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Commentary

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Public Health Decisions Are Made at the Tails of the Distribution: A Novel Tool to Estimate Usual Intake Distributions from Short-Term Dietary Assessment Methods

Regan L Bailey and Shinyoung Jun

Department of Nutrition Science, Purdue University, West Lafayette, IN, USA

Dietary data are notoriously challenging in a number of ways: difficulty and cost of collection, reliance on self-report, and measurement error, to name just a few (1). To further compound this complexity, researchers and policymakers are interested in "usual" intake, i.e., long-term average or habitual daily intake, for most applications relevant to dietary data, including *1*) nutrition monitoring (e.g., to estimate compliance with recommendations); *2*) nutrition research (e.g., to examine relations between dietary exposures and health outcomes); and *3*) for policy development (e.g., The Dietary Guidelines for Americans) or evaluation (e.g., to examine the effect of food assistance programs over time). The central problem to these goals is that usual intakes are rarely directly observable and, therefore, need to be estimated from self-report, usually through short-term tools like 24-h recall (24HR) or food record or longer-term tools like FFQs. However, all available self-reported dietary assessment methods are prone to random and systematic measurement error (2). The 24HR is currently considered the least biased assessment method, when compared with FFQs, relative to energy, protein, sodium, and potassium (3–5); but the 24HR suffers more from random error (3–6). A primary source of random error in the 24HRs is within-person variation that occurs based on substantial variability in daily consumption patterns (6). Random error does not affect the mean intake estimate of a particular food component for a population, but affects the probabilities in the tails of the distribution because it leads to a larger variance than the true usual intake distribution [**Figure 1**, reproduced from (7)]. Most public health decisions are made at the tails of the distribution; stated differently, they are made to address those who are at potential risk of inadequacy or excess (Figure 1). Therefore, multiple statistical tools have been developed to mitigate random error in order to produce usual intake distributions, as described in detail elsewhere (8, 9). Although these tools and methods are critical to use for estimating usual intake distributions, extraordinary proficiency is needed in terms of statistical programming; for example, to run the National Cancer Institute (NCI) method (10), one should know how to implement and modify multiple macros jointly and troubleshoot SAS codes. This has been a primary challenge in the widespread adoption of the NCI method in the nutrition community, despite it being publicly available and free.

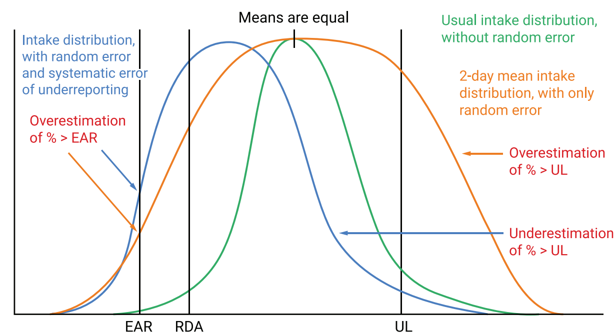

FIGURE 1 Hypothetical distributions of dietary intakes highlighting the impact of measurement error at the tails of the distribution. Reproduced with permission from Bailey et al. (7). EAR, Estimated Average Requirement; UL, Tolerable Upper Intake Level.

Luo et al. (11) have developed a novel, user-friendly, and "all-in-one" macro that can be used to carry out a wide range of analyses. The Simulating Intake of Micronutrients for Policy Learning and Engagement (SIMPLE) macro serves as a connector or interface that directly links to the full NCI macros to greatly reduce the analysts' burden without compromising the quality and accuracy of the results. Furthermore, the SIMPLE macro has the ability to use both the Estimated Average Requirement cut-point approach and the probability approach (i.e., the SIMPLE-iron macro) as well as to utilize the single-day recall data by applying an external variance ratio (i.e., the SIMPLE-1D macro). The SIMPLE macro also includes additional features, such as carrying out checks on the input data sets, incorporating nutrient intake from dietary supplements, and supporting a variety of specific analyses, including modeling nutrition-related interventions (e.g., fortification, supplementation, and breast-feeding support group). In this article, the authors describe 2 examples (1 domestic and 1 international using national survey

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Address correspondence to RLB (e-mail: reganbailey@purdue.edu).
Abbreviations used: NCI, National Cancer Institute; SIMPLE, Simulating Intake of Micronutrients for Policy Learning and Engagement; 24HR, 24-h dietary recall.

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data) of how the SIMPLE macro can be utilized and provide an extensive codebook as Supplemental Material and via the Online Science Framework to help those who wish to use the free tool. Nevertheless, some degree of SAS programming skills is still needed to utilize the SIMPLE macro. The other limitations of the SIMPLE macro are that it does not shorten the computation time for an analytical run; but, it saves the analyst's time that would have been spent on *1*) learning the theory of advanced dietary analysis thoroughly enough to modify the existing NCI macros appropriately, and *2*) modifying several NCI macros and the output data sets for each NCI macro. Furthermore, given that the SIMPLE macro is both user-friendly and free, it can reduce the time and financial commitment needed to train researchers and analysts across all regions, but importantly in low- and middle-income countries where fortification and other nutrition decisions and policies are critical, thereby reducing the disparity in access to high-quality tools to inform such stakeholders.

Simply put, the SIMPLE macro tool is a tremendous advancement in the field of nutrition. Even though dietary assessment tools have measurement error, it does not render them unimportant for research, monitoring, and policy settings. Novel tools like the SIMPLE macro will enable us to address measurement error to the extent possible and increase the number of researchers able to carry out usual intake analysis (1).

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