9

Research Recommended to Improve the Uses of Dietary Reference Intakes

This report has attempted to provide the necessary information to users of the Dietary Reference Intakes (DRIs) for assessing the intakes of groups and individuals. Readers of the report may notice, however, that at various points only very general guidelines are provided. It is clear that much research is still needed in this area. In this last chapter, therefore, areas are listed in which research results are either unavailable or inconclusive. By highlighting these topics, it is hoped that research on these topics will be undertaken. The topics are not necessarily in order of priority; increased knowledge in any of the areas listed below would be of benefit to those who wish to use the DRIs for dietary assessment.

RESEARCH TO IMPROVE ESTIMATES OF NUTRIENT REQUIREMENTS

Even for nutrients for which an Estimated Average Requirement (EAR) is available, requirement data on which the EAR is based are typically very scarce. Estimated EARs and Recommended Dietary Allowances (RDAs) are often based on just a few experiments or studies with very small sample sizes, and therefore considerable uncertainty exists about the true median and standard deviation of the distribution of requirements within a group. Additional research is needed in this area to:

- improve existing estimates of the EAR and RDA;
- provide better information on requirements so it becomes pos-

sible to establish an EAR (and an RDA) for nutrients for which information is currently insufficient; and

- improve estimates of the distribution of requirements so that the appropriate method for assessing the prevalence of inadequacy for groups can be determined (cut-point method vs. probability approach).

For nutrients currently with an Adequate Intake (AI) (for age groups older than infants), research that allows replacement of the AIs with EARs will allow for additional applications. As discussed in earlier chapters, EARs present more possibilities for assessing individual and group prevalence of inadequacy. Whenever the data permit, EARs rather than AIs should be established.

Although there is need to improve the database of controlled experimental studies relevant to the EAR, there is even greater need to broaden the approach to estimating requirements. Congruence of evidence should be expected from different sources—including epidemiological and clinical investigations as well as experimental and factorial approaches—before being confident with an EAR. What is needed now is action in this direction and both financial and peer support for such approaches.

Establishment of Tolerable Upper Intake Levels (ULs) provides an opportunity to evaluate the risk of adverse effects for individuals and populations, and is an extremely important step forward in assessing intakes. Research should be undertaken to allow ULs to be set for all nutrients. In addition, information on the distribution of the UL (i.e., risk curves) would allow greatly expanded applications of the UL, particularly for population groups. More information is needed on ways to identify and conceptualize the risk of exceeding the UL.

Research on the factors that can alter requirements or upper limits is also needed to enable more accurate applications of the Dietary Reference Intakes (DRIs) to specific individuals and populations. Adjustment factors for considerations such as body size, physical activity, and intakes of energy and other nutrients may be appropriate but are often unknown.

RESEARCH TO IMPROVE THE QUALITY OF DIETARY INTAKE DATA

Much has been written about ways to improve the quality of the intake data on which assessments are based; a number of these issues

were discussed in Chapter 8. Some of these topics are revisited now and specific areas in which research is still needed are identified.

Perhaps one of the most important advances to improve application of human nutrient requirement estimates has been the further development and refinement of statistical procedures to reduce if not eliminate the distorting effect of random error in dietary data. What has become apparent in dealing with the random error is that the remaining issue of paramount importance in dietary data collection and analysis is the presence and true extent of bias (such as under- or over-reporting of food intake). The same amount of effort that went into determining statistical approaches for estimation and reduction of the effect of random error should be directed toward the estimation and amelioration of bias. This is a relatively unexplored field. Methods for directly estimating bias regarding energy intake have been developed and used to demonstrate that the problem is serious. Efforts have begun in the management of bias during data analysis but these are far from satisfactory at present. The handling of bias is seen as a very high-priority area awaiting new initiatives and innovative approaches.

Another area of need is behavioral research to determine why people under-report food intake. Advances in this area would allow development of improved dietary data collection tools that would not trigger this behavior. Such information would also help in the derivation of statistical tools to correct the bias associated with this phenomenon.

Better ways to quantify the intake of supplements are needed. Methods for collecting accurate supplement intake data have not been widely investigated. For the Third National Health and Nutrition Examination Survey, different instruments were used to collect food intake data and supplement intake data, and the correct methodology for combining these data is uncertain. Furthermore, the intake distribution from supplements usually cannot be adjusted because the current data do not permit the estimation of the day-to-day variability in supplement intake. Despite the difficulties in maintaining a supplement composition database for the rapidly changing market, investigation of better methods of quantifying supplement intakes is a high-priority research area.

Food composition databases need to be updated to include the forms and units that are specified by Dietary Reference Intakes (DRIs). Chemical methodology to facilitate analysis of various forms of certain nutrients (e.g., α- vs. γ-tocopherol) may be required. The DRI recommendations also imply that databases need to separate nutrients inherent in foods from those provided by fortification,

particularly when intakes are compared with the Tolerable Upper Intake Level (UL) for nutrients such as niacin. For some nutrients, it may also be necessary to change the units of measurement (e.g., dietary folate equivalents [DFEs], as suggested for folate [IOM, 1998b] and the milligrams of α-tocopherol, suggested for vitamin E in place of α-tocopherol equivalents [IOM, 2000]).

