Resources for Scale-up

Developing and Validating a Food-Based Global Diet Quality Score

Sabri Bromage, Walter C Willett
Harvard T H Chan School of Public Health, Boston, MA, USA
Megan Deitchler
Intake – Center for Dietary Assessment, Washington, DC, USA

Characterizing the collective contribution of foods to health

In contrast to nutrient profiling models that evaluate the overall nutritional value of individual foods, food-based diet quality metrics attempt to characterize the collective contribution of foods to health. The two approaches are complementary means of providing a quantitative basis upon which to develop programmatic guidance for improving population diets. Below we describe a novel food-based metric of diet quality for global use, and key takeaways of our research to develop and evaluate this metric.

From 2018 to 2020, an international team led by researchers in the Department of Nutrition at Harvard TH Chan School of Public Health, Instituto Nacional de Salud Pública de México, and *Intake* – Center for Dietary Assessment at FHI Solutions set out to develop and validate a global standard metric of diet quality: the Global Diet Quality Score (GDQS). This was done using secondary analyses of data from multiple world regions.

In this research, we aimed to address several prominent gaps in global nutritional surveillance[1,2] – particularly in low- and middle-income countries (LMICs) – by creating a metric that would be simple to collect and analyze, and that would validly describe population diet quality in terms of both nutrient adequacy and diet-related risk of noncommunicable disease (NCD). This metric would allow for robust population-based assessments, comparisons among populations, and tracking of diet quality over time.

> **"This metric would allow robust population-based assessments, comparisons among populations, and tracking of diet quality over time"**

How does the GDQS work?

- The GDQS is a score ranging from 0 to 49 that is assigned to individuals based on their consumption of 25 food groups identified as globally important contributors to nutrient adequacy or risk of NCDs based on current nutrition science and epidemiological literature[3,4] (**Table 1**). Point values are assigned to each food group based on three or four categories of amount of consumption defined in *grams per day*.
- The GDQS includes 16 'healthy' food groups that receive increasing points for *higher* amounts of consumption, seven 'unhealthy' foods that receive increasing points for *lower* consumption, and two food groups – red meat and high-fat dairy – that receive increasing points up until specific consumed amounts, after which no points are given (the scoring approach for red meat and high-fat dairy reflects that these food groups are important contributors to nutrient adequacy in LMICs, while also recognizing that high consumption of these foods is associated with NCD risk).
- GDQS scores ≥ 23 are associated with a low risk of both nutrient inadequacy and NCD risk, scores ≥ 15 and < 23 indicate moderate risk, and scores < 15 indicate high risk.
- The GDQS serves as a summary measure of overall diet quality with respect to both nutrient adequacy and diet-related NCD risk, while two GDQS sub-metrics – the GDQS+, composed of only the 16 healthy GDQS food groups, and the GDQS–, composed of the 9 GDQS food groups classified as unhealthy or unhealthy in excessive amounts – are useful for quantifying the contributions of healthy and unhealthy foods to overall diet quality in a given population.
- While the GDQS is assigned at the level of individuals, these sub-metrics are intended to be used to describe and compare diet quality at the group level.

What is the basis for the GDQS scoring approach?

We identified gram per day cutoffs for scoring the 25 GDQS food groups based primarily on their ability to produce a reasonably even distribution of trichotomous categories of consumed amounts in quantitative 24-hour recall and food-frequency questionnaire data from nonpregnant, nonlactating women in 10 sub-Saharan African countries, China, India, Mexico, and the USA. For high-fat dairy, we added a fourth scoring range to target very high consumption equivalent to roughly 3+ servings per day.

Variation in point values assigned to different consumption amounts was informed by the literature on contributions of different food groups to health, as well as secondary analysis in which we evaluated and statistically compared the performance of 32 metric variants in predicting outcomes related to nutrient adequacy and NCD risk in cross-sectional and cohort data from sub-Saharan Africa, China, India, Mexico, and the USA, and incrementally improved metric performance based on this analysis. In this analysis, we found that using three or four scoring categories per GDQS food group provided a predictive advantage over using two, so we adopted this approach despite the added burden for data collection that it implies.

