


The Nutrient Density of Snacks: A Comparison of Nutrient Profiles of Popular Snack Foods Using the Nutrient-Rich Foods Index

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Julie Hess, BA¹, Goutham Rao, MD²,
and Joanne Slavin, PhD, RD¹

Abstract

Background: Although Americans receive almost a quarter of their daily energy from snacks, snacking remains a poorly defined and understood eating occasion. However, there is little dietary guidance about choosing snacks. Families, clinicians, and researchers need a comprehensive approach to assessing their nutritional value. **Objective:** To quantify and compare the nutrient density of commonly consumed snacks by their overall nutrient profiles using the Nutrient-Rich Foods (NRF) Index 10.3. **Methods:** NRF Index scores were calculated for the top 3 selling products (based on 2014 market research data) in different snack categories. These NRF scores were averaged to provide an overall nutrient-density score for each category. **Results:** Based on NRF scores, yogurt (55.3), milk (52.5), and fruit (30.1) emerged as the most nutrient-dense snacks. Ice cream (−4.4), pies and cakes (−11.1), and carbonated soft drinks (−17.2) emerged as the most nutrient-poor snacks. **Conclusions:** The NRF Index is a useful tool for assessing the overall nutritional value of snacks based on nutrients to limit and nutrients to encourage.

Keywords

snacks, nutrient density, nutrient-rich foods index, nutritional assessment

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Introduction

Although current cross-sectional data suggest that most Americans, including children and adolescents, consume a significant portion of their daily energy as snacks, snacking remains a poorly understood behavior.¹ There is little information on how and why individuals and families select snacks, and no consistent definition of “snacks” or “snacking” used by most consumers or even the research community.^{2,3} Many studies, including the National Health and Nutrition Examination Surveys, rely on participants to define “snacks” themselves.⁴ While some individuals define snacks as an eating occasion between meals, others define snacks based on the type of food consumed, location of food consumption, or time of day of consumption.³ Unlike other eating occasion labels like breakfast, lunch, or dinner, “snacks” commonly describes a type of food as well as an eating occasion. Even dietary guidance is prone to inconsistency in defining snacking. The 2015 Dietary Guidelines for

Americans, for instance, caution against excessive consumption of “snacks,” with regard to the type of food, because they add sugars and saturated fat to the American diet, but they recommend snacks as an eating occasion, suggesting carrots with hummus as a sample “snack meal.”⁵

Based on consumer definitions, however, Americans receive a quarter of their daily energy from snacks.⁴ The 2015 Scientific Report of the Dietary Guidelines Committee states that 96% of the US population over the age of 2 years eats at least one snack every day⁶ and that daily consumption of 2 to 3 snacks is even more common. The results of 2 recent studies suggest that the type of snack, rather than the frequency of consuming

¹University of Minnesota, St. Paul, MN, USA

²Case Western Reserve University, Cleveland, OH, USA

Corresponding Author:

Joanne Slavin, Department of Food Science and Nutrition, University of Minnesota, 1334 Eckles Avenue, St. Paul, MN 55108, USA.
Email: jslavin@umn.edu



snacks, is the most important determinant of whether snack consumption is associated with adiposity, diet quality, or body mass index.^{7,8} However, the term “snacking” is still often associated with the consumption of foods high in saturated fat, sugar, and sodium,⁹ commonly referred to as “snack foods.”^{4,7,8}

While “snack foods” are often associated with nutrients to limit, like most foods, “snacks” also include nutrients to encourage. Yet guidance about overall nutrient composition and the nutrient density of snacks remains largely unavailable. Food labels, for example, draw consumer attention to the calorie and fat content (perceived by many to be less healthful nutrients) at the top of the label but not to the same food’s other nutrients such as calcium, potassium, and fiber, listed further down the label. Consumers who read labels, including adults who purchase snacks for their children, tend to read only the first 5 components (servings, calories, total fat, saturated fat, and *trans* fat) of the nutrition facts label, none of which are nutrients to encourage.¹⁰ This may explain why label reading does not necessarily lead to the selection of foods high in nutrients to encourage.¹¹ Comprehensive dietary guidance about common snack choices based on nutrient density would be useful for different stakeholders. With this guidance, parents could more easily identify healthful snacks for their children, clinicians would have reliable information for counseling patients about snacking and dietary needs, and researchers would be able to assess more easily the impact of dietary trends or interventions that involve snacking.

