Mean Adequacy Ratio (MAR)

Overview

The Mean Adequacy Ratio (MAR) is a member of the class of indicators that are used to evaluate individual intake of nutrients. This index quantifies the overall nutritional adequacy of a population based on an individual's diet using the current recommended allowance for a group of nutrients of interest (Hatloy et al., 1998 [1]). It was first developed in the 1970s as a way to evaluate the effectiveness of food stamps in rural Pennsylvania (Madden & Yoder, 1972 [2]). The MAR is based on the Nutrient Adequacy Ratio (NAR), a measure that expresses an individual's intake of a nutrient as a percentage (capped at 100%) of the corresponding recommended allowance for that nutrient, given the respondent's age and sex. The MAR is then calculated by averaging the NAR. The other indicators in the Data4Diets platform that measure individual nutrient intake include: total macronutrient intake [3], probability of inadequate intake [4], total individual micronutrient intake [5], and total individual energy intake [6]. Rather than quantifying caloric intake, the MAR scales data on total nutrient intake to derive a comprehensive indicator of overall dietary adequacy, although it does not capture issues related to overconsumption or under-consumption.

Method of Construction

The first step to estimate the MAR is to estimate the NAR for all nutrients of interest. The NAR is equal to the ratio of an individual's nutrient intake to the current recommended allowance of the nutrient for his or her age and sex, and can be represented as a ratio or as a percentage. In the United States, this recommended allowance is referred to as the Recommended Dietary Allowance (RDA), whereas in many other countries, it is referred to as the Recommended Nutrient Intake (RNI).

If the intake of a nutrient exceeds the RDA/RNI, the NAR is capped at 100% or 1, depending on whether it is expressed as a percentage or ratio. This prevents nutrients with very high intake (NAR value > 1) from masking nutrients with very low intake (low NAR value) when they are averaged to calculate the MAR (Hatloy et al., 1998 [7]).

Once the NAR is calculated for each nutrient, the MAR is calculated by averaging all the NAR values together, as demonstrated in the equation below:

$$\text{MAR} = \frac{Sum\ of\ NAR}{Number\ of\ nutrients} \times 100\ (if\ representing\ as\ a\ percentage)$$

The MAR is reported on a scale from 0 to 100% (or 1), where 100% (or 1) indicates the requirements for all the nutrients were met.

When repeated measurements of nutrient intake are available for at least a subsample of individuals, the "probability approach" can be calculated. The repeated days are required to adjust the population nutrient intake distribution to take account of the intra-subject variability. This process allows for the usual intake distribution to be calculated allowing measurement of the individual probability of inadequacy [4] for each nutrient and a mean probability of adequacy (MPA) over a range of nutrients (Arimond et al., 2010 [8]).

For more information on how to calculate this indicator, please see the highly detailed Methods section of the

following paper published in the *European Journal of Clinical Nutrition* (Hatloy et al., [7] 1998 [1]).

Uses

Data are collected at the individual level to assess nutrient adequacy of populations, and can be calculated to include or exclude nutrients depending on programmatic or research priorities. The MAR has been used to validate dietary diversity indicators, and can provide additional context when examined in conjunction with standard individual dietary diversity scores (Acham et al., 2012 [9]; Steyn et al., 2014 [10]). As an index, it does not reveal which micro- or macronutrients are or are not consumed in adequate amounts, and instead provides a general picture of adequacy aspects of an individual's diet quality within a population. Total intake for an individual micronutrient or macronutrient may be more appropriate if disaggregated information on specific nutrients is needed. In addition, data on individual intake can be paired with findings on individual health outcomes or demographic information, such as religion, income, education, or other characteristics of interest in order to assess differences between sub-population groups based on various other demographic characteristics.

Strengths and Weaknesses

One strength of this indicator is that it allows researchers to consider and communicate a population's overall nutritional adequacy, rather than focusing on specific nutrients that may not alone indicate healthy diet composition (for example the NAR only investigates one nutrient at a time). However, this indicator is based on RDAs or RNIs, which are estimates of the necessary nutrient intake to meet the requirement of 97-98% of healthy people, and may vary for some nutrients (like zinc and iron) depending on the assumed absorption, which can differ depending on the type of food consumed (Institute of Medicine, 2006 [11]). Thus, even a MAR of 1 (meaning requirements of all nutrients are met) does not guarantee that a population's needs are met nor that individuals within the population can properly absorb and use the nutrients. Additionally, a MAR below 1 does not necessarily indicate that a population suffers from nutritional deficiencies. Inherent in the way that the RDAs/RNIs are defined, the cut-off amount is actually above the required intake for all but 2-3% of the population (Institute of Medicine, 2000 [12]). Thus, a population's nutritional status cannot be inferred from this measure (Institute of Medicine, 2000 [12]).

Data Source

Individual-level dietary data can be obtained from Weighed Food Records [13], quantitative 24-hour Dietary Recalls [14] , or quantitative Food Frequency Questionnaires [15].

The Food and Agriculture Organization/ World Health Organization Global Individual Food consumption data Tool [16](FAO/WHO GIFT [16]) 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. National or regional Food Composition Tables should be used to identify the nutrient contents of the foods and can be found at FAO's International Network of Food Data Systems (INFOODS [17]) or the International Life Science Institute's (ILSI) World Nutrient Databases for Dietary Studies (WNDDS [18]). RDAs/RNIs can be obtained from the Institute of Medicine for the United States (Institute of Medicine, 2006 [11]), from the British Nutrition Foundation for the United Kingdom (British Nutrition Foundation, 2016 [19]), or the European Food Safety Authority of the European Union (EFSA, 2017 [20]). As an alternative to country-specific RDAs/RNIs (e.g. if they do not exist for the country of interest), the FAO/WHO global RNIs can be used (FAO/WHO, 2001 [21]).

Links to guidelines

- Hatloy et al., (1998). "Food variety ? a good indicator of nutritional adequacy of the diet? A case study from an urban area in Mali, West Africa" [22]

Links to validation studies

- Steyn et al., (2014). "Which dietary diversity indicator is best to assess micronutrient adequacy in children 1 to 9 y?" [23]

Links to illustrative analyses

- Acham et al., (2012). "Dietary diversity, micronutrient intake, and their variation among black women in informal settlements in South Africa: A cross-sectional study" [24]
- Torheim et al., (2003). "Validation of food variety as an indicator of diet quality assessed with a food frequency questionnaire" [25]

Expert review conducted by:

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Food Security Dimensions

- Quality [27]

Data Collection Levels

- Individual [28]

Data Sources and Methods

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

Requires Food Composition Database

- Yes [29]

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