The Distribution of Child Nutritional Status across Countries and Over time

Priya Bhagowalia, Susan Chen and William. A. Masters
Department of Agricultural Economics
Purdue University

Presented by:
Priya Bhagowalia
pbhagowa@purdue.edu

Prepared for AGEC 691: SHaPE SEMINAR
September 21, 2007
Malnutrition

- Nutritional status is among the most important and practical measures of human welfare, compared to real incomes or expenditures as proxies for money metric utility (Deaton, 1997).

- Under nutrition is the underlying cause of 6 million each year –Almost all of these deaths occur in developing countries, three-quarters of them in sub-Saharan Africa and South Asia (FAO, 2005).

- 17.5 million of preschool children were overweight in developing countries in 1995 (de Onis and Blössner, 2000)
Prevalence and severity of obesity exceeds the prevalence and severity of under nutrition in many developing countries (Popkin and Mendez 2004; Martorell et al. 2000; Jolliffe 2004).

As countries grow, they experience not only the benefits of growth but also develop some problems that plague modern industrialized societies: Nutrition Transition
Motivation

- Recent studies dealing with measurement issues have been motivated by the poverty literature of which inequality and its measurement forms the core (Madden, 2006; Sahn and Stifel, 2002).

- Threshold based measures such as z scores levels of -2 and +1 standard deviations for underweight and overweight respectively, fail to capture differences at other levels of bodyweight, whether at the extremes or within the “normal” range.

- We compare the full distributions of z scores, to compute the fraction of the population that is under- or overweight, compared to a reference distribution of z scores rather than a threshold level of z scores.
Methodology

- Kernel estimates of the density of z scores for each country from survey data.

- Threshold based FGT measures compared to the distributional equivalent of FGT measures to estimate the change in incidence of every bodyweight level.

- Foster-Greer-Thorbecke (FGT) measures designed to summarize the shortfall of income, with flexible degree of emphasis on changes at the extremes; examine income distribution. Here adapted to measure “nutritional poverty”.

Methodology

- Summarize differences across distributions using Foster-Greer-Thorbecke (FGT) measures of shortfall or excess in z scores, computed first as deviations from standard thresholds of underweight, and overweight, and then as deviations from the reference population at each bodyweight.

- Identify country characteristics that act as determinants of “nutritional poverty” specifically the effect of income, local agriculture, demography and health.

- Use Nationally representative Demographic and Health Surveys (DHS) data, of children aged 6-36 months, covering 52 countries during the period of 1986 to 2005 to compute height for age (HAZ), weight for age (WAZ) and weight for height (WHZ) z scores.
Countries included in the study
What is a z score?

- The difference between the value for an individual and the median value of the reference population for the same age or height, divided by the standard deviation of the reference population. In equation form:

\[ z = \frac{y_{50} - y_i}{\sigma_y} \]

- We want to compare each population with the healthiest possible distribution of z scores - The WHO reference population, thus the z score itself is a deviation.

- From a development perspective, the idea is to move as much as possible towards the median.
Why treat body weight as continuous?
Changes in the Distribution of z scores over time

Figure 1: Density Estimates of Weight for Height z scores: South Asia

India

Bangladesh

Nepal

Pakistan

Sri Lanka
Changes in the Distribution of z scores over time: A closer look

The graph shows the distribution of weight-for-height z-scores for Mali over different years. The x-axis represents weight for height z-scores, ranging from -5 to 5. The y-axis represents density, ranging from 0 to 0.4.

- The blue dashed line represents data from 1987.
- The red line represents data from 1995.
- The green line represents data from 2001.

The graph indicates changes in the distribution over time, with shifts in the peaks and spread of the data points.
Changes in the Distribution of z scores over time

Figure 4: Density Estimates of Weight for Height z scores: Middle East

- **Egypt**
  - 1992
  - 1995
  - 2000
  - 2003
  - 2005

- **Morocco**
  - 1987
  - 1992
  - 2003

- **Tunisia**

- **Yemen**
Changes in the Distribution of z scores over time:
A closer look

![Graph showing changes in the distribution of z scores over time for Morocco.](image)
Results: Some trends

- Based on threshold and distributional measures, underweight, stunting and wasting headcounts were the highest for South Asia and some countries in Africa.

