge of this facet of the issue is just emerging.

Three mechanisms have been proposed to account for the less than predicted impact of nut consumption on body weight. The first focuses on the satiety value of nuts and it is posited that inclusion of nuts in the diet results in a spontaneous reduction of energy intake at other times of the day to offset some or all of the energy provided by the nuts. Second, nut consumption may increase energy expenditure and thereby dissipate a portion of the energy they provide. Third, there may be inefficiencies in the absorption of the energy from nuts that reduces their theoretical contribution to energy intake.

The appetitive properties of nuts have been assessed through preload studies and compensatory dietary responses. When ingested in isoenergetic loads, almonds, chestnuts and peanuts lead to sharp declines of self-reported hunger.[12] The changes are significantly greater than those to selected items matched on weight or volume. The active principles of nuts that account for this property have not been identified and it is possible that none alone is sufficient, i.e., there may be synergies among components of the whole nut. Although appetitive sensations serve as potential predictors of ingestive behavior, the plethora of environmental factors that alter food availability, health beliefs and other determinants of behavior, limit their utility. Measurement of dietary compensation is a more direct measure. By definition, foods that promote a reduction of energy consumed from other sources are satiating. Numerous studies have measured this property and consistently show the majority of energy provided by nuts is offset by reductions of intake of other foods.[13] Compensation scores generally range from 55-100% with a mean of roughly 65-75%.

Although the compensatory dietary response to nuts accounts for a large proportion of their energy, the residual

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would still promote positive energy balance in the absence of other mechanisms affecting energy usage. A recent trial[8] attempted to quantify the energetics of nut consumption using almonds as a model and addressed the three mechanisms identified above. Twenty, healthy, adult (24±9 years of age) females with a mean BMI of 25.9±3.1 participated in a randomized, cross-over trial with two 10-week test periods separated by a three-week washout. During one arm, 1440kJ/day of almonds were provided with no dietary advice except that the day's allotment of nuts had to be consumed. A second arm differed only in that nuts were disallowed. Energy intake was measured using the multi-pass approach on six random days of each treatment arm. Resting energy expenditure (REE) and the thermic effect of feeding (TEF) were assessed by indirect calorimetry. Body-weight was measured weekly and body composition was measured by bioelectrical impedance and air displacement plethysmography at weeks one and eight. Physical activity was determined by triaxial accelerometery and activity logs for three days during weeks four and eight. Fecal energy loss was determined the last week during a four-day controlled feeding period. Total energy expenditure (TEE) was measured during weeks eight and nine by doubly-labeled water. Plasma alpha-tocopherol was used to document dietary adherence.

The findings from that work confirm the minimal impact of almond consumption on body weight as well as their strong satiety effects. Seventy-four percent of the energy from the almonds was offset by reduced energy intake from other sources. No differences of REE, TEF or physical activity were observed, but there was a non-significant increase in daily energy expenditure, based on the doubly-labelled water measurement, that would account for roughly 14% of the almond's energy. There was a significant increase in fecal energy loss as well accounting for about 7% of the energy of the almonds. Thus, by the three routes, 95% of the ingested energy was accounted for in ways that would not promote weight gain. Though TEE has not been assessed in intervention studies with nuts previously, there are reports of increased REE with chronic consumption[14,15] that may be related to their fatty acid composition.[16] The limited bioaccessibility has been demonstrated with almonds, walnuts and peanuts.[13]

Because of the widespread problem of overweight/obesity and high proportion of individuals attempting to reduce their body weight, the role of nuts in weight management regimens is also of importance. Restriction of dietary fat is a common approach to weight loss, but recent findings suggest this may not be necessary or sufficient. Some trials reveal greater weight loss on higher fat diets, including those that promote nut consumption[17] due, in part, to improved dietary compliance.[18] Further, data from the National weight control registry indicate diets moderate in fat can be effective for long-term successful weight reduction.[19] A more definitive answer will be provided by a trial nearing completion[11].

Given the reported health benefits of nut consumption, such as improved lipid profile and increased fiber, micronutrient and phytochemical intake, there are recommendations for increased intake. However, documentation that this will not exacerbate other health issues such as overweight/obesity is critical. The available evidence indicates weight gain may not be a concern when nuts are consumed in moderation.

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