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Food Consumption and Nutrition Division
Discussion Paper 204

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Nutrition Mapping in Tanzania: An Exploratory Analysis

Kenneth R. Simler

In recent years, new techniques for estimating the degree of poverty in small geographic units have successfully produced high-resolution poverty maps that pinpoint "poverty hot spots." This paper explores the possibility of applying these methods—also known as small-area estimation—to the study of children's nutritional status as measured by anthropometry. This research in Tanzania is the first attempt to map nutrition in an African country using small-area estimation. The study asks two questions: first, is nutrition mapping feasible? Second, what is the spatial distribution of undernutrition in Tanzania?

Nutritional status is important because the percentage of children under the age of five who are underweight is the indicator used to measure progress toward the target of the Millennium Development Goal to reduce by half the number of people who suffer from hunger. More fundamentally, it provides information about the welfare of some of the most vulnerable members of society: young children.

Information on children's nutritional status usually comes from household sample surveys. Because these surveys include only a few thousand children, estimates of undernutrition are only possible at high levels of aggregation, such as a nation as a whole or large subnational regions. Regional or national averages mask pockets where the prevalence of undernutrition is especially high. This paper uncovers the heterogeneity underlying broad averages by employing small-area methods, which combine detailed information obtained from household samples with more limited information about several million households that is available in a national census.

While there is some variation between regions, the prevalence of undernutrition is much more variable among the districts and subdistricts that make up a region.

Methods and Data

A child's growth status is assessed by measuring the child's height and weight and comparing them with the heights and weights of well-nourished children of the same age and sex. The internationally accepted way to do this is by calculating the Z-score, which determines the number of standard deviations by which the child's height or weight varies from the norm (median). A score of –2 or more below the median indicates that the child is undernourished. The principal indicators are stunting (low height-for-age), which indicates chronic deprivation in the past, and wasting (low weight-for-height), which is usually seen in children who are severely ill or victims of famine. Underweight (low weight-for-age) is a composite of the two, indicating either past or current food deprivation or illness.

The estimation methodology is fairly straightforward. At the household level, 1991–92 Demographic and Health Survey (DHS) data are used to estimate the statistical relationship between the children's Z-scores and a set of independent variables that appear in both the household survey and the 1988 Population Census. (Data from Tanzania's 2002 census were not available.) In Stage 1, the regression parameters from the household survey data are estimated. In Stage 2, the estimated regression coefficients are applied to the census data to produce Z-score estimates for each child less than five years of age included in the census. The Z-scores are used, in turn, to estimate the prevalence of stunting and underweight. Variables include individual characteristics of the child such as age and sex, and socioeconomic household information such as employment, education levels, and housing conditions. Separate models are estimated for rural and urban dwellers and for children less than 24 months old and those 24 to 60 months old. Height-for-age and weight-for-age Z-scores are estimated separately for each group of children for a total of eight sets of regressions. The variables selected differ slightly across the eight models. In addition to the DHS and census data, the explanatory variables include geo-referenced data on geographic features, climatic conditions, and human settlements, which are integrated with the tabular data at the district level.

Results

The Stage 1 regressions show that the explanatory variables account for only about 20 percent of the

variation in Z-scores in urban areas and less than 15 percent in rural areas. This is consistent with past research, which has shown that regression models are less successful at explaining nutritional status than they are at explaining income or poverty. The predictive power of the models is good, as the within-sample predictions are within one-tenth of a percentage point of the actual rates of stunting and underweight. The low explanatory power of the Stage 1 models means that the small-area estimates in Stage 2 estimates have wide confidence intervals, making it difficult to detect statistically significant differences.

Nevertheless, distinct spatial patterns in undernutrition emerge. While there is some variation among regions, the range of undernutrition is much greater among the districts and subdistricts that make up a region. The most striking finding is that rates of stunting and undernutrition appear to be much lower in urban areas than in rural. A frequently seen pattern is an urban center, perhaps a district headquarters, with lower than average undernutrition rates, surrounded by rural areas with higher than average rates. To reduce undernutrition in rural areas will require not only sufficient supplies of nutritious food, but also adequate health care and safe water. At the same time, urban areas cannot be ignored because their rates, though lower, are still high.

The maps produced show the estimated stunting and undernutrition rates at the regional, district, and subdistrict (grouped ward) levels in 1988 (the census year). As the map resolutions become higher, one can see a great deal of heterogeneity within each level. For example, stunting in a certain region may average 65 percent, while only 40 percent of the children in a district in the region may be stunted. At the subdistrict level, however, it is clear that only a few wards have extremely low rates, while the rest are much higher.

The answer to the question of whether nutrition mapping is feasible is a qualified "yes." Although the models of children's nutritional status are not as successful as poverty mapping models at explaining variation, the spatial pattern of undernutrition at the district level seems plausible. Considering these findings, updating the nutrition maps using the 2002 Population Census and a more recent DHS survey seems worthwhile. Constructing high-resolution nutrition maps for other countries would also appear to be a useful area for future research.

Keywords: nutrition mapping, malnutrition, anthropometry, small area estimation, Tanzania

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