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Healthy snacking recommendations: One size does not fit all

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HIGHLIGHTS

- The influence of snacking and eating frequency likely varies with different target populations.
- Snacking may be health-promoting, especially with respect to energy and fluid balance, for older adults.
- Most Americans, regardless of their snacking behaviors, do not appear to be eating healthy diets.
- Public health messages targeting both snacking and meal behavior are needed.

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ABSTRACT

An underlying factor contributing to a lack of consensus in the scientific literature regarding the health effects of snacking may be the diversity of study populations. In fact, the influence of snacking likely varies with different target populations. Accordingly, the purpose of this paper is to demonstrate that snacking may make important contributions to a healthy diet, especially among older adults (≥65 years). However, these dietary behaviors may have a different consequence among adults (18–60 years) experiencing psychosocial stress as measured by food insecurity. Food insecurity refers to the condition in which individuals do not have access at all times to enough food for an active, healthful life. Another reason for a lack of consensus regarding the effects of snacking is that reports describing the contribution of snacking to the diet of adults have generally focused on single nutrients. Because of the complexity of dietary intake and the possible interaction of nutrients, it is often difficult to attribute health outcomes to the effects of a single dietary component. Thus, the relationship between snacking frequency and overall dietary quality among adults (≥20 years) will be described. Developing recommendations regarding snacking and meal frequency is extremely problematic for numerous reasons. One universal dietary recommendation regarding snacking and meal frequency is not appropriate for every life-stage group. Also, research has demonstrated that individuals view snacking as an unhealthy behavior. Because individuals are more likely to acknowledge, integrate, and act on nutrition knowledge that corresponds with their existing knowledge, changing dietary behaviors with messages containing the term snacking may be ill-conceived. Descriptive alternatives to the term snacking are needed in developing messages for health promotion campaigns.
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1. Introduction

Most Americans have difficulty in achieving their food and nutrient recommendations and are subsequently placing themselves at risk for certain chronic diseases [1]. One of the federal responses to this public health concern has been the release of the Dietary Guidelines for Americans (DGA) every five years since 1980 [2]. The DGA issued in 2010 emphasize two major concepts: "Maintain caloric balance over time to achieve and sustain a healthy weight" and "Focus on consuming nutrient-dense foods and beverages" [3]. Individual dietary behaviors influence food, food component, and nutrient intakes. Whereas specific DGA recommendations regarding foods and nutrients to increase, as well as foods and food components to limit, have been established, individual dietary behaviors to achieve these recommendations have not. The 2010 DGA advisory committee noted that there was limited evidence to support recommendations regarding snacking and meal frequency and inadequate evidence regarding overall eating frequency [4].

Although additional scientific reports have focused on these dietary behaviors since the DGA advisory committee review, a clear consensus regarding the nutrition-related health impacts of snacking and eating frequency remains elusive [5–10]. The health-promoting qualities of foods and beverages consumed as snacks have been debated because these items are often considered to contribute primarily empty calories from fat and added sugars to the diet [11]. In addition, it has been suggested that individuals did not compensate for their increased energy intake from snacking by decreasing their intake at other eating occasions [12]. Consequently, consuming snacks may lead to a positive energy balance and, subsequently, weight gain. Conversely, other researchers contend that snacks are high in carbohydrate and low in fat,

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and the replacement of fat with carbohydrate may help achieve and sustain a healthy weight [9]. Researchers examining the metabolic consequences of snacking and eating frequency have demonstrated a reduced blood glucose and insulin response with a nibbling as opposed to a gorging diet [8]. Postprandial surges in blood glucose observed with a gorging diet are a sign of impaired glucose tolerance, a risk indicator for type 2 diabetes. The effects of snacking and/or eating frequency on other health outcomes, including high blood pressure, heart disease indicators, and poor cognitive function, have also been studied [8,9]. However, the body of literature regarding the relationship between snacking and/or eating frequency and all of these outcomes remains inconclusive.

Inconsistent findings regarding the health effects of snacking may be attributed to the heterogeneity among the published studies examining this relationship. Differing study designs, and omitting potential confounding factors may contribute to the mixed findings. Varying definitions of dietary behaviors, such as snacking, is another factor that may contribute to differences among studies. Interpretations regarding studies (including those highlighted in this paper) based on a 24-hour recall interview must be tempered. Reports based on 24-hour recall interview data are by design observational and not experimental; thus, snacking and meal observations are constructed from participants' descriptions. During a 24-hour recall interview conducted for the NHANES, participants are asked to report the time each food or beverage was consumed and what they would call each eating occasion. Specific food probes are used to collect detailed information as well as the amount consumed for each food. Although a 24-hour recall interview is systematic, it is still based on individuals describing their dietary behaviors. This makes the 24-hour recall interview a transactional communication process and involves both encoding and decoding on the part of researchers and study participants.

