

# Examining the Quality of Foods and Beverages Across the Food Stream

Sharon I. Kirkpatrick, PhD, MHSc, RD

## ARTICLE INFORMATION

### Article history:

Submitted 1 August 2018

Accepted 29 August 2018

### Keywords:

Grocery Purchase Quality Index

Healthy Eating Index

Food stream

Food purchasing

Diet quality

2212-2672/Copyright © 2018 by the Academy of Nutrition and Dietetics.

<https://doi.org/10.1016/j.jand.2018.08.166>

**D**IETARY RISK FACTORS ARE RECOGNIZED AS KEY contributors to mortality and morbidity globally,<sup>1</sup> leading to significant attention to interventions to support healthy eating.<sup>2-4</sup> Various frameworks have been developed to identify the nature and targets of potential interventions,<sup>2-4</sup> with the aim of tackling a range of influences on eating patterns. For example, the World Cancer Research Foundation's NOURISHING Framework<sup>2</sup> identifies strategies to address the food system, food environments (including varied settings in which foods and beverages are offered, purchased, and consumed), and individuals. These targets are each part of the food stream (Figure), conceptualized as "the flow of foods from agricultural production, through processing and distribution channels, to the food that ends up on our plates."<sup>5</sup> The food stream has also been described as "factory to fork" by Slining and colleagues,<sup>6</sup> who noted the need for surveillance to extend beyond food consumption to consider the food supply and its dynamic nature. Metrics enabling the characterization of the quality of foods and beverages at various points along the food stream in relation to evidence about diet and health can enhance our understanding of the range of factors that influence what we eat and drink,<sup>5</sup> as well as provide insights to inform multi-level interventions to address these factors.

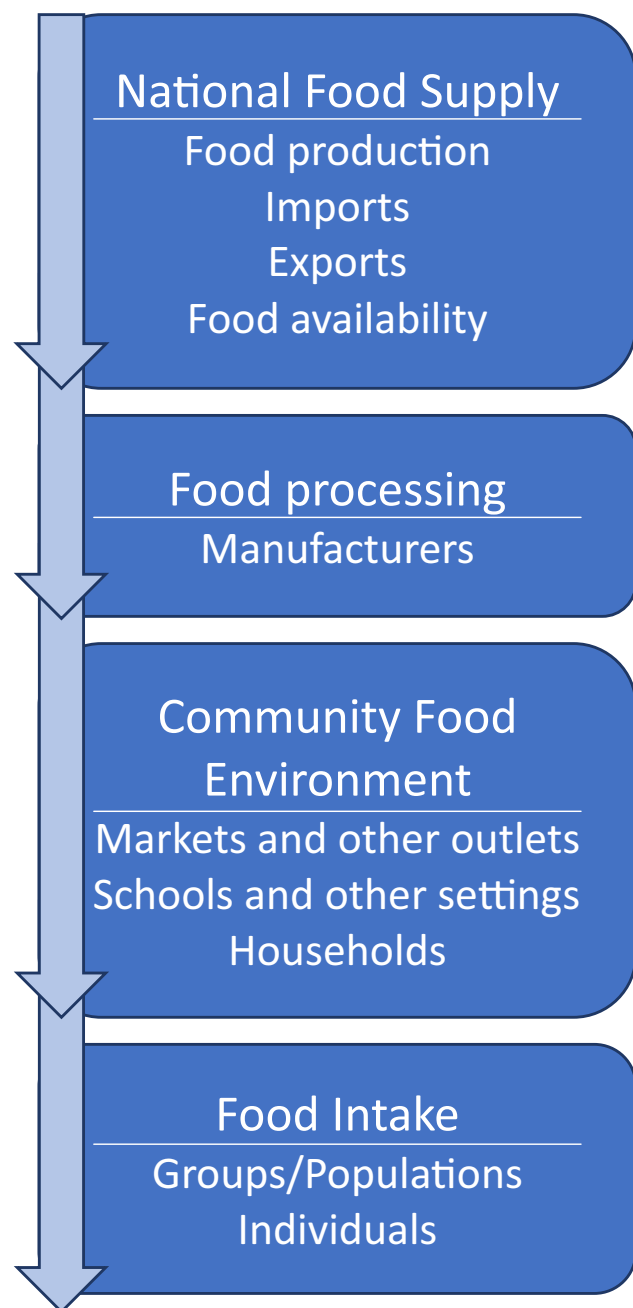
In the United States, food consumption at the individual level is monitored using the National Health and Nutrition Examination Survey (NHANES)<sup>7</sup> and other forms of surveillance, providing ongoing data on the dietary patterns of adults and children. Drawing upon dietary intake data, the quality of eating patterns can then be characterized using indices such as the Healthy Eating Index (HEI).<sup>8-10</sup> For example, analyses of NHANES using the HEI-2010,<sup>9</sup> which corresponds to federal guidance espoused by the 2010 Dietary Guidelines for Americans (DGA),<sup>11</sup> suggest that diet