RESEARCH TO IMPROVE STATISTICAL METHODS FOR USING THE DRIs TO ASSESS INTAKES OF INDIVIDUALS

Chapter 3 and Appendix B present an approach to assess the adequacy of an individual's usual intake of nutrients with an Estimated Average Requirement (EAR) or with an Adequate Intake (AI). The following two serious limitations in the application of the method were identified:

- Currently there is not sufficient information to permit calculation of the standard deviation (*SD*) of daily intake for each individual. It is well known that the *SD* of daily intake is typically heterogeneous across individuals; however, no research has been conducted to allow the adjustment of a pooled *SD* estimate to better reflect an individual's daily variability in intakes.
- The approach for testing whether usual intake is greater than requirements (or greater than the AI or less than the Tolerable Upper Intake Level [UL]) makes the critical assumption that daily intakes for an individual are normally distributed. No alternative methodology exists for the many instances in which this assumption is untenable. Research is needed to devise methods for quantitatively assessing individual intakes when the distribution of daily intakes is not symmetrical around the individual's usual intake.

RESEARCH TO IMPROVE STATISTICAL METHODS FOR USING THE DRIs TO ASSESS INTAKES OF GROUPS

The assessment of dietary intake data for groups is challenging because these analyses (presented earlier in this report) do not lend themselves to standard statistical methods. Several methodological issues deserve attention from the scientific community.

Methods for developing standard deviations for prevalence estimates (sometimes referred to as the standard error of the estimate) should be investigated. As discussed in Chapter 8, estimates of the prevalence of inadequacy are not precise because of the uncertainty existing both in requirement estimates and in intake assessments.

When the standard deviation of the prevalence estimate is not known, formal inferences cannot be made about the prevalence of nutrient inadequacy in a group; for example, one cannot determine whether a prevalence estimate differs from zero, or whether prevalence estimates in two groups are different. The statistical approaches included in this report can be used to partially estimate the standard deviation of a prevalence estimate, but these approaches account only for the uncertainty in the estimates of usual intakes in the group.

Uncertainty also exists in requirement estimates. Although the Estimated Average Requirement (EAR) is a fixed and known quantity, based on data reported in the scientific literature, it is also an estimate of an unobservable median requirement for a group. Statistical methods for estimating the standard deviation of the EAR and the standard deviation of the usual intake distribution are, in principle, available. More difficult from a statistical point of view is combining the two sources of uncertainty into an estimate of the standard deviation for the prevalence of nutrient inadequacy.

Research is needed on ways to better match the biomarkers used to set requirements with the effect of dietary intake on those same biomarkers. Research is also needed on the appropriate biochemical data to collect so that these data can be combined with dietary intake data in assessment. Biomarker and other biochemical data are usually too expensive, time-consuming, or both, to collect on large numbers of individuals. However, when this information is available, it can be used in combination with intake data to give a more accurate estimate of the probability of inadequacy. Because biomarker and intake data are very different proxies for the same unobservable variable (nutrient status), combining the information they provide into an estimate of nutritional status for each individual in a group is a challenging statistical task.

Additional research is also needed for applications that assess the nutrient intakes of different subgroups of the population. In particular, evaluations of nutrition assistance programs typically compare nutrient intakes for program participants and a similar group of nonparticipants. A difficult and not fully explored research question is how to estimate differences in the prevalence of inadequacy between subgroups, after controlling for other factors that also affect nutrient intake. Chapter 7 describes a possible approach to addressing this question based on multiple regression analysis, but research is needed to apply this approach to existing survey data sets such as the Continuing Survey of Food Intakes by Individuals and the National Health and Nutrition Examination Surveys.

Ways to assess the performance of methods used to estimate the prevalence of inadequacy should be investigated. Both the probability approach and the cut-point method assume that intakes and requirements are not correlated or exhibit only low correlation. In addition, the cut-point method requires that the distribution of requirements in the population is approximately symmetrical and that the variability of intakes is larger than the variability of requirements. The results presented in Appendix D (that assess the performance of the EAR cut-point method for estimating the prevalence of inadequate intakes) are from simulation studies that should be considered preliminary. A detailed investigation of the effect of violating these assumptions was beyond the scope of this report, but is a high research priority. This investigation would best be done using well-designed, well-planned, and well-implemented simulation studies. This type of study would permit recommendations to be made regarding the best approach for assessing each nutrient and would provide an estimate of the expected bias in prevalence estimates when the conditions for application of the cut-point method are not ideal.

Many of the statistical approaches suggested in this report for adjusting intake distributions and estimating the prevalence of inadequacy for groups can only be implemented with the aid of computer software. Although initial efforts have been made to develop these types of programs, a wider variety of software that can assist users of the Dietary Reference Intakes (DRIs) in correctly applying the methods recommended in this report is needed. There is also a need to upgrade the software used in dietary assessment to incorporate the appropriate statistical methodology described in this report.