Diversity among researchers is reflected in numerous ways in which snacking, meals, and the combination of these two have been defined [5,7,9]. Researchers have used various labels for the combination of both snack and meals: these include eating occasions, eating events, eating moments, and eating episodes [13]. As for snacks, researchers have categorized them by their nutrient content (especially energy content), time dimensions (time of day, time interval between occasions, and occasions per day), and participant-defined eating occasions, as well as any combination of these characteristics. The work described in this paper is based on multiple characteristics and has included the occurrence (or non-occurrence) of snacking, snacking frequency, and percent of calories from snacking.

Diversity among researchers also exists regarding whether the definition of snacking should include both solid foods and beverages [5]. It has been noted that individuals have different satiety responses to solid foods and beverages, and therefore beverages should not be included in a universal snacking definition. On the other hand, researchers have shown that adults view drinking-only episodes without food as important parts of their daily routine [13]. In addition, a focus on the energy contribution from snacking may miss the overall nutritional impact of this dietary behavior. Both solid foods and beverages were considered snacks in the work highlighted in this paper.

Diversity among study participants' definitions of dietary behaviors is also apparent. Factors such as culture can greatly influence meal and snack behaviors. Culture can influence the acceptability and preference of foods and beverages as well as the timing, sequence, amount and combinations in which items are eaten [14–16]. The cultural diversity of the United States has been expanding; more than half the growth in the population between 2000 and 2010 was due to the increase in Hispanic population [17]. Culture and social norms also influence the labeling of eating occasions. In 2011, over 60.6 million people aged five and older (21% of the population) spoke a language other than English at home [18]. Differences in the labels of eating occasions are obvious when considering different languages but can also be found among individuals speaking the same language.

Another major reason for a lack of consensus in the scientific literature regarding the health effects of snacking may be the diversity of study populations. In fact, the influence of snacking likely varies with different target populations. Accordingly, the purpose of this paper is to demonstrate that snacking and increased eating frequency may make important contributions to a healthy diet, especially among older adults (≥65 years). Focusing on the dietary behavior of older adults is important because these behaviors are influential, modifiable lifestyle factors that may promote additional years of high functioning, living independently, and higher quality of life [19,20]. In addition, little research attention has been given to the effects of snacking and eating frequency on the health and well-being of older adults. However, these dietary behaviors may have a different consequence among adults (18–60 years) experiencing psychosocial stress as indicated by their food insecurity status. Food insecurity refers to the condition in which individuals do not have access at all times to enough food for an active, healthful life. Focusing on food insecure individuals is important because they are more likely than food secure individuals to have chronic conditions such as obesity, diabetes mellitus, high blood pressure, heart disease, and food allergies [21–24]. In addition, although the dietary behaviors of low-income individuals have been extensively examined, little attention has been given to individuals classified as food insecure [25]. Another reason for a lack of consensus regarding the effects of snacking is that reports describing the contribution of snacking to the diet of adults have generally focused on single nutrients [26]. Because of the complexity of dietary intake and the possible interaction of nutrients, it is often difficult to attribute health outcomes to the effects of a single dietary component. Thus, the relationship between snacking frequency and overall dietary quality among adults (≥20 yrs) will be described. Finally, this paper will conclude with a discussion describing the complexity of developing national recommendations regarding snacking.

2. Snacking and older adults

Food and nutrient needs of individuals vary depending on many individual-level factors such as age [27]. It is well established that infants, toddlers, children, adolescents, young adults, middle age adults, and older adults have varying nutritional needs [28]. To further complicate this issue of age diversity, people of the same age increasingly display variability in physiological, functional, and physical ability especially after 70 years of age [29]. A comparison of people over age 70 who have the same chronological age may demonstrate as much as a 15- to 20-year age-related difference in the level of reserve capacity and functioning.