quality has improved over time, but at a pace that is too slow for Healthy People 2020 objectives<sup>12</sup> to be achieved.<sup>13</sup> Various metrics have been applied to examine other points along the food stream, including foods and beverages offered in varied settings given their potential influence on consumption. For example, using the NOVA classification,<sup>14</sup> which differentiates foods based on their level of processing, the degree to which supermarkets offer primarily ultra-processed foods<sup>15</sup> and differences in food prices in relation to the degree of processing have been characterized.<sup>16</sup> The characteristics of foods and beverages advertised in children's programming have also been assessed using NOVA.<sup>17</sup> Within the context of environmental influences, understanding the quality of food *purchased* from grocery stores and other retail outlets is also of importance, given NHANES analyses indicating that grocery, convenience, and specialty stores are the source of around two-thirds of energy in the US diet.<sup>18</sup>

In this issue of the *Journal*, Brewster and colleagues<sup>19</sup> describe the Grocery Purchase Quality Index-2016 (GPQI-2016) and its potential to contribute to evaluations of the impact of nutrition education programs and retail-oriented interventions on food purchasing. The GPQI-2016, a tool for assessing the quality of household grocery purchases, was shown to perform similarly to the HEI-2015, based on analyses of data from the 2012 US Department of Agriculture (USDA) National Household Food Acquisition and Purchase Survey.<sup>19</sup> The GPQI-2016 and HEI are *a priori* indices developed to assess adherence with existing knowledge about what constitutes a healthy eating pattern. As described by Burggraf and colleagues,<sup>20</sup> *a priori* dietary indices "determine conceptually defined dietary components, which are considered important for the promotion of health, and which reflect risk gradients for major diet-related diseases." The GPQI-2016 was based on the USDA Food Plans, which indicate the types and quantities of foods to purchase and prepare at home to obtain diets that meet the DGA.<sup>11,21,22</sup> The HEI<sup>8-10</sup> assesses the alignment of the quality of eating patterns or other mixes of foods also in relation to the DGA.<sup>11,21,22</sup>

The 2005, 2010, and 2015 iterations of the HEI are each density-based in that most components, such as Fruits, Vegetables, Protein Foods, and Added Sugars, are expressed relative to energy (kcal), allowing the index to be used to "assess the overall quality of any mix of foods."<sup>23</sup> The standards for scoring are based on age- and sex-specific recommendations that are similar when expressed on a density basis.<sup>5</sup> As Reedy and colleagues<sup>23</sup> described, the HEI can thus be applied to both environmental- and individual-level data and therefore "provides a useful metric for studies linking data across various levels of the socioecologic framework of dietary behavior." Indeed, the HEI has been used to assess the

## RESEARCH



**Figure.** The food stream refers to the flow of foods from agricultural production, through processing and distribution channels, to the food that ends up on our plates. Adapted from <https://epi.grants.cancer.gov/hei/uses.html>.

