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Using the Adequate Intake for Nutrient Assessment of Groups

This chapter briefly describes the inherent limitations of the Adequate Intake (AI) as a Dietary Reference Intake, and its limited application in assessing nutrient adequacy of groups.

DERIVATIONS OF THE AI

How is the Adequate Intake (AI) defined?

The AI is a recommended average daily nutrient intake level, based on experimentally derived intake levels or approximations of observed mean nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate.

An AI is established when there is insufficient scientific evidence to determine an Estimated Average Requirement (EAR). In the judgment of the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes, the AI is expected to meet or exceed the amount needed to maintain a defined nutritional state or criterion of adequacy in essentially all members of a specific apparently healthy population. Examples of defined nutritional states include normal growth, maintenance of normal circulating nutrient values, or other aspects of nutritional well-being or general health. The AI is developed as a guide for individuals about an appropriate level of intake for nutrients for which data are insufficient to establish a requirement.

When the AI is based on observed mean intakes of population groups, it is likely to always exceed the average requirement that would have been experimentally determined.

In the Dietary Reference Intake (DRI) nutrient reports (IOM, 1997, 1998b, 2000), the AI has been estimated in a number of different ways (see Appendix F). Because of this, the exact meanings and interpretations differ. In some cases, the AI was based on the observed mean intakes of groups or subpopulations that are maintaining health and nutritional status consistent with an apparent low incidence of inadequacy. In other cases, the AI was derived from the lowest level of intake at which all subjects in an experimental study met the criterion of adequacy; this is different from (and generally lower than) the group mean intake that is consistent with all subjects meeting the criterion of adequacy. The AI was sometimes estimated as an approximation of intake in a group with knowledge of actual requirements of only a few individuals.

The methods of derivation of the AI may differ substantially among nutrients and among life stage groups for the same nutrients; it follows that interpretation and appropriate use of the AI must differ also. In Table 5-1, AIs that represent estimates of desirable group mean intakes are identified. Note that the indicators of adequacy are not always indicators of a classical nutrient deficiency state; in some cases they also include factors that may be directed to decreasing risk of chronic, degenerative diseases. Following, and shown in detail in Appendix F, are some examples of nutrients with an AI and the basis for their derivation:

- Calcium: For infants the AI is a direct estimate of a suitable intake based on average content of human milk for an assumed volume of intake. For adolescents and adults the AI is an approximation of the calcium intake that would be sufficient to maintain desirable rates of calcium retention, as determined from balance studies, factorial estimates of requirements, and limited information on bone mineral content and bone mineral density (IOM, 1997).
- Vitamin D: The AI is a value that appears to be needed to maintain—in a defined group with limited, but uncertain, sun exposure and stores—serum 25-hydroxyvitamin D above the concentration below which vitamin D deficiency rickets or osteomalacia occurs. This concentration is rounded to the nearest 50 IU and then doubled as a safety factor to cover the needs of all people regardless of sun exposure.
- Fluoride: For infants the AI is based on reported group mean intakes; for children and adults the AI is based on factorial esti-

TABLE 5-1 Nutrients with Adequate Intakes (AIs)

Nutrient	Life Stage Group	Group Mean Intake?[a]
Calcium	0–12 mo	Yes
	1–18 y	No
	19–50 y	No
	>51 y	No
	Pregnancy and lactation (all ages)	No
Fluoride	0–12 mo	Yes
	1–18 y	Yes
	19–50 y	Yes
	>51 y	Yes
	Pregnancy and lactation (all ages)	Yes
Magnesium	0–12 mo	Yes
Phosphorus	0–12 mo	Yes
Selenium	0–12 mo	Yes
Biotin	0–12 mo	Yes
	1–18 y	No
	19–50 y	No
	>51 y	No
	Pregnancy and lactation (all ages)	No
Choline	0–12 mo	Yes
	1–18 y	No
	19–50 y	No
	>51 y	No
	Pregnancy and lactation (all ages)	No
Folate	0–12 mo	Yes
Niacin	0–12 mo	Yes
Pantothenic Acid	0–12 mo	Yes
	1–18 y	Yes
	19–50 y	Yes
	>51 y	Yes
	Pregnancy (all ages)	Yes
	Lactation (all ages)	No
Riboflavin	0–12 mo	Yes
Thiamin	0–12 mo	Yes
Vitamin B_6	0–12 mo	Yes
Vitamin B_{12}	0–12 mo	Yes
Vitamin C	0–12 mo	Yes
Vitamin D	0–12 mo	No
	1–18 y	No
	19–50 y	No
	>51 y	No
	Pregnancy and lactation (all ages)	No
Vitamin E	0–12 mo	Yes

[a] See Appendix F for details

mates of suitable group mean intakes. The criterion of adequacy was an intake that would be associated with low occurrence of dental caries.

