Steps forward in assessing populations\textsuperscript{1,2}

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The path toward the accurate assessment of dietary intakes and nutritional status of populations has not been smooth. In moving toward this goal, a new probability approach to assess the prevalence of inadequate dietary intakes became available with the release of the original Dietary Reference Intakes (DRIs)\textsuperscript{3} between 1997 and 2006 (1) and the accompanying reports on their uses (2, 3). The DRI approach built on the concept, largely pioneered by the late George Beaton, of defining a distribution of requirements. This was initially proposed by Health and Welfare Canada in 1983 (4), and more detailed methods were developed in a National Research Council report in 1986 (5). Data on the distribution of nutrient requirements allow identification of the median requirement [Estimated Average Requirement (EAR)] and its SD, which in turn can be used to identify a Recommended Dietary Allowance (RDA), an intake that is sufficient to cover 97.5% of the population. In setting the original DRIs, however, data on the requirement distributions were not always available, and in these cases (which included calcium and vitamin D) Adequate Intakes were set instead. The recently released updated DRIs for calcium and vitamin D (6) moved us forward by setting EARs and RDAs for these nutrients, and an article by Taylor et al in this issue of the Journal (7) shows new methodology for assessing the vitamin D status of populations by using serum 25-hydroxyvitamin D [25(OH)D] as a biomarker.

Setting an EAR has important implications for assessing nutrient intakes or status of populations. Provided certain assumptions are met, the prevalence of inadequate intakes can be estimated by the percentage of the population with a usual intake below the EAR (the cutoff, or shortcut, probability approach). This approach has seemed counterintuitive to many nutrition professionals and has resulted in considerable confusion and challenges in its adoption. Some have used the RDA as a cutoff, but this approach clearly overestimates the prevalence of inadequacy. However, the correct use of the EAR cutoff approach has now been adopted by many investigators, including those evaluating national nutrition surveys (8).

The Institute of Medicine report that set new DRI values for calcium and vitamin D (6) represents several steps forward in assessing intakes of these 2 nutrients. Importantly, the committee used serum 25(OH)D as a criterion for vitamin D requirements and set reference measures at 2 levels: the average (the level that would indicate adequate nutrient status for 50% of a population) and a "high end" (the level that would indicate adequate nutrient status for 97.5% of a population). By using this information, the committee replaced the former Adequate Intakes for vitamin D with EARs and RDAs for all age groups except for infants. New data on calcium requirements also led to EARs and RDAs for calcium. Fourteen years after the first report on DRIs for calcium and vitamin D, it is finally possible to estimate the prevalence of inadequate intakes for these nutrients.

Another step forward has been taken by Taylor et al (7), who report that the prevalence of inadequate nutrient status for vitamin D can be estimated as the percentage of the population below the average reference value for serum 25(OH)D, after adjustment of the distribution to remove the effect of intraindividual variation. The authors note that the same theory that is applied to estimating the prevalence of inadequate intakes (by using the EAR) can be applied to estimating the prevalence of inadequate serum values (by using the average reference value, not the "high end" value). After examining each of the assumptions of the cutoff probability approach, they conclude that all are met and that it is valid to use this methodology to estimate vitamin D inadequacy in a population. Because factors other than intake, such as sun exposure, can have a major impact on vitamin D status, estimating inadequacy by using a biomarker has considerable appeal. A similar approach for iodine was recently proposed (9). These authors showed the use of the EAR cutoff approach for urine iodine concentrations and, in particular, the importance of adjusting for intraindividual variation in this biomarker.

An issue for vitamin D is the use of the same biomarker as a measure of both exposure (from the combination of oral intake and sunlight) and effect (ie, biological function or functions related to nutrient requirements). Although total serum 25(OH)D is considered to be the best available indicator of vitamin D exposure, emerging evidence suggests that at least some biological functions may be more closely linked to "bioavailable" 25(OH)D, and that variability exists in the proportions of these 2 measures (10). Research is needed that can lead to a better understanding of the validity of 25(OH)D as a biomarker of effect.

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\textsuperscript{3}Abbreviations used: DRI, Dietary Reference Intake; EAR, Estimated Average Requirement; RDA, Recommended Dietary Allowance; 25(OH)D, 25-hydroxyvitamin D.

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Despite these questions, the goal is ultimately to implement an intervention to address an undesirably high prevalence of inadequacy in a population. For vitamin D, this might take several forms, including increasing intakes from food or from supplements as well as increasing sun exposure. The prevalence of inadequacy is estimated to be an undesirably high 19% on the basis of the serum biomarker (6, 7). The cutoff approach can also be used to estimate how much serum values would need to shift to obtain a prevalence of only 3–5%. From the article, it appears that the fifth percentile of serum 25(OH)D is ~25 nmol/L. To shift this percentile to the Average Reference Value of 40 nmol/L would require an increase of 15 nmol/L. What interventions are likely to shift the distribution by this sizable amount? This is an urgent question that calls for further study.

Planning an intervention solely on the basis of the prevalence of inadequacy that is estimated from dietary intakes (~71%) would not be appropriate in the case of vitamin D, because intake is not usually the primary determinant of vitamin D status. Clearly, we are considerably further down the path than we were in 1997 when the first DRI report was issued. Both the new vitamin D report and the recent description of a methodology for using a serum biomarker represent some of the many steps forward that are needed to fully implement the new DRI paradigm.

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REFERENCES