extent to which the US food supply,<sup>23,24</sup> offerings at fast-food restaurants and food pantries,<sup>25,26</sup> and individual-level diets<sup>27,28</sup> align with federal dietary guidance. The use of the HEI at these different levels can help identify dietary components for which adjustments to the food supply and food environments are required to support healthy food choices. The findings of such research may also point to the need for complementary efforts, such as front-of-package labeling, taxation, and nutrition education,<sup>2</sup> particularly in cases in which gaps between dietary guidance and current food

offerings and consumption are substantial. For example, examinations of the food supply have suggested poor alignment with recommendations in terms of the relative balance of components such as fruits, vegetables, whole grains, and sodium.<sup>23,24</sup> Although realignment of the food supply is an area of attention, for example, with respect to sodium, changes are incremental and take time,<sup>29</sup> speaking to the need for other strategies to support healthy eating in the interim.

The HEI is amenable to application to multiple levels or points along the food stream, but using it to characterize the quality of foods purchased at grocery stores and other retail outlets poses a unique challenge. A key step in arriving at HEI scores is calculating the amounts of each dietary component of interest provided by the applicable mix of foods and beverages.<sup>5</sup> For the food supply, loss-adjusted data on amounts of various dietary components, including energy (kcal), have been used.<sup>24</sup> In the case of fast-food offerings or individual diets, the applicable foods and beverages are ready to eat and these calculations can be conducted using databases, such as the USDA Food and Nutrient Database for Dietary Surveys (<https://www.ars.usda.gov/northeast-area/beltsville-md-bhnrc/beltsville-human-nutrition-research-center/food-surveys-research-group/docs/fndds/>) and Food Patterns Equivalents Database (<https://www.ars.usda.gov/northeast-area/beltsville-md-bhnrc/beltsville-human-nutrition-research-center/food-surveys-research-group/docs/fped-overview/>).<sup>25</sup> Because these databases are based on codes maintained for surveys of food consumption, the Food and Nutrient Database for Dietary Surveys and Food Patterns Equivalents Database predominantly include foods in their as-consumed forms and not foods requiring preparation, such as raw meats, pancake and cake mixes, and dry grains and rice, thus not aligning well to purchases that include foods not in ready-to-eat form. The GPQI-2016, in contrast, is specifically intended for use to score the quality of as-purchased foods and beverages, classifying products into broad food groups rather than matching them to specific food codes as would be required to apply the HEI. Thus, as noted by Brewster and colleagues,<sup>19</sup> the GPQI is better suited than the HEI to assess food purchasing because foods are considered in their as-purchased form. The derivation of GPQI scores can be labor-intensive, but less so compared to approaches used previously.

The GPQI-2016 thus adds to the toolbox in terms of assessing facets of the food stream, with a particular focus on retail food purchases. The GPQI-2016 on its own may be valuable for examining the impact of interventions such as point-of-purchase strategies to shift purchasing as an antecedent to consumption.<sup>30</sup> For example, in a recent review, Hartmann-Boyce and colleagues<sup>30</sup> noted the potential for interventions in grocery stores as part of multifaceted approaches to support healthy eating and reduce chronic disease, but identified the need for studies to test interactions between interventions and socioeconomic status. Such studies could make use of the GPQI-2016. Further, using the GPQI-2016 in conjunction with other compatible measures of diet quality, such as the HEI, can allow assessment of various influences on diet quality within multi-level studies that examine multiple points along the food stream, including both food purchasing and consumption. This is important, given that Hartmann-Boyce and colleagues<sup>30</sup> found relatively few of the reviewed studies on grocery store interventions assessed consumption in addition to purchasing.