Unintentional weight loss, the involuntary decline in body weight over time, is an important health risk factor among older persons. Preventing unintentional weight loss in older people is essential because it predisposes them to continued weight loss, malnutrition, and increased morbidity and mortality. Older adults may have difficulty maintaining health-promoting diets for various reasons, including physiological, psychological, economic, and social factors [30]. All of these factors affect dietary behaviors and may result in inadequate intakes of energy, macronutrients, and micronutrients as well as dehydration among older adults. Snacking may be a means for older adults to obtain shortfall nutrients that cannot be obtained by consuming only three meals a day. Accordingly, we have examined the contribution of snacking to the energy, macronutrient, micronutrient, and fluid intakes of older adults.

2.1. Macronutrient results

Using NHANES data from 1999-2002, we showed that snacking was common among this age group, reported by the majority of older adults [30]. Older adults who snacked had higher intakes of energy, protein, carbohydrate, total fat, and saturated fat. Snacking contributed

approximately a quarter of older adults' daily energy and carbohydrate intakes and a fifth of their daily fat intake. The contribution of snacking to daily protein intakes was less than that from carbohydrate and fat, yet snacking still provided 14% of their protein intakes. Although snacking may have contributed more carbohydrate and fat, these results do not support the contention that snacking contributes only fat and added sugar to the diet. The contribution of snacking to alcohol was less than 12%, and total alcohol intakes were not different between snackers and nonsnackers.

Older adults who snacked and those who did not snack reported on average approximately five-and-a-half and three-and-a-half total eating occasions per day respectively. Those older adults who snacked reported on average two-and-a-half snacking occasions per day, and each snacking occasion contributed 150 cal. Snackers and nonsnackers consumed comparable amounts of energy during meals. Older adults who did not report snacking had, on average, very low intakes of energy. These findings suggest that older adults who reported eating only during meal occasions were unable to compensate for their lack of energy from snacking at meal occasions. These findings are supported by Coakley and colleagues, who observed that eating between meals was associated with increased weight in adults aged 45–64 years, but not in those aged 65 and over [31]. Other researchers examining the relationship between snacking and/or eating frequency and weight status among adults have used younger age groups and/or different age categories (for example comparing 20–59 year olds to 60–90 year olds) [32–37].

2.2. Micronutrient results

In addition to the energy contribution of snacking, we have examined the micronutrient contribution of this dietary behavior. This work was based on NHANES data from 2003-2006, which contains two days of dietary information. In order to provide a more complete estimate of usual snacking patterns, we used both days of intake data to explore the relationship between snacking and older adults' daily intake of vitamins, carotenoids, and minerals [38].

In this analysis almost all older adults reported snacking at least once during the two days of observation. The average number of snacking occasions was roughly two per day. As snacking frequency increased, older adults' daily intakes of vitamins A, C, and E, as well as beta-carotene, increased noticeably. However, intakes of the B-complex vitamins, vitamin K, and lycopene were not linked to snacking frequency. Older adults' intakes of magnesium, copper, and potassium also increased markedly as snacking frequency increased, although intakes of calcium, phosphorous, iron, and zinc were not associated with snacking. Intakes of selenium decreased with snacking frequency. Given the food sources of selenium, the relationship between snacking and this mineral was somewhat expected.

An important finding from this work is that snacking frequency was associated with vitamin E and potassium intake, because these two nutrients have been acknowledged as a concern for older adults [39]. Vitamins C and E, beta-carotene, and copper were all related to snacking frequency. These four nutrients have antioxidant potential in the body. Oxidative damage can contribute to the development of age-related eye disease, atherosclerosis, cancer, coronary heart disease, diabetes, respiratory diseases, and rheumatoid arthritis [40]. Future work examining the relationship between snacking and the intake of these micronutrients among younger-old (65–74 years), middle-old (75–84 years), or oldest-old adults (85 years and older) is needed.

2.3. Fluid results

Another nutritional concern for older adults is dehydration. Insufficient water intake and increased water excretion make aged individuals susceptible to dehydration. While both intake and excretion may be affected by aging, promoting adequate fluid intake has been noted as the most important modifiable health behavior for maintaining fluid homeostasis in older adults [41]. Changes in dietary behavior predispose all older adults to dehydration. Many older adults deliberately avoid drinking beverages because they fear nighttime incontinence [42]. In addition, older adults may not recognize that they are thirsty because the sensation of thirst decreases with age [43]. Prolonged dehydration can cause changes in body chemistry, kidney failure, kidney stones, urinary tract infections, bowel cancer, and death [44–48].