Further details on design and operationalization of the GDQS are available online.[6]

> **"A single food-based metric can capture outcomes related to both nutrient adequacy and NCD risk in diverse settings"**

Key takeaways from design and evaluation of the GDQS[5]

1. *A single food-based metric can capture outcomes related to both nutrient adequacy and NCD risk in diverse settings, with performance comparable to that of existing metrics intended to capture only one of those domains.*

The GDQS' expanded list of food groups in comparison with those of other food-based metrics (such as the Minimum Dietary Diversity – Women [MDD-W],[7] which includes 10 food groups) captures a broader range of dietary contributors to both nutrient adequacy and NCD risk, and compensates for the predictive advantage that might otherwise be had by including nutrient components in the metric design (as in the Alternative Healthy Eating Index – 2010 [AHEI-2010],[8] which is based on six food groups and five nutrient components).

As part of our secondary analysis evaluating metric performance in different regions, we found the GDQS performed comparably with the MDD-W in predicting anthropometric and biochemical indicators of undernutrition (including underweight, anemia, and serum folate deficiency); and comparably or better than the AHEI-2010 in capturing NCD-related outcomes (including metabolic syndrome, change in weight and waist circumference, and incident type 2 diabetes).

2. *Including both healthy-scoring and unhealthy-scoring food groups improved metric performance in predicting outcomes reflective of **both** nutrient adequacy and NCD risk.*

This finding is explained by the fact that consumption of healthy, nutrient-dense foods has been associated with better metabolic health in epidemiological studies (either directly, or by replacing unhealthy foods in the diet), while lower consumption of unhealthy food groups is also associated with better nutrition status. Consequentially, the GDQS does not differentiate food groups or point values when targeting either category of outcome (use of a single metric design also makes the GDQS simpler to use).

Unlike in the MDD-W, unhealthy foods receive increasing points for *lower* consumption in the GDQS. This somewhat reduces correlations between the GDQS and nutrient intakes because unhealthy foods contain some nutrients. However, inclusion of these foods did not compromise associations with anthropometric and biochemical indicators of undernutrition in the analysis of data from sub-Saharan Africa and India.

> **"A key feature of the GDQS is that it is entirely food-based, which facilitates use of the metric in limited-resource settings"**

Advantages of a food-based approach to measuring diet quality

A key feature of the GDQS is that it is entirely food-based. This facilitates use of the metric in limited-resource settings where data needed to calculate nutrient intakes (including local food composition data, recipes, and food preparation methods) are often inadequate or outdated. The GDQS' food-based design is therefore highly conducive to cross-country comparisons of diet quality.

The GDQS' ease of collection and analysis also allows rapid assessment of population diet quality, for obtaining time-relevant results. Furthermore, because the GDQS describes diet quality in terms of the contributions of healthy and unhealthy food groups, it provides simple and actionable data for improving population diet quality.

Funding statement

Funding for the GDQS research initiative was provided by FHI Solutions, recipient of a Bill & Melinda Gates Foundation grant to support *Intake* – Center for Dietary Assessment.

TABLE 1: GDQS and GDQS sub-metric food groups and scoring[5]

Inclusion in metrics	Scoring classification	Food group	Categories of consumed amounts (g/day)			
			Low	Middle	High	Very high
GDQS and GDQS +	Healthy	Citrus fruits	< 24	24–69	> 69	–
		Deep-orange fruits	< 25	25–123	> 123	–
		Other fruits	< 27	27–107	> 107	–
		Dark-green leafy vegetables	< 13	13–37	> 37	–
		Cruciferous vegetables	< 13	13–36	> 36	–
		Deep-orange vegetables	< 9	9–45	> 45	–
		Other vegetables	< 23	23–114	> 114	–
		Legumes	< 9	9–42	> 42	–
		Deep-orange tubers	< 12	12–63	> 63	–
		Nuts and seeds	< 7	7–13	> 13	–
		Whole grains	< 8	8–13	> 13	–
		Liquid oils	< 2	2–7.5	> 7.5	–
		Fish and shellfish	< 14	14–71	> 71	–
		Poultry and game meat	< 16	16–44	> 44	–
		Low-fat dairy	< 33	33–132	> 132	–
		Eggs	< 6	6–32	> 32	–
GDQS and GDQS –	Unhealthy in excessive amounts	High-fat dairy* (in milk equivalents)	< 35	35–142	> 142–734	> 734
		Red meat	< 9	9–46	> 46	–
	Unhealthy	Processed meat	< 9	9–30	> 30	–
		Refined grains and baked goods	< 7	7–33	> 33	–
		Sweets and ice cream	< 13	13–37	> 37	–
		Sugar-sweetened beverages	< 57	57–180	> 180	–
		Juice	< 36	36–144	> 144	–
		White roots and tubers	< 27	27–107	> 107	–
		Purchased deep-fried foods	< 9	9–45	> 45	–

Source: Table adapted from Table 3 in Bromage S, Batis C, Bhupathiraju SN, Fawzi WW, Fung TT, Li Y, et al. Development and validation of a novel food-based Global Diet Quality Score. Manuscript submitted in February 2021 for publication consideration in a Journal of Nutrition Supplement: 'The Global Diet Quality Score (GDQS): A New Method to Collect and Analyze Population-Based Data on Diet Quality.'