Studies combining compatible metrics could contribute to understanding, for example, whether interventions to shift the quality of foods and beverages purchased have differential impacts on the dietary patterns of particular subgroups, such as young children who may be less likely to obtain foods and beverages outside of the home compared to school-aged children. Such a study could be extended to multiple environments and levels, for example, applying the GPQI-2016 to assess food purchases at grocery and convenience stores, and the HEI to appraise the quality of ready-to-eat foods offered at schools and nearby recreation centers or other settings, as well as children's intakes at school and at home. The resulting evidence could support the development of systems-oriented interventions to address multiple influences on diet. Indeed, the use of metrics such as these indices to collect data across the food stream could allow expanded use of systems methods, such as agent-based models, to better understand dietary patterns and their drivers and consequences.<sup>31</sup>

Although there are challenges to applying indices such as the HEI and the GPQI-2016, these tools can provide unique insights into gaps between dietary guidance and both food environments and dietary intake. The use of compatible metrics at multiple levels can thus inform interventions to create a food supply and food environments that support food purchasing and eating patterns aligning with recommendations for health and reduced disease risk. The GPQI-2016 is a novel index that can contribute to such pursuits.

## References

- Forouzanfar MH, Afshin A, Alexander LT, et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: A systematic analysis for the Global Burden of Disease Study 2015. *Lancet*. 2016;388(10053):1659–1724.
- Hawkes C, Jewell J, Allen K. A food policy package for healthy diets and the prevention of obesity and diet-related non-communicable diseases: The NOURISHING framework. *Obes Rev*. 2013;14:159–168.
- Kumanyika S. INFORMAS (International Network for Food and Obesity/non-communicable diseases Research, Monitoring and Action Support): Summary and future directions. *Obes Rev*. 2013;14:157–164.
- Vandevijvere S, Swinburn B. International Network for Food and Obesity/Non-Communicable Diseases (NCDs) Research, Monitoring and Action Support (INFORMAS). Towards global benchmarking of food environments and policies to reduce obesity and diet-related non-communicable diseases: design and methods for nation-wide surveys. *BMJ Open*. 2014;4(5):e005339.
- National Cancer Institute. Research Uses of the HEI. National Cancer Institute website. <https://epi.grants.cancer.gov/he/uses.html>. Revised February 12, 2018. Accessed July 31, 2018.
- Slining MM, Yoon EF, Davis J, Hollingsworth B, Miles D, Ng SW. An approach to monitor food and nutrition from “factory to fork.” *J Acad Nutr Diet*. 2015;115(1):40–49.
- Centers for Disease Control and Prevention. NHANES—About the National Health and Nutrition Examination Survey. 2016. Centers for Disease Control and Prevention website. [https://www.cdc.gov/nchs/nhanes/about\\_nhanes.htm](https://www.cdc.gov/nchs/nhanes/about_nhanes.htm). Revised September 15, 2017. Accessed August 17, 2018.
- Guenther PM, Reedy J, Krebs-Smith SM. Development of the Healthy Eating Index-2005. *J Acad Nutr Diet*. 2008;108(11):1896–1901.
- Guenther PM, Casavale KO, Reedy J, et al. Update of the healthy eating index: HEI-2010. *J Acad Nutr Diet*. 2013;113(4):569–580.
- Krebs-Smith SM, Pannucci TR, Subar AF, et al. Update of the Healthy Eating Index: HEI-2015. *J Acad Nutr Diet*. 2018;118(9):1591–1602.
- US Department of Agriculture and US Department of Health and Human Services. *Dietary Guidelines for Americans*. 2010. 7th ed. Washington, DC: US Department of Agriculture; 2010.
- Office of Disease Prevention and Health Promotion. Healthy People 2020. Healthy People website. <https://www.healthypeople.gov/>. Updated August 17, 2018. Accessed August 17, 2018.
- Wilson MM, Reedy J, Krebs-Smith SM. American diet quality: Where it is, where it is heading, and what it could be. *J Acad Nutr Diet*. 2016;116(2):302–310.