Due to the severity of the consequences of dehydration and the lack of research attention to this issue, we investigated dietary behaviors having to do with fluid intake among older adults [49]. We used the 1999–2002 NHANES to examine differences among the total water intake of the three older age groups (65–74, 75–84, and 85 years and older). We found that total water intake for the middle-old and oldest-old was lower than water intake for the younger-old. Total water intake was based on the contributions from drinking water, beverages, and food sources. The relative contribution of drinking was comparable for all the three age groups, while the relative contribution from food was slightly greater for the oldest-old compared to the youngest-old. Compared to the young-old group, the relative contribution of beverages to total water intake was lower in the middle-old and lowest in the oldest-old.

Because we found differences regarding the contribution of beverages, we evaluated the water intake from beverages at meals versus beverages at snack occasions. The water intake from beverages consumed as snacks was considerably less for the two older age groupings when compared to the young-old group. The water contribution from beverages consumed during meal occasions was not different, however. These fluid balance findings parallel our energy balance findings; older adults did not make up for a snacking deficit at meal occasions.

2.4. Nutrition-related health benefit of snacking for older adults

The 2010 DGA advisory committee highlighted the need for research that would further our understanding of the nutrition-related health benefits of dietary behaviors, such as snacking [4]. Physical function is a concern for older adults because failing physical function can limit their daily activities, predispose them to falls, and increase their mortality and morbidity risk [50–52]. Of the many methods of measuring physical function, gait speed is often used because it is convenient, adequate, and reliable. Furthermore, gait speed—a performance-based measure of physical function—has been recommended as a "geriatric vital sign" to assess the overall health status among older adults [52,53]. Because gait speed tends to decrease early in the disabling process, it can be monitored during interventions aimed at preventing or delaying disability, mortality, hospitalization, and other adverse events [51,54].

As previously described, we observed snacking to be positively associated with energy, macronutrient, micronutrient, and fluid intake; therefore this dietary behavior may influence gait spend through multiple pathways. Inadequate protein and energy intakes may contribute to functional decline through an increase in the loss of the muscle mass, a decrease in the energy reserves, decreased immune function, increased skin fragility, and poor healing [55]. Research examining other age groups has linked voluntary physical activity (which is a different concept than physical performance) and eating frequency. Physical activity may be positively associated with eating frequency, as individuals with high levels of physical activity eat more often due to greater appetite [9]. Being physically active may increase older adults' appetites and promote greater energy intake. Both of these factors, being physically active and adequate energy intakes, may work synergistically to promote a healthy gait speed. It has also been noted that cutting back on snacking may actually work against recommendations encouraging regular exercise, because fewer, larger meals may lead to gastric fullness and lethargy, which may reduce motivation to exercise [9]. Again, these mechanisms—the relationship between snacking and physical performance—may work

synergistically among older adults. Micronutrients may also play a role. As previously noted, vitamins C and E, beta carotene, and copper (which we found to be linked to snacking) have antioxidant potential, and low antioxidant intakes are associated with higher risk of chronic conditions, which can lead to poor physical function [56]. Dehydration hinders physiological function and thus physical function by impairing cardiovascular, thermoregulatory, metabolic, and central nervous system function [57].

Using NHANES 1999–2002, we examined the associations between snacking behavior and gait speed [58] among adults 60 years and older. Snacking behavior was assessed by snacking frequency as well as the percentage of total daily energy intake contributed by snacking. Both measures of snacking behavior were found to be associated positively with gait speed, and these associations remained after controlling for numerous confounders. Participants who snacked four or more times in a day had faster gait speeds. Participants whose snacking contributed 20% or more to their daily energy intake had faster gait speeds than those whose snacking contributed less than 10% of their intake. The relationship between snacking and gait speed observed in our study may actually be an underestimation. This work was limited by the sample size of older adults and we were unable to investigate differences among younger-old, middle-old or oldest-old adults.

3. Snack and meal frequency food insecurity

The dietary behaviors that appear to make important contributions to a healthy diet among older adults likely have different contributions to the diets of adults experiencing food insecurity. Unlike older adults who may experience a negative energy balance, nutrient deficiencies, and ultimately, weight loss, food insecure adults, particularly food insecure women, may be at risk for a positive energy balance and subsequent weight gain. Because of these differences, the relationship between dietary behaviors and energy and macronutrient intake among food insecure adults will be highlighted in this paper.

According to an expert panel from the Life Sciences Research Office (LSRO), food security was defined as, "access by all people at all times to enough food for an active, healthy life and includes at a minimum: the ready availability of nutritionally adequate and safe foods, and the assured ability to acquire acceptable foods in socially acceptable ways"[59]. Food insecurity was defined as, "the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain." Issues of uncertainty, insufficiency, and social unacceptability are reflected in the conceptual definition of food insecurity.