- Choline: The AI is based on a single experiment in adult men. Choline's potential role in reducing chronic disease risk was considered in developing its AI.
- Biotin: For infants exclusively fed human milk, the AI is based on the biotin content of human milk. This level is extrapolated for all other age groups.
- Pantothenic acid: The AI is based on estimated mean intakes of apparently healthy populations.

COMPARISON OF THE AI, RDA, AND EAR

In general, how does the Adequate Intake (AI) compare with the Estimated Average Requirement (EAR) and the Recommended Dietary Allowance (RDA)?

The amount of evidence suitable for setting the AI is less than that available for setting the EAR and deriving the RDA. When the AI represents a suitable group mean intake, by definition, it is above the (unknown) EAR and generally should be above the (unknown) RDA.

Like the RDAs (which are derived from the EARs), the AIs are levels of nutrient intake that should be associated with a low risk of developing a condition related to a nutrient deficiency or some other negative functional outcome (see Appendix F for details). Intakes at the level of the RDA or AI would not necessarily replete or rehabilitate individuals previously undernourished, nor would they be adequate for persons afflicted by a disease that increased requirements.

LIMITATIONS OF THE AI IN DIETARY ASSESSMENT

Can the Adequate Intake (AI) be used to determine the prevalence of inadequate nutrient intakes in a group?

No.

The AI cannot be used to calculate the prevalence of inadequate nutrient intakes for groups. However, for nutrients with appropriately estimated AIs (see Table 5-1), groups with mean intakes at or above the AI can generally be assumed to have a low prevalence of inadequate intakes (low group risk) for the defined criterion of nutritional status. When mean intakes of groups are below the AI, assumptions cannot be made about inadequacy of intakes (except when intakes are zero, in which case intake is clearly inadequate). Thus, the following statements can be made:

- If the mean intake of a group is at or above the AI, and the variance of intake is similar to the variance of intake in the population originally used to set the AI, the prevalence of inadequate nutrient intakes is likely to be low (although it cannot be estimated) (see Table 5-1 and Appendix F). This evaluation can be used with confidence when the AI is based directly on intakes of healthy populations (as is the case for all AIs except for vitamin D for infants 0 through 12 months of age, for pantothenic acid, and fluoride for children and adults). However, one would have less confidence making this type of evaluation when the AI is not based directly on the intakes of healthy populations.
- If the mean intake is below the AI, the adequacy of the group's intake cannot be determined.

Can the proportion of the population below the AI be used as an indicator of the percentage of the population whose intakes are inadequate?

No.

Because the AI should be above the true Estimated Average Requirement (EAR), any prevalence estimates of nutrient inadequacy calculated by counting individuals with intakes below the AI would be overestimates—potentially major overestimates—of the true prevalence. Thus, although the EAR may be used as a cut-point, *the AI may not be used as a cut-point to estimate the percentage of a population with inadequate intakes.*

Can the relative adequacy of two groups—or of one group at two different times—be assessed by comparing mean intakes with the AI or by comparing the proportion of the groups below the AI?

No.

Because the AI may be above the (unknown) Recommended Dietary Allowance (RDA), mean intakes well below the AI may still have a low prevalence of nutrient inadequacy. It is not possible to know exactly where the mean intake as a percentage of the AI becomes associated with an increased risk of inadequacy. For example, mean intakes at 70 and 90 percent of the AI may have virtually identical very low risks of inadequacy. Therefore, comparisons of this type should be avoided.

Can we calculate back from the AI to a proxy for a nonexistent EAR?

No.

Another potential misuse of the AI is calculating back under the assumption that a proxy for the EAR can be determined. Because the AI is used as a target in counseling individuals—just as the RDA is used as an intake target—there is a strong possibility that the AI will be misused in much the same way as the former RDAs were misused. Some may assume that it is appropriate to use an actual standard deviation of intake or assume a certain coefficient of variation of requirements to calculate back from the AI to a value that might be assumed to be close to the EAR.

Two times the assumed coefficient of variance of requirements (approximately 10 percent) might be subtracted from the AI with the assumption that the resulting number would be a proxy for the requirement. In fact this would only be the case if the AI were set so that only 2 to 3 percent of the population was below the EAR and the requirement was normally distributed (Beaton, 1994). Conceptually this may be the case, but in actuality the AI is derived from a different perspective. In fact, the AI involves significantly more assumptions and judgment, and is set differently for each nutrient. For all of these reasons it is not appropriate to calculate a pseudo EAR from the AI. Such attempts will result in estimates of the prev-

alence of nutrient inadequacy that are erroneous and usually too high.

SUMMARY

Since the Adequate Intake (AI) is set in different ways for different nutrients and its relationship to the requirement for the nutrient is unknown, it cannot be used to estimate the proportion of the population with inadequate intake.