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$$\pi_n = \left(\frac{y_n^k}{y_n} \right) \left(\frac{p_n^k}{p^k} \right)$$

k = 1

Indicators for monitoring hunger at global and subnational levels

Ricardo Sibrián

This paper presents three different hunger indicators and outlines how they can be used to assess the extent of food insecurity in population groups globally and within countries at community, regional, or other subnational levels. Hunger refers to the supply, access, consumption, and intake of food at levels that are insufficient to fulfill human requirements. If the requirements are not met through the adequate absorption and use of essential nutrients, food deprivation and undernutrition occur.

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INTRODUCTION

The World Food Summit (WFS) in 1996 and, more recently, the Millennium Development Goals (MDG) in 2000 set targets for hunger reduction using indicators of food deprivation, such as MDG indicator 1.9, which reflects the proportion of a population below the minimum level of dietary energy consumption, and the number of people suffering from food deprivation. The MDG target aims to reduce hunger by half in terms of the population proportion (MDG 1.9), whereas the WFS target calls for halving the number of hungry people. The MDG targets for hunger reduction also include MDG indicator 1.8, which reflects the prevalence of underweight children under 5 years of age. These MDG and WFS indicators reflect the magnitude and trends of hunger at national, regional, and global levels.

Since 1999, the Food and Agricultural Organization of the United Nations (FAO) has assessed and monitored the extent of global food insecurity using information on the amount of food available for human consumption (private and public) at the country level; this information is derived from food balance sheets, which are based on country-level data on food production and trade. The food deprivation estimates are reported in annual publications of the State of Food Insecurity in the World¹ and, since 2005, in annual MDG Reports² to the United Nations General Assembly.

Monitoring hunger calls for at least two separate time points to recognize the effects of food security policies and interventions. Indicators to monitor hunger are expressed in terms of magnitude and trends.

CAUSALITY OF HUNGER

Hunger is a broad term that is used frequently and in a variety of contexts; broadly speaking, it refers to a phenomenon involving causes and effects in a wide range of situations that may be extreme, such as acute food shortage (causing famine), or chronic, such as food shortage (causing undernourishment).

In a broad sense, there are several levels of causality related to hunger. Food deprivation is an exogenous factor associated with undernutrition, which is an endogenous factor that becomes an exogenous factor associated with early death. Food deprivation is a reciprocal cause and effect of other exogenous factors such as poverty. In this sense, causes and effects of food deprivation in an emergency situation may be completely different from those in a chronic situation. In other words, when food deprivation is used as an indicator, hunger is measured as a cause of undernutrition, and when nutritional status (e.g., body dimensions such as weight and height) is used as an indicator, hunger is measured as an effect of food deprivation, among other causes of undernutrition. The

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effect of food deprivation (undernourishment) on under-nutrition may be exacerbated by concomitant factors with synergistic negative effects. For example, when food is scarce, undernutrition may undermine nutrient utilization, productivity may decrease, and poverty may consequently increase. These effects are linked to the environment and healthcare, among other factors; consequently, food-security policies and actions should consider these factors concomitantly with food deprivation and undernutrition. In practice, food deprivation is measured in the total population, whereas nutritional status is usually measured in child populations. However, food-insecure population groups may not have undernourished children because coping strategies are used to protect the young from food deprivation.

INDICATORS OF HUNGER

Hunger can be measured using three major indicators: 1) the prevalence of undernourishment (food deprivation); 2) the prevalence of critical food poverty (income deprivation); and 3) the prevalence of underweight in children (child undernutrition). These indicators can be derived using either a parametric or a nonparametric approach.³ The parametric estimates have similar basic principles: 1) they are based on observed distributions with estimated parameters of mean and variance; 2) they refer to normative or ideal distributions with targeted mean and variance; 3) they use cutoff values derived from normative distributions for low-level food insecurity; and 4) they measure the magnitude of hunger as the proportion of people below the cutoff values derived from estimated distributions.

These principles are illustrated in Figure 1; solid-line curves are for normative or target distributions and broken-line curves depict intermediate situations. All density-function curves have specific cutoff values for estimating proportions of food deprivation (Figure 1A), critical food poverty (Figure 1B), and child undernutrition (Figure 1C) using the parametric approach. The parametric approach is calculated on the basis of parameters (mean and coefficient of variation) of a population, whereas the nonparametric approach is based on estimates corresponding to the individuals or households sampled in the national household survey. FAO uses the parametric approach under the assumption of log-normality of dietary energy consumption or income distribution.

Food deprivation

The proportion of the population below the minimum level of dietary energy consumption (pU) as a measure of