In the United States, the Household Food Security Survey Module (FSSM) has been used to assess the prevalence of food insecurity [59–61]. The items in the FSSM elicit information on whether a household experienced food-related difficulties due to lack of resources during the last 12 months. Measurement of food insecurity at the household or individual level in the United States involves the measurement of quantitative, qualitative, psychological, and social or normative factors that are fundamental to the experience of food insecurity, qualified by their involuntary and cyclical nature.

Given the factors related to food insecurity, experiencing this condition likely elicits a chronic stress response [25]. Stress has been shown to affect eating in a bidirectional manner; some individuals decrease their food intake and lose weight during or after stress, while others increase their intake during stress [62,63]. A possible biological mechanism has been proposed to explain this stress-eating paradox [64]. Chronic stress can lead to greater cortisol exposure, which then influences the reward system. Greater activation of the reward system leads to excessive intake of highly palatable foods. The abundance of highly palatable foods and beverages (generally calorically dense items) in the environment of those who are food insecure would result in overeating rather than under-eating.

Despite the vulnerability of food insecure individuals, little research attention has been given to their diets. Consequently, we examined the association between food insecurity and several dietary outcomes in men and women with data from the 1999–2002 NHANES [65]. The NHANES 1999–2002 data are released in four food security categories: food secure, marginally food secure, food insecure without hunger, and food insecure with hunger. We found no differences in total energy intake across levels of food for men or women. Marginally food secure women had higher intakes of protein than food secure women. Food insecure with hunger women had higher intakes of total and saturated fat than food secure women. However, the higher protein intake and fat intake did not translate into higher energy intakes. Although we found no associations with total energy, there were key findings regarding the snack and meal patterns of food insecure individuals. Food insecure without hunger and food insecure with hunger women had significantly fewer meals than food secure women, as did the food insecure without hunger men compared to food secure men.

These findings are important because they validate the food insecurity concept of the FSSM item that focuses on skipping meals as a food choice coping mechanism. This finding is also perplexing, because skipping meals should lead to lower daily energy intakes. However, we found the energy contribution per meal as well as the total energy from snacking was greater for food insecure without hunger women than for food secure women. Among food insecure without hunger men, the daily number of snacks and the total energy from snacking were higher than those for food secure men. Thus, an increase in meal size and the energy from snacking could explain why food insecure individuals who report skipping meals may yet be in a positive energy balance.

4. Snacking and overall dietary quality

Other researchers have shown that snacking contributes to individuals' intake of vitamins C and E, dietary folate, dietary fiber, iron, calcium, magnesium, iron, and potassium as well as monounsaturated fatty acids [4,5]. However, focusing on single nutrients and food components makes inferring the effect of snacking on any nutrition-related health outcome difficult. It has been noted that it may be impossible to attribute the effects of a single dietary component to any health outcome [66]. As a result, nutrition researchers have begun to focus on overall diet quality. The Healthy Eating Index-2005 (HEI-2005), developed by the United States Department of Agriculture (USDA), is a reliable measure of overall diet quality that assesses adherence to the 2005 DGA [67].

The HEI-2005 is composed of 12 nutrient- and food-based components [68]. All the major food groups found in the US Department of Agriculture's MyPyramid as well as oils are included as nine adequacy components in the HEI-2005. The remaining three components, saturated fat, sodium, and energy from solid fat, alcohol, and added sugars (SoFAAS), represent moderation components. Except for the SoFAAS score, all component scores are evaluated with a density approach; that is, food and nutrient components are expressed as the amount per 1000 kcal. A density standard approach allows the components to be independent of an individual's energy requirement, and diets can be assessed irrespective of the total amount of foods consumed.

Using NHANES data from 1999-2004, we observed that snacking was modestly associated with higher HEI-2005 scores among adults 20 years and older [26]. Although the magnitude of the association between snacking and overall diet quality was modest, the direction of the association is notable. Snacking was not associated with poorer overall diet quality and was associated with a slightly more nutrient-dense diet. HEI scores may indicate nutrient density because the food group components are all in their most nutrient-dense form [68]. While the association was positive for snacking and overall diet quality, all adults, irrespective of their snacking behavior, had less than desired HEI-2005 scores. We also found that the relationship between snacking and HEI-

2005 did not vary by age. It should be noted though that the HEI-2005 does not specifically target older adults. For example, the HEI-2005 does not incorporate a component for fluid intake. We also examined the relationship between snacking and individual component scores from the HEI-2005. Total fruit, whole fruit, whole grains, milk, oils, and sodium component scores were positively associated with snacking frequency. Snacking was inversely associated with total vegetable and meat and bean components and not associated with the dark green and orange vegetables and legumes and the total grain component scores. An inverse association between SoFAAS and snacking frequency was also observed. These mixed findings regarding the component scores illustrate the complexity of assessing diet quality. Foods and beverages that have generally been labeled as low quality because of one attribute may make other healthful contributions to the diet. Much of the literature on snacking has emphasized its contribution to single nutrients and thus overlooks the total impact of snacking.