- Monteiro CA, Cannon G, Moubarac JC, et al. The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing. *Public Health Nutr*. 2018;21(1):5–17.
- Spiteri SA, Olstad DL, Woods JL. Nutritional quality of new food products released into the Australian retail food market in 2015—is the food industry part of the solution? *BMC Public Health*. 2018;18(1):222.
- Mackay S, Vandevijvere S, Lee A. Ten-year trends in the price differential between healthier and less healthy foods in New Zealand [published online ahead of print July 23, 2018]. *Nutr Diet*. <https://doi.org/10.1111/1747-0080.12457>.
- Allemandi L, Castronuovo L, Tiscornia MV, Ponce M, Schoj V. Food advertising on Argentinean television: Are ultra-processed foods in the lead? *Public Health Nutr*. 2018;21(1):238–246.
- Drewnowski A, Rehm CD. Energy intakes of US children and adults by food purchase location and by specific food source. *Nutr J*. 2013;12(1):59.
- Brewster PJ, Durward CM, Hurdle JF, Stoddard GJ, Guenther PM. The Grocery Purchase Quality Index-2016 performs similarly to the Healthy Eating Index-2015 in a national survey of household food purchases. *J Acad Nutr Diet*. In press. <https://doi.org/10.1016/j.jand.2018.08.165>.
- Burggraf C, Teuber R, Brosig S, Meier T. Review of a priori dietary quality indices in relation to their construction criteria. *Nutr Rev*. 2018;76(10):747–764.
- US Department of Health and Human Services and US Department of Agriculture. *Dietary Guidelines for Americans*. 2005. 6th ed. Washington, DC: US Department of Health and Human Services; 2005.
- US Department of Health and Human Services and US Department of Agriculture. *2015–2020 Dietary Guidelines for Americans*. 8th ed. Washington, DC: US Department of Health and Human Services; 2015.
- Reedy J, Krebs-Smith SM, Bosire C. Evaluating the food environment: Application of the Healthy Eating Index-2005. *Am J Prev Med*. 2010;38(5):465–471.
- Miller PE, Reedy J, Kirkpatrick SI, Krebs-Smith SM. The United States food supply is not consistent with dietary guidance: Evidence from an evaluation using the Healthy Eating Index-2010. *J Acad Nutr Diet*. 2015;115(1):95–100.
- Kirkpatrick SI, Reedy J, Kahle LL, Harris JL, Ohri-Vachaspati P, Krebs-Smith SM. Fast-food menu offerings vary in dietary quality, but are consistently poor. *Public Health Nutr*. 2014;17(4):924–931.
- Nanney MS, Grannon KY, Cureton C, et al. Application of the Healthy Eating Index-2010 to the hunger relief system. *Public Health Nutr*. 2016;19(16):2906–2914.
- Guenther PM, Kirkpatrick SI, Reedy J, et al. The Healthy Eating Index-2010 is a valid and reliable measure of diet quality according to the 2010 Dietary Guidelines for Americans. *J Nutr*. 2013;144(3):399–407.
- Reedy J, Lerman J, Tooze JA, et al. Evaluation of the Healthy Eating Index-2015. *J Acad Nutr Diet*. 2018;118(9):1622–1633.
- Poti JM, Dunford EK, Popkin BM. Sodium reduction in US households' packaged food and beverage purchases, 2000 to 2014. *JAMA Intern Med*. 2017;177(7):986–994.
- Hartmann-Boyce J, Bianchi F, Piernas C, et al. Grocery store interventions to change food purchasing behaviors: A systematic review of randomized controlled trials. *Am J Clin Nutr*. 2018;107(6):1004–1016.
- Reedy J, Krebs-Smith SM, Hammond RA, Hennessy E. Advancing the science of dietary patterns research to leverage a complex systems approach. *J Acad Nutr Diet*. 2017;117(7):1019–1022.

**AUTHOR INFORMATION**

S. I. Kirkpatrick is an associate professor, School of Public Health and Health Systems, University of Waterloo, Waterloo, Ontario, Canada.

Address correspondence to: Sharon I. Kirkpatrick, PhD, MHSc, RD, School of Public Health and Health Systems, University of Waterloo, 200 University Ave West, LHN 1713, Waterloo, Ontario, Canada N2L 2G1. E-mail: [sharon.kirkpatrick@uwaterloo.ca](mailto:sharon.kirkpatrick@uwaterloo.ca)

**STATEMENT OF POTENTIAL CONFLICT OF INTEREST**

No potential conflict of interest was reported by the author.

**FUNDING/SUPPORT**

There is no funding to disclose.