Inadequacy of specific micronutrient intake

Overview

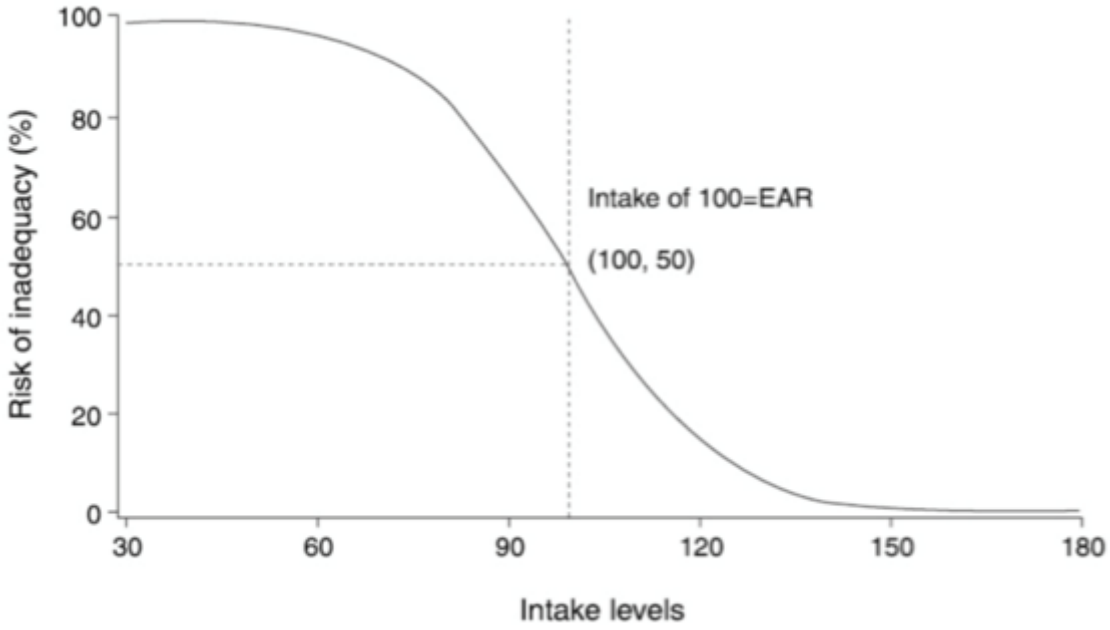
The inadequacy of micronutrient intake is an indicator that estimates the percent of a given population that is at risk of inadequate intake for a specific micronutrient. Two methods can be used to assess inadequacy: Estimated Average Requirement (EAR) fixed cut-point method, or the probability method. Both methods require nutrient intake data for a population that has been adjusted to represent the distribution of "usual" nutrient intakes. Micronutrients are of particular nutritional importance because malnutrition due to micronutrient deficiency continues to be a widespread problem in poor and developing countries. Micronutrients, such as iron, iodine, vitamin A, and zinc, are essential not just for infants and children to ensure proper growth and development, but are also necessary for adults for continued work productivity, healthy pregnancies, and overall cognitive and physical health (Muller & Krawinkel, 2005 [1]). It is important to note that the EAR fixed cut-point method cannot be used for iron in the case of menstruating women and young children due to a highly skewed requirement distribution as a result of increased iron needs. The other indicators that interpret individual intake data in the Data4Diets platform include Mean Adequacy Ratio [2](MAR), total individual micronutrient intake [3], total individual macronutrient intake [4], and total individual energy intake [5].

Method of Construction

Both methods of calculating this indicator require nutrient intake data for a population that has been adjusted to represent the distribution of "usual" nutrient intakes. The data used to estimate this distribution are collected using quantitative dietary assessment techniques, such as repeated 24-hour dietary recalls or multiple-day weighed food records, which are then translated into nutrient intakes using national or regional Food Composition Tables. To provide accurate estimates of the percent of a population at risk of inadequate intake, repeated intakes (either 24-hour Dietary Recall [6] or Weighed Food Records [7]) are required on at least a sub-sample of the population, in order to account for day-to-day variation.

The EAR fixed cut-point approach plots the EAR value onto the distribution of "usual" nutrient intakes to establish a cut-point, and calculates the percent of intakes that fall below that point to estimate the percent of the population at risk of inadequate intakes. The EAR for a nutrient is its estimated average requirement for a population (i.e. 50% of the population will have a requirement >EAR and 50% will have a requirement <EAR in relation to their usual nutrient intakes). See Figure 1 below for a visual representation of this method:

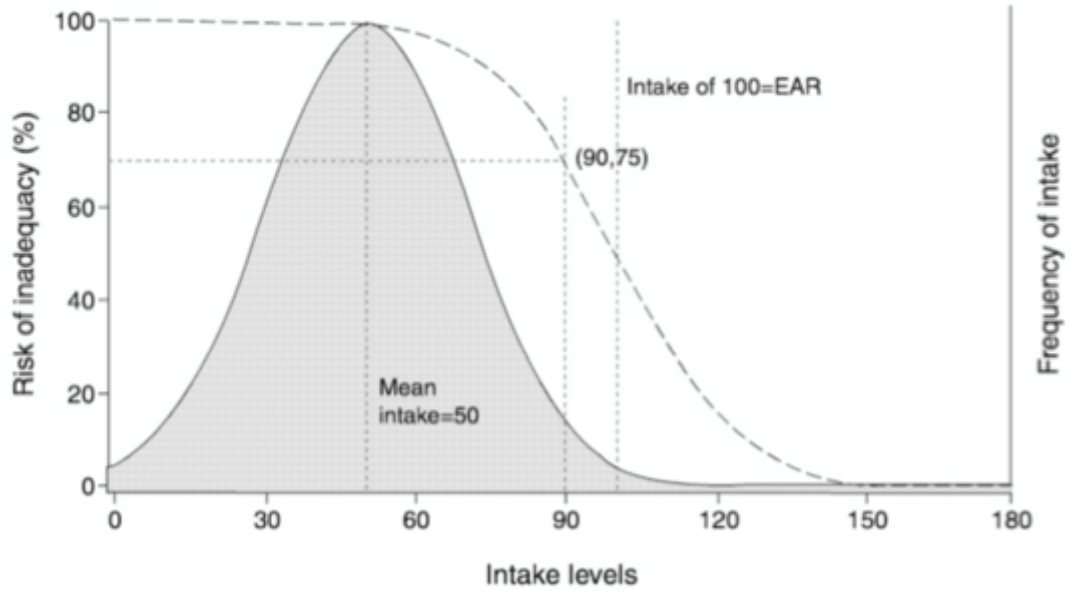
Figure 1



Source: Institute of Medicine, (2000). "Dietary Reference Intakes: Applications in Dietary Assessment." [8]

The probability approach uses intake data from the study population to construct a distribution of intakes for that population, and uses this distribution of intakes along with the distribution of "usual" requirements to estimate the percent at risk of inadequate intakes in the population. See Figure 2 below for a visual representation of this method:

Figure 2



Source: Institute of Medicine, (2000). "Dietary Reference Intakes: Applications in Dietary Assessment." [8]

The probability of inadequacy can be manually calculated as a weighted average of the risk of inadequacy at each potential level of intake. To perform this calculation, the requirement distribution is divided into categories based on gender and age, and the number of people from the population with nutrient intakes falling into each category is determined and multiplied by the probability of inadequacy for that category. These values are summed across all categories and then divided by the total population and multiplied by 100 to estimate the percent at risk of inadequate intake in the population.

For an explanation of situations in which the cut-off method can be used, refer to Box 4-2 in the Dietary Reference Intakes (DRI) document (Institute of Medicine [IOM], 2000 [9]). For a list of nutrients for which the probability approach

can be used, refer to Table 4-1 in the same document (IOM, 2000 [9]).

For more detail on using both the probability and cut-point methods for estimating inadequacy, refer to Chapter 4 of the DRI document (IOM, 2000 [9]). To read about DRIs and their appropriate uses, refer to the following paper published in *Public Health Nutrition* (Murphy & Poos, 2002 [10]).

Uses

This indicator is used to estimate the percent of a given population that is at risk of inadequate intakes of individual nutrients, so it can be used to identify the need for nutrient-specific interventions such as fortification or supplementation.

Strengths and Weaknesses

The main strength of this method is that it provides an estimate of the percent of a population that is at risk of inadequate intake of specific nutrients. Although this indicator does not provide a measure of overall dietary adequacy in a single index, it does provide a measure of overall dietary adequacy when the percent at risk of inadequate intakes is calculated for multiple nutrients separately. A weakness, however, is that this indicator requires an EAR, which is unknown for certain nutrients, and is unknown for most nutrients during infancy. In addition, the DRIs for many nutrients, such as iron and zinc, vary depending on the assumed absorption, which can differ depending on the type of food consumed. Therefore, this indicator (and any others that rely on nutrient requirements) can only estimate the risk of inadequate nutrient intake, rather than confirming deficiency. Although this indicator uses individual-level dietary data, it can only be used to estimate risk of inadequate intake at the population level, and cannot be used to identify individuals who are deficient or at risk of inadequacy (Yates et al., 1998 [11]).

Data Source

The data used to estimate the "usual" distribution of intakes for a nutrient are collected using quantitative dietary assessment techniques, such as repeated 24-hour Dietary Recalls [6], multiple-day Weighed Food Records [7], or quantitative Food Frequency Questionnaires [12], which are then translated into nutrient intakes using national or regional Food Composition Tables. As noted above, repeated intakes are required on at least a sub-sample of the population.

The Food and Agriculture Organization/World Health Organization Global Individual Food consumption data Tool [13] (FAO/WHO GIFT [13]) is a source for individual-level quantitative dietary data. The FAO/WHO GIFT aims to make publicly available existing quantitative individual food consumption data from countries all over the world. Food Composition Tables can be found at FAO's International Network of Food Data Systems (INFOODS [14]) or the International Life Science Institute's (ILSI) World Nutrient Databases for Dietary Studies (WNDDS [15]). EARs can be obtained from the Institute of Medicine (IOM, 2006 [16]), or other country-specific national sources.

Links to guidelines

- National Research Council, (1986). "Chapter 5: The probability approach in nutrient adequacy: Assessment using food consumption surveys" [17]
- IOM, (2006). "Dietary Reference Intakes: The essential guide to nutrient requirements" [18]
- IOM, (2000). "Dietary Reference Intakes: Applications in dietary assessment" [9]

Links to validation studies

- Murphy and Poos, (2002). "Dietary Reference Intakes: Summary of applications in dietary assessment" [10]

Links to illustrative analyses

- Bermudez et al., (2012). "Estimating micronutrient intakes from household consumption and expenditure surveys (HCES): An example from Bangladesh" [19]
- Barbosa et al., (2014). "A study of the prevalence of adequacy of iron and vitamin c in children?s diets" [20]

Expert review conducted by:

- Dr. Elaine Ferguson, Associate Professor, London School of Hygiene & Tropical Medicine (LSHTM)

Food Security Dimensions

- Quality [22]

Data Collection Levels

- Individual [23]

Data Sources and Methods

- 24-Hour Dietary Recall (24HR)
- Weighed Food Record (WFR)
- Food Frequency Questionnaire (FFQ)
- Food Composition Databases

Requires Food Composition Database

- Yes [24]

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