The purpose of our study was to quantify the nutrient density of commonly consumed snacks using the Nutrient-Rich Foods (NRF) Index, and therefore fill an important need by showcasing a way to assess the nutritional value of snacks, which make up a large part of the diets of children and families.¹² For the purposes of this article, snacks are defined as food or caloric beverages consumed between regular meals (breakfast, lunch, and dinner). The NRF Index assigns scores to foods based on their nutrients to encourage (protein, calcium, vitamin D, potassium, magnesium, iron, vitamin A, vitamin C, vitamin E, and fiber) and nutrients to limit (sodium, saturated fat, and total sugar). Higher scores indicate more nutrient-dense foods.

Methods

We obtained data on the most commonly consumed snack categories in the United States from the 2014 National Eating Trends (NET) survey administered in paper form by the NPD Group, a market research company. The NET survey includes data from roughly 5000

individuals annually, 23% of whom are children. NET participants are recruited from a national mail panel, and the main food preparer/purchaser in each household (panelist) records the food and beverage consumption of all household members for a 2-week period. Panelists could record up to 3 snacks (defined as a between meal eating occasion) and up to 3 meals per individual per day.¹³ Although families enrolled in the NET are nationally representative in many ways, including geographic distribution, survey participants are, in general, better educated than Americans as a whole. For example, roughly 46% of main food preparers/purchasers have a college degree compared with about 33% of Americans as whole.¹⁴ Hispanics and African Americans are also underrepresented in the sample compared to the US population, making up just 7.9% and 5.8% of participants, respectively, compared with 13.3% and 17.6% of Americans as a whole.¹⁵

Next, we obtained brand information for the 3 market leaders in each snack category identified from the NET based on 2014-2015 sales data from Information Resources, Inc (IRI; <http://www.iriworldwide.com/en-US>). Table 1 includes a list of leading brands and specific products selected for analysis. Table 1 does not list nonbranded products (fruit and some varieties of milk). The nonbranded types of milk most commonly consumed for snacks were 2% milk and whole milk, and the most popular types of fruit selected for snacks were apples, bananas, and grapes. Table 1 also does not include “private label” top sellers. If 1 of the 3 market leaders was identified as “private label” in the IRI data, a generic version of the product (ie, “chocolate chip cookies”) was selected from the nutrient database (described below) in lieu of a branded product.

Nutrient data for snacks were obtained from the Nutrition Data System for Research software, version 2014, developed by the Nutrition Coordinating Center at the University of Minnesota, Minneapolis, MN. This software includes nutrition information on several branded food products. When nutrient details for specific branded foods were not available in this database, we obtained nutrient information by contacting manufacturers directly. We calculated NRF scores for each product and for each snack food category using Microsoft Excel (Version 2010, Microsoft, Inc, Redmond, WA). A few food items included in this analysis, namely, diet cola, sugar free gum, and brewed tea (from tea bags), contain no calories or very few calories in each serving and were excluded from our calculations.

Finally, we calculated nutrient-density scores for each food. There are several versions of the NRF Index.^{16,17} This study uses a modified version of the

Table 1. Market-Leading Snack Selections.

Snack Category	Market Leader (Brand)	Product
Candy	Hershey's	Hershey's Milk Chocolate Bar
	M&M	M&M's Peanut
	Trident Sugarless Gum	Trident Spearmint Gum
Pies and cakes	Betty Crocker	Supermoist Yellow Regular Cake Mix
	Duncan Hines	Classic Yellow Regular Cake Mix
	Entenmanns	All Butter Pound Cake
Carbonated soft drinks	Coca-Cola	Coca-Cola
	Diet Coke	Diet Coke
	Pepsi	Pepsi
Chips	Lay's	Lay's Potato Chips (classic)
	Pringles	Pringles Potato Crisps (original)
	Ruffles	Ruffles Potato Chips (original)
Cookies	Nabisco Chips Ahoy	Nabisco Chips Ahoy (original chocolate chip)
	Nabisco Oreo	Nabisco Oreo Chocolate Sandwich (original)
Crackers	Sunshine Cheez-It	Cheez-It (original)
	Pepperidge Farm Goldfish	Goldfish (original)
	Nabisco Ritz	Ritz (original)
Ice Cream	Breyers	Breyers Frozen Natural Vanilla Ice Cream (regular)
	Ben & Jerry's	Frozen Half-Baked Ice Cream (regular)
Milk	Dairy Pure	2% Milk
Popcorn	Orville Redenbacher's Microwave Popcorn	Orville Redenbacher's Pop Up Bowl Microwave Popcorn
	Pop Secret Microwave Popcorn	Pop Secret Movie Theater Butter Microwave Popcorn
Snack nuts and seeds	Planters	Regular Deluxe Mixed Nuts (sea salt, whole and halves, plastic jar)
	Wonderful	Wonderful regular pistachios, salted
Tea	Lipton	Diet green tea with citrus liquid prepared tea with caffeine
	Arizona	Green tea with ginseng and honey (prepared plastic tea jug)
	Lipton	Tea natural black tea bags
Yogurt	Chobani	Chobani Regular Nonfat Plain
	Dannon	Dannon Light N Fit Vanilla Yogurt