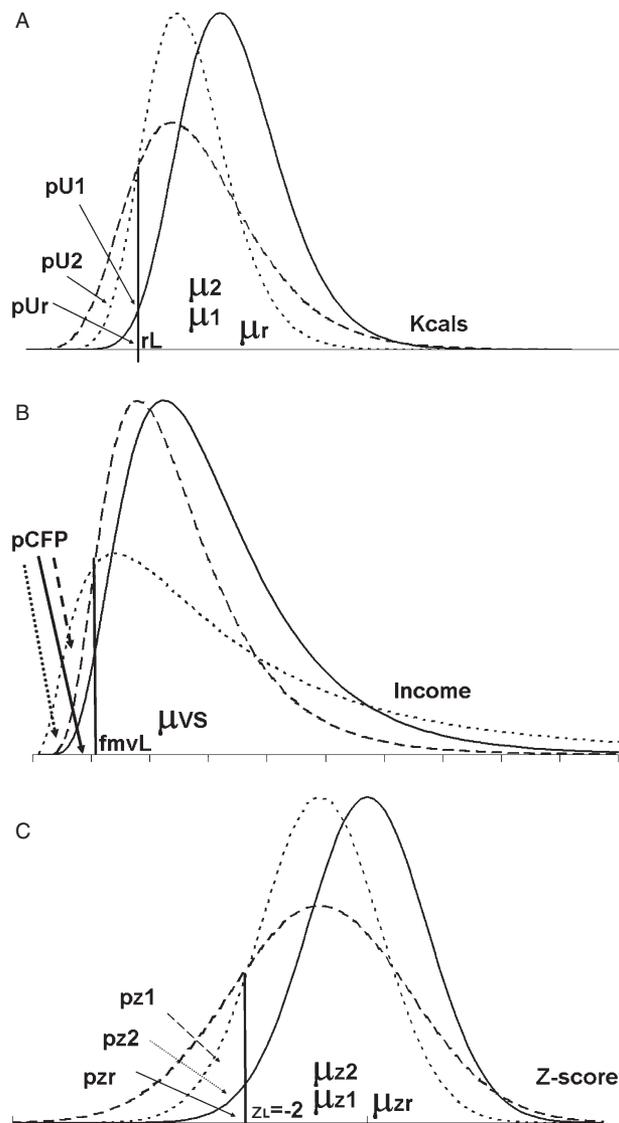


Figure 1 Indicators of hunger. **A** Proportion of food deprivation within framework of distribution of dietary energy consumption. **B** Proportion of critical food poverty within framework of distribution of income. **C** Proportion of child undernutrition within framework of distribution of Z-score of weight-for-age or of height-for-age.

food deprivation has been documented elsewhere using the FAO approach.⁴ This approach takes into account the amounts of food consumed and how unequal the distribution of food is within the population as well as the amount of food required to meet the population's minimum energy needs using a probabilistic framework of targeted populations.

Food-insecurity assessments at subnational levels, using the FAO approach for monitoring and identifying vulnerable population groups, can be conducted using private food-consumption data (households only) and income (or total expenditure) data collected in household surveys. Food-insecure subnational population groups

are identified based on household and household-member characteristics, such as geographic location and other criteria.⁵

Figure 1A illustrates different levels of food deprivation resulting from various levels of food consumption, i.e., dietary energy consumption (DEC), and levels of access to food, i.e., the coefficient of variation of DEC (CV[x]), for the same cutoff value of minimum energy requirement (r_L) using the FAO approach. The pU estimated for the observed population is quite high because of low-level energy consumption and high-level inequality in access to food, as shown by the broken-line curves (pU1 and pU2). The curves depict the main effects of increased DEC alone (pU1 versus pUr) and decreased CV(x) level alone (pU2 versus pU1).

Critical food poverty

Two new indicators are proposed in this paper to measure income deprivation: 1) the prevalence of food poverty (pFP) and 2) the prevalence of critical food poverty (pCFP). The pFP is defined as the proportion of the population living on less than the cost of the average dietary energy needs, and the pCFP is defined as the proportion of the population living on less than the cost of the FAO-designated minimum dietary energy needs. The cutoff points are the costs of the normative average and the FAO minimum dietary energy needs, both from a nutritionally balanced diet. The energy cost corresponds to nutritionally balanced food consumption in terms of energy-yielding nutrients⁶ by a low-income population group (first quintile). Both pFP and pCFP are defined within a probability distribution framework of income in a similar manner to the prevalence of food deprivation.

Figure 1B illustrates different levels of pCFP resulting from various income (or total expenditure) levels and different income inequalities, CV(v), for the same cutoff value of income, r_L (critical food poverty line for pCFP). The pCFP for an ideal (normatively implicit) population with a high income (or total expenditure) level and a low inequality level is less than 5% (solid curve). The observed density functions of income (or total expenditure) based on estimated means and variances to assess the pCFP are shown with broken-line curves. The income level with a balanced food consumption pattern may vary among subnational population groups, such as geographic regions, or other criteria resulting from dynamics in the food economy (e.g., production, local trade, market prices, and distribution systems); the cost of basic food baskets will vary accordingly.

The rationale for the new pFP and pCFP is based on: 1) differences in food needs across countries and subnational population groups and 2) variations in dietary energy prices associated with the nutritional quality of

food, food consumption patterns, and income levels within countries under log-normal distribution assumptions of income. The cost of balanced energy in terms of energy-yielding nutrients follows the World Health Organization (WHO)/FAO dietary guidelines⁶ of 12.5% from proteins, 22.5% from fats, and 65% from carbohydrates.

Undernutrition

The prevalence of underweight (or stunting) in children under 5 years of age (pZ) refers to the proportion of the child population below the minimum level of weight (or height) for an attained age. It is proposed here that pZ be estimated within a probability distribution framework of the standardized Z-score of weight-for-age (or height-for-age), similarly to the pFP and pCFP described above, for children aged 24–59 months; this age group displays a relatively stable nutritional status for monitoring purposes.

Figure 1C illustrates with a solid line the reference child population with a Z-score of 0.0 and a standard deviation of 1.0, as adopted by WHO,^{7,8} with an expected insignificant magnitude of pZr (less than 2.3%). The other two curves depict different levels of nutritional status in children, pZ1 and pZ2; these values are far to the left of the reference curve, reflecting a high level of child undernutrition with respect to the reference child population.

CONCLUSION

The indicators for monitoring hunger described in this paper are MDG indicators 1.8 and 1.9 as well as the prevalence of food poverty and of critical food poverty. All indicators described and proposed can be implemented at the national and subnational levels for targeting and monitoring purposes using a parametric approach.

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Declaration of interest. The author has no interests to declare.

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