5. Developing national recommendations

Developing national recommendations regarding snacking is extremely problematic for numerous reasons. One size does not fit all when considering the consequences of snacking on measures of health, and thus one universal dietary recommendation may not be appropriate for every life-stage group. The need for age-adjusted dietary recommendations for children has been well recognized [69]. Based on the nutritional needs of older adults and national demographic trends, it is apparent that dietary recommendations specifically for this life-stage also are needed [58]. In the United Kingdom, nutritional guidelines for older adults have been released by the Caroline Walker Trust [8]. These guidelines suggest six eating occasions daily: three meals plus three snacks at mid-morning, mid-afternoon, and late evening.

Another concern is that research endeavors in this area do not include consistent definitions of these dietary behaviors. Defining dietary behaviors is not only an issue for researchers and study participants in the United States. Chamontin and colleagues reported that among British adults, a snack, snacking, and snack food elicited different responses regarding the types of food and beverages, eating location, commensal nature, and time of day [70]. These researchers concluded that using any terms with the root "snack" should be avoided in research endeavors and educational messages for the public because they are unclear.

Similarly, in the United States, developing national recommendations regarding snacking is complicated by the public's existing perceptions of this dietary behavior. Public health programs cannot be effective if their message development is based entirely on clinical and epidemiological research findings [71]. Message strategies need to be relevant and meaningful to the target audience. Published reports describing people's perceptions regarding eating occasions are limited [72]. A conceptual framework based on adults' perceptions of eating and drinking episodes was proposed by Bisogni and colleagues and involved eight dimensions: food and drink, location, time, activities, social settings, mental processes, physical condition, and recurrence [13]. These dimensions can overlap and provide a holistic view of eating. Time (in terms of clock, calendar, and season) was identified as an aspect of eating or drinking. Furthermore, these researchers observed that meals were an important marker for adults in organizing their day [13]. Other qualitative work has focused on identifying the schema adults use to classify their foods for different eating contexts [73]. Three major categories were found: personal-experience-based, context-based, and food-based. These categories provide important insights into the processes adults employ to guide their dietary behaviors [73]. One recent report presented qualitative information regarding the U.S. college students' perceptions of the factors that distinguish meals and snacks [72]. Five environmental cues that distinguished a snack or meal occasion for college students were observed. These environmental cues were: eating with or without family members; eating while standing or seated; using cloth or paper napkins; using ceramic or paper plates; and eating for 30 or 10 min. Other cues that distinguished a snack or meal focused on the food and/or beverage being consumed during the eating occasions. These cues included the expense, the size, quality, quantity, form (prepared versus pre-packaged), and healthfulness of the items consumed. College students were likely to view snacks to be inexpensive, packaged, and unhealthy.

Although scientific reviews published since the 2010 DGA have noted that strong evidence linking snacking to excess body weight is lacking [7,8,10], this perception still persists among the public [70,72,74]. Because research has demonstrated that individuals view snacks as unhealthy, developing messages promoting the healthfulness of snacks appears to be an uphill battle. Descriptive alternatives to the term "snacking" might prove to be more useful. As previously mentioned, qualitative work has shown that eating occasions, especially meals, were important markers for adults to organize their daily activities. Messages that focus on eating behaviors in the context of other daily activities, such as sleeping, exercising, working, relaxing, and socializing, would likely be more effective than messages using the term snack.

6. Summary

The nutrition-related health outcomes of snacking and eating frequency likely depend on who is being studied. Our work suggests that snacking may be health-promoting, especially with respect to energy and fluid balance, for older adults. We found that most Americans, regardless of their snacking, scored poorly on the HEI-2005. These overall dietary results emphasize the need for public health messages targeting both snacking and meal behavior. Formative research is desperately needed to develop messages targeting healthy dietary behaviors. One possible context for these messages could be based on the interplay among adults' daily activities.

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