NRF Index 9.3, to which we have added vitamin D (listed as a nutrient to encourage in the 2010 and 2015 Dietary Guidelines for Americans).^{5,18} We have designated this vitamin D–augmented version of the NRF Index as “NRF 10.3.” First, for each 100 kcal of a specific food, the amount of each nutrient to encourage was expressed as a percentage of its daily recommended value.¹⁹ These percentage values were added together. Next, for 100 kcal of the same food, the amount of each nutrient to limit was calculated as a percentage of the recommended limit. These percentage values were also added together. The NRF Index was then calculated as the sum of the values for nutrients to encourage minus the sum of the values of nutrients to limit. Table 2 provides an example. For the NRF Index calculations in this study, we chose to incorporate total sugar values as

opposed to added sugar values. It is often difficult or impossible based on common data sources to accurately distinguish between added and total sugars for many snack foods.²⁰

Results

Fruit, selected as a snack by 48% of NET respondents in the 2-week survey period, was the most popular snack and had an NRF Index score of 30.1. Cookies, chips, and ice cream followed in popularity, selected by 44%, 33%, and 33%, respectively (Table 3). Among the most popular snack categories, NRF scores varied from –17 to 55 (Table 4). Yogurt, milk, and fruit were the most nutrient-dense snack categories, while ice cream, pies and cakes, and carbonated regular soft drinks were the most nutrient-poor snacks. The

Table 2. Nutrient-Rich Foods Index 10.3 Sample Score Calculation for Apples.

Nutrients	Amount in 100 kcal of Apples	Daily Reference Value	Percent Daily Value	
Protein (g)	0.50	50	1.00	Sum of nutrients to encourage: 48.56
Calcium (mg)	11.32	1000	1.13	
Vitamin D (IU)	0	400	0	
Potassium (mg)	206.13	3500	5.89	
Magnesium (mg)	9.43	40	2.36	
Iron (mg)	0.23	18	1.28	
Vitamin A (IU)	103.77	5000	2.08	
Vitamin C (mg)	8.86	60	14.76	
Vitamin E (IU)	0.47	30	1.57	
Fiber (g)	4.62	25	18.49	
Saturated fat (g)	0.05	20	0.25	Sum of nutrients to limit: 16.34
Sodium (mg)	1.89	2400	0.08	
Total Sugars (g) ^a	20.01	125	16.01	
Nutrient-Rich Foods Index score:				32.22

^aNo daily value for total sugars. The Daily Reference Value used here (125 g) was adopted from an overview of the Nutrient-Rich Foods Index.¹⁰

Table 3. Popularity of Snack Categories.

Category	Percentage of Individuals Selecting at Least Once in 2-Week Period
Fruit	48%
Cookies	44%
Chips	33%
Ice cream	33%
Candy/gum	32%
Popcorn	29%
Carbonated soft drinks	28%
Crackers	25%
Cake	24%
Milk	21%
Nuts/seeds	16%
Tea	15%
Yogurt	14%

Table 4. NRF 10.3 Scores for Snack Categories.