The naming of food group categories as 'healthy,' 'unhealthy,' and 'unhealthy when consumed in excessive amounts' provides a simple method for communicating how the foods in each food group contribute to an overall healthy diet, as reflected in the epidemiological literature and operationalized by the GDQS.

* Hard cheese should be converted to milk equivalents using a conversion factor of 6.1 when calculating total consumption of high-fat dairy for the purpose of assigning a GDQS consumption category. See[6] for details on how to apply this conversion factor appropriately, according to the method used to collect the data.

As a simple metric of diet quality, the GDQS does not intend to capture information related to the consumption of fortified foods. Fortified foods should be classified in the food groups that correspond to the unfortified versions of those foods (e.g., orange juice fortified with calcium should be classified in the juice category; liquid oil fortified with vitamin A should be classified in the liquid oil category).

Points assigned			
Low	Middle	High	Very high
0	1	2	–
0	1	2	–
0	1	2	–
0	2	4	–
0	0.25	0.5	–
0	0.25	0.5	–
0	0.25	0.5	–
0	2	4	–
0	0.25	0.5	–
0	2	4	–
0	1	2	–
0	1	2	–
0	1	2	–
0	1	2	–
0	1	2	–
0	1	2	–
0	1	2	0
0	1	0	
2	1	0	–
2	1	0	–
2	1	0	–
2	1	0	–
2	1	0	–
2	1	0	–
2	1	0	–

Correspondence: Sabri Bromage ScD, MPH,
655 Huntington Avenue, Building II, Boston, MA 02115, USA
Email: sbromage@mail.harvard.edu

References

1 Arimond M, Deitchler M. Measuring Diet Quality for Women of Reproductive Age in Low- and Middle-Income Countries: Towards New Metrics for Changing Diets. Washington, DC: *Intake* – Center for Dietary Assessment/FHI 360; 2019.

2 Miller V, Webb P, Micha R, Mozaffarian D, Global Dietary Database. Defining diet quality: a synthesis of dietary quality metrics and their validity for the double burden of malnutrition. Lancet Planet Health. 2020 Aug 1;4(8):e352–70.

3 Micha R, Shulkin ML, Peñalvo JL, Khatibzadeh S, Singh GM, Rao M, et al. Etiologic effects and optimal intakes of foods and nutrients for risk of cardiovascular diseases and diabetes: Systematic reviews and meta-analyses from the Nutrition and Chronic Diseases Expert Group (NutriCoDE). PLoS One. 2017 Apr 27;12(4):e0175149.

4 Willett W, Rockström J, Loken B, Springmann M, Lang T, Vermeulen S, et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. Lancet. 2019 Feb 2;393(10170):447–92.

5 Bromage S, Batis C, Bhupathiraju SN, Fawzi WW, Fung TT, Li Y, et al. Development and validation of a novel food-based Global Diet Quality Score. Manuscript submitted in February 2021 for publication consideration in a Journal of Nutrition Supplement: 'The Global Diet Quality Score (GDQS): A New Method to Collect and Analyze Population-Based Data on Diet Quality.'

6 *Intake* – Center for Dietary Assessment. The Global Diet Quality Score: Data Collection Options and Tabulation Guidance. Internet: https://www.intake.org/news/global-diet-quality-score-data-collection-options-and-tabulation-guidance (accessed 8 April 2021).

7 Martin-Prevel Y, Allemand P, Wiesmann D, Arimond M, Ballard T, Deitchler M, et al. Moving Forward on Choosing a Standard Operational Indicator of Women's Dietary Diversity. Rome, Italy: Food and Agricultural Organization of the United Nations; 2015.

8 Chiuve SE, Fung TT, Rimm EB, Hu FB, McCullough ML, Wang M, et al. Alternative dietary indices both strongly predict risk of chronic disease. J Nutr. 2012;142:1009–18.

Translating Science.
Nurturing Lives.

sightandlife

Connect with us!

@sightandlife

@sightandlife

sight-and-life

@sightandlife

Translating Science. Nurturing Lives.

sightandlife

Sight and Life uses evidence to change the way nutrition is delivered to people who need it the most.

sightandlife.org