Review Article

Using DRIs for dietary assessment

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Nutrient standards such as the Dietary Reference Intakes (DRIs) may be used to assess diets of both individuals and of population groups. The goal is to estimate the *probability* of dietary adequacy (or inadequacy) for an individual and the *prevalence* of dietary adequacy for a group. The DRI that is needed to estimate the probability of dietary adequacy is the estimated *average* requirement for a nutrient (EAR), as well as an estimate of the *standard deviation* of the requirement. The probability of adequacy for an individual should be based on usual long-term intake, because the DRIs apply to a person's usual intake, rather than to intake on only a few days. Due to day-to-day variation in intakes, it is usually necessary to record or observe a person's intake for a large number of days. For population groups, the prevalence of adequacy can be calculated as the average of each person's probability of adequacy, and should correspond to the proportion of the population with nutrient intakes exceeding nutrient needs. A short-cut method to estimating the prevalence of adequacy simply calculates the proportion of intakes that are above the EAR. It is not necessary to have usual long-term intake for each person in the group, but a statistical procedure must be used to remove the effect of day-to-day variation from the intake distribution before the prevalence of adequacy within a group is estimated. With the new DRIs, a more informative assessment of both individual and group intakes is possible.

Key Words: nutrient standards, dietary assessment, Dietary Reference Intakes, usual intake

INTRODUCTION

Nutrient standards have been set by many countries for use in planning and assessing dietary nutrient intakes. For the US and Canada, the current nutrient standards are the Dietary Reference Intakes (DRIs). They were set by panels convened by the Institute of Medicine between 1997 and 2005. A summary report on the DRIs is now available.[1] A subcommittee on the uses and interpretation of the DRIs made more detailed recommendations on how to correctly use the new DRIs to assess intakes.[2] Papers that describe the process of assessing nutrient intakes with the DRIs have also been published in nutrition journals.[3,4]

Nutrient standards such as the DRIs are frequently used to assess the intakes of individuals, and also of groups of people. Because the new nutrient standards usually specify an Estimated Average Requirement (EAR), and an estimate of its standard deviation, a *distribution* of requirements is available (Figure 1). Using simple statistical calculations, the *probability* that a given intake is adequate can be estimated by examining where the intake is located on this distribution of requirements. If it is near the upper tail of the distribution, then the intake has a high probability of being adequate. If it is near the lower tail of the distribution, then the probability of adequacy is low. This ability to calculate a probability of adequacy has made it possible to more accurately evaluate dietary intake data.

Dietary assessment can also be improved if the nutrient standards include an estimate of an upper level that may increase the risk of intake being excessive. For the DRIs, this nutrient standard is the Tolerable Upper Intake Level (UL).

The Recommended Dietary Allowance (RDA) is another nutrient standard. It is defined as the EAR plus two standard deviations (Fig 1). Intake at the RDA should be adequate for almost all individuals (97-98%). However, the RDA is not very useful for assessing the actual probability of adequacy, because an intake below the RDA may still be adequate for many people. Thus, it is more informative to calculate the probability of adequacy for a specific intake, rather than simply stating that intake is above (or below) the RDA.

Estimating the probability of dietary nutrient adequacy for an individual person

The actual calculation of the probability of adequacy is easily done with a calculator or a computer program. If the nutrient requirements are normally distributed (as is usually assumed to be the case), then the probability of adequacy is simply the area under the requirements curve that is to the left of the intake level. For example, intake at the EAR has a 50% probability of adequacy, while intake at the RDA has a 97.5% probability of adequacy. The probability of *in*adequacy can also be calculated, and is just 100 minus the probability of adequacy. For example, intake at the RDA has a 2.5% probability of inadequacy.

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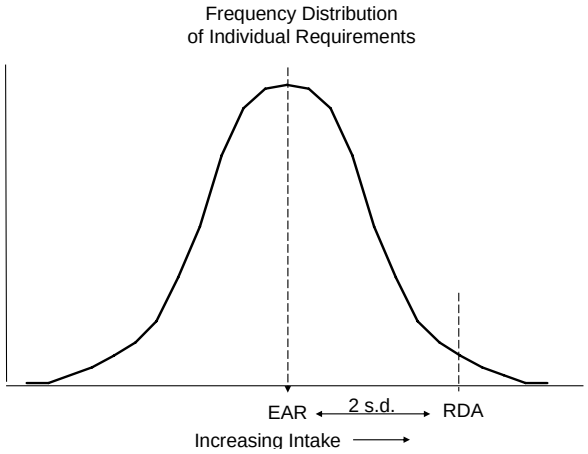

Figure 1. Distribution of nutrient requirements with mean = estimated average requirement (EAR).

Assessing usual intake. Nutrient standards apply to usual intake, not to intake on just one day, or a small number of days. Nutrient intake can vary significantly from day to day, such that intake over many days must be collected in order to measure usual intake. Assessing an individual's usual intake is difficult because it is time-consuming and burdensome to determine a person's usual long-term diet. The number of days that are sufficient depends on the nutrient of interest. For example, some nutrients do not very substantially from day to day (such as protein intake), while others have large day to day variations, primarily because they are found in relatively few foods (such as vitamin B12 which is found only in animal products).

Assumption of the probability calculation. The probability of adequacy can only be estimated if intake is independent of requirement. Therefore, this approach cannot be used to evaluate energy intakes, because energy intake is highly correlated to energy requirements.

Alternatives to the probability approach. Because it is so difficult to capture true usual intake, it may be desirable to assess an individual's intake more qualitatively.[2] For example, the following evaluation might be made:

- Intakes below the EAR very likely need to be improved.
- Intakes between the EAR and RDA probably need to be improved.
- Intakes above the RDA are probably adequate if they have been observed on several days.