Category	NRF 10.3 Score
Yogurt	55.3
Milk	52.5
Fruit	30.1
Nuts and seeds	26.7
Chips	19.3
Tea	12.3
Crackers	5.5
Popcorn	1.4
Cookies	-2.1
Candy/gum	-4.0
Ice cream	-4.4
Pies and cakes	-11.1
Carbonated drinks	-17.2

Abbreviation: NRF, Nutrient-Rich Foods Index.

median NRF score for all snack options assessed was 6.0. With the breadth of scores (-17 to 76) for individual snacks, the mean NRF score for commonly consumed snacks was 12.6 ± 24.1 .

Potato chips had a surprisingly high score (19.3). While chips are commonly considered a food high in nutrients to limit, potatoes naturally contain potassium, magnesium, fiber, and vitamin C, and the oil used in chip production adds vitamin E. In addition, chip companies have transitioned to vegetable oils in recent years, limiting saturated fat content.

The snacks in the categories with the highest nutrient density, namely, yogurt and milk, contain high amounts of nutrients to encourage, especially protein,

calcium, potassium, vitamin D, and magnesium, with relatively small amounts of nutrients to limit (saturated fat, total sugars, and sodium) in a 100 kcal serving. Yogurt scored higher than milk in this analysis because the leading yogurt products are all nonfat, which has less saturated fat than the market-leading milk varieties (2% and whole). Both yogurt and milk do have relatively low amounts of iron, vitamin A, vitamin C, vitamin E, and fiber. Fruit, the third most nutrient-dense category, contains high amounts of vitamin C, fiber, potassium, and magnesium, and relatively low amounts of protein, calcium, vitamin D, vitamin A, vitamin E, and iron. Compared with yogurt

and milk, fruit has a higher total sugar content (a “nutrient to limit” in this analysis), which decreased its NRF score.

The most nutrient-dense snacks, milk and yogurt, were also the least frequently consumed. Only 21% of consumers recorded milk for a snack, and a mere 14% of respondents ate yogurt.

Discussion

Snacks are often considered “unhealthy” foods. Based on NRF scoring, however, this generalization is inaccurate. Several of the foods evaluated in this analysis, including all of the yogurt products, milks, fruits, nuts and seeds, and potato chips had relatively high NRF Index scores, indicating nutrient density. Other frequently selected snacks including soft drinks, pies and cakes, ice cream, and cookies had negative NRF scores and, therefore, low nutrient density.

A narrow focus on one component of a food obscures its overall nutritional value. Flavored milk, for example, contains more added and total sugars than plain milk, but is also rich in calcium and vitamin D, both of which are nutrients to encourage. Unfortunately, current dietary recommendations adopt this narrow view. The 2015 Dietary Guidelines for Americans recommend “choosing nutrient-dense foods and beverages” and then define these foods and beverages as containing “little or no solid fats and added sugars, refined starches, and sodium” but mention no specific nutrients to encourage.⁵ Evaluating the nutritional value of any food based only on its contribution of nutrients to limit is unreasonable.²¹

Our analysis provides a more balanced analysis of the nutritional value of commonly consumed snacks but is prone to several limitations. The NRF Index has inherent limitations. Weighing nutrients equally as in the NRF Index calculations may not be a valid method for assessing overall nutritional value. It is not clear to what degree each nutrient to encourage or nutrient to limit contributes to or detracts from health or the overall nutritional value of a food. Weighing nutrients equally also cannot account for interactions among different nutrients. For example, dietary fat promotes absorption of vitamin D.²²

Conclusions

The NRF Index is a useful, though imperfect, tool for a more balanced understanding of commonly consumed snacks in the United States. Physicians, dietitians, and other clinicians faced with the challenging task of providing brief counseling on diet and exercise to children

and their parents could use the NRF Index to discuss specific snack foods based on their overall nutrient profiles.

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Author Contributions

JH: Ms. Hess conducted the data analysis for this publication with the assistance of the coauthors. She wrote the 1st draft of the paper and made revisions as suggested by the coauthors.

GR: Dr. Rao made significant revisions to the paper and supplied information on the use of NRF in clinical settings.

JS: Dr. Slavin was involved in the design of the study and met regularly with Ms. Hess to direct its progress. She has revised the manuscript and approved of its content.

Declaration of Conflicting Interests

The author(s) declared the following conflicts of interest with respect to the research, authorship, and/or publication of this article. Dr. Rao has served on the Dannon Company’s Yogurt Advisory Board since 2012.

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