Another approach that is often used in dietary counselling is to compare intakes to food-based dietary guidelines (FBDGs), rather than to nutrient standards. For example, the number of servings of vegetables might be compared to the FBDG's for a country or region.

Evaluating the prevalence of nutrient inadequacy for a group of people

For groups, it is more common to estimate the prevalence of inadequacy, rather than the prevalence of adequacy. Conceptually, a group can be viewed as a collection of individuals. If the probability of inadequacy is calculated for each individual in the group, then the average probability of inadequacy is equal to the prevalence of inadequacy within the group. The estimate of the prevalence of inadequacy should agree with the prevalence of the condition that was used to set the EAR. For example, if the EAR for vitamin A was set to prevent night blindness, then the prevalence of dietary vitamin A inadequacy should correspond to the prevalence of night blindness in the population group (assuming that the intake data are accurate, and that inadequate vitamin A intake is the primary factor causing night blindness).

The EAR cutpoint approach. The prevalence of inadequacy within a group can also be estimated as the proportion of the group with intakes below the EAR. For many assessment applications for groups, this is a much easier approach than calculating the probability of inadequacy for each individual and then taking the average. The cutpoint approach is an approximation that depends on several statistical assumptions (see next section). The EAR cannot be used to screen for individuals with a high probability of inadequacy, because intake at the EAR has a 50% probability of adequacy, and the goal of screening typically is to identify individuals at very high risk (perhaps only 5-10% probability of adequacy).

Assumptions for the EAR cutpoint method. As was the case for calculating the probability of adequacy for individuals, a prevalence of adequacy can only be calculated for groups if intake is independent of the requirement for a nutrient. In additional, the cutpoint method requires that the distribution of requirements is symmetrical around the EAR (which is thought to be true for most nutrients, although not for iron), and that the variance of intakes within the group is greater than the variance of requirements (which is true for most groups, unless the diets are very monotonous).

Adjusting the intake distributions for a group. Day to day variation in intakes is a concern when assessing group intakes, as it was when assessing individual intakes. However, for groups, a statistical method may be used to remove the effect of day to day variation from the intake distribution, even if only one day of data is available for most of the group. If a second day of dietary data is available for at least a representative subsample of the

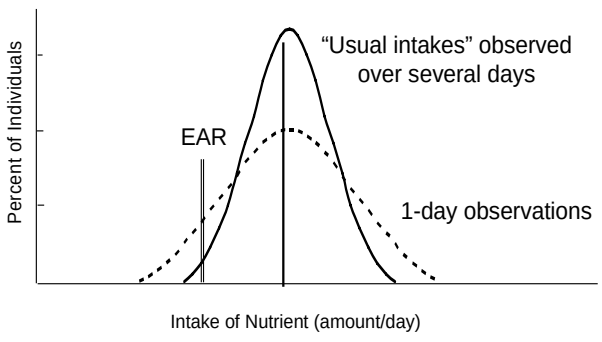

Figure 2. Hypothetical distribution of one-day intakes of a group of people compared to usual intakes observed over several days.

Table 1. Example of an assessment of zinc intakes from a US national dietary survey[†]

	Mean Intake (Mg/d)	Percent less than the EAR[‡]
Males		
9-13 years	13	<3
14-18	15.1	4
19-30	14.5	6
31-50	15.1	4
51-70	13.2	20
> 70	12	30
Females		
9-13 years	9.8	10
14-18	9.5	26
19-30	10.3	13
31-50	10	11
51-70	9.4	18
> 70	8.2	36

[†] Data from reference 6. [‡] Calculated after adjusting the intake distribution to remove the effect of day to day variation in intakes. Zinc EAR = 7.0 mg/d for adolescents 9-13 years old, 7.3 – 8.5 mg/d for adolescents 14-18 years old, 9.4 mg/d for adult men, and 6.8 for women; from reference 1.

group, then it is possible to calculate the day to day variation in intake for each nutrient. This variation estimate may then be used to adjust the distribution of one day intakes so that it better reflects a usual intake distribution. As shown in Figure 2, the adjusted distribution is narrower, because there are fewer intakes in the tails of the distribution. Computer software is available to help with this adjustment process.[5]

An example of assessing intakes for a group in the United States. The EAR cutpoint approach has been used to evaluate nutrient intakes reported during a nationwide dietary survey in the US.[6] For each nutrient, the estimated prevalence of inadequacy was calculated for several different age groups, after adjusting the intake distributions for day to day variation. The results for zinc for adolescents and adults are shown in Table 1. The prevalence of inadequacy was particularly high (over 18%) for older adults and for adolescent girls 14-18 years old. These groups might be targeted for educational interventions to increase the consumption of zinc-rich foods.

Using the UL to assess the possible risk of excessive intake

For an individual, usual intake above the UL may incur a risk of adverse effects from excessive nutrient intake. For example, intake above the vitamin C UL of 2000 mg/d is associated with a risk of osmotic diarrhea. An individual with usual intake above 2000 mg/d (probably from dietary supplements) might be counselled to consume less.

For a group of people, the prevalence of intakes above the UL can be calculated. If the prevalence is high (perhaps over 5%), then it may be desirable to consider interventions to target those people with potentially excessive intakes. As discussed above, the prevalence of potentially excessive intakes should be determined after the effect of day to day variation has been removed from the intake distribution. The ULs are meant to apply only to usual intakes, not to short-term intakes.

SUMMARY

New nutrient standards that specify a mean requirement, such as the EAR, can be used to estimate the probability of nutrient adequacy for an individual's usual intake, and the prevalence of nutrient adequacy for a group. This approach to assessing dietary nutrient intakes is more informative than former methods which relied on the RDA.

AUTHOR DISCLOSURES

Suzanne P Murphy, no conflicts of interest.

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