- Prevalence rates for Obesity and Over weight higher in the Middle East, Latin and the Caribbean and Central Asia.

- Over time, the prevalence of overweight has increased while the prevalence rates for underweight do not decline.
Sensitivity of Threshold vs. Distributional, Underweight

Comparison of threshold and full distribution measures: FGT0 Wasting
Sensitivity of Threshold vs. Distributional, Overweight

Comparison of threshold and full distribution measures: FGT0 overweight for height
Under- & overweight vs. per-capita income
## Regression results

Table 8A: Regression of WHZ on Real GDP and RealGDP2

<table>
<thead>
<tr>
<th></th>
<th>WHZ0fu</th>
<th>WHZ0tu</th>
<th>WHZ1fu</th>
<th>WHZ1tu</th>
<th>WHZ2fu</th>
<th>WHZ2tu</th>
</tr>
</thead>
<tbody>
<tr>
<td>REALGDP</td>
<td>-13.15*</td>
<td>-4.33*</td>
<td>-0.22*</td>
<td>-0.13*</td>
<td>-0.52*</td>
<td>-0.39*</td>
</tr>
<tr>
<td></td>
<td>2.72</td>
<td>0.99</td>
<td>0.05</td>
<td>0.03</td>
<td>0.11</td>
<td>0.09</td>
</tr>
<tr>
<td>REALGDP2</td>
<td>1.29*</td>
<td>0.37*</td>
<td>0.02*</td>
<td>0.01*</td>
<td>0.04*</td>
<td>0.03*</td>
</tr>
<tr>
<td></td>
<td>0.39</td>
<td>0.14</td>
<td>0.01</td>
<td>0.00</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>70.16*</td>
<td>15.69*</td>
<td>0.95*</td>
<td>0.45*</td>
<td>2.00*</td>
<td>1.39*</td>
</tr>
<tr>
<td></td>
<td>3.47</td>
<td>1.27</td>
<td>0.06</td>
<td>0.04</td>
<td>0.14</td>
<td>0.12</td>
</tr>
<tr>
<td>n</td>
<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
</tr>
</tbody>
</table>
Table 8B: Regression of WHZ on Real GDP, RealGDP2, DPT and Urban population

<table>
<thead>
<tr>
<th></th>
<th>WHZ0fu</th>
<th>WHZ0tu</th>
<th>WHZ1fu</th>
<th>WHZ1tu</th>
<th>WHZ2fu</th>
<th>WHZ2tu</th>
</tr>
</thead>
<tbody>
<tr>
<td>REALGDP</td>
<td>-16.47</td>
<td>-12.51</td>
<td>-0.46</td>
<td>-0.42</td>
<td>-1.54</td>
<td>-1.47</td>
</tr>
<tr>
<td></td>
<td>29.00</td>
<td>11.43</td>
<td>0.51</td>
<td>0.34</td>
<td>1.29</td>
<td>1.09</td>
</tr>
<tr>
<td>REALGDP2</td>
<td>22.60</td>
<td>7.54</td>
<td>0.35</td>
<td>0.27</td>
<td>1.05</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>36.70</td>
<td>14.50</td>
<td>0.65</td>
<td>0.43</td>
<td>1.63</td>
<td>1.38</td>
</tr>
<tr>
<td>DPT</td>
<td>-2.31*</td>
<td>-0.78*</td>
<td>-0.04*</td>
<td>-0.02*</td>
<td>-0.09*</td>
<td>-0.06*</td>
</tr>
<tr>
<td></td>
<td>0.55</td>
<td>0.22</td>
<td>0.01</td>
<td>0.01</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>URBAN</td>
<td>-4.80*</td>
<td>-1.15*</td>
<td>-0.07*</td>
<td>-0.03*</td>
<td>-0.14*</td>
<td>-0.09*</td>
</tr>
<tr>
<td></td>
<td>0.88</td>
<td>0.35</td>
<td>0.02</td>
<td>0.01</td>
<td>0.04</td>
<td>0.03</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>85.91*</td>
<td>20.51*</td>
<td>1.20*</td>
<td>0.59*</td>
<td>2.55*</td>
<td>1.78*</td>
</tr>
<tr>
<td></td>
<td>4.06</td>
<td>1.60</td>
<td>0.07</td>
<td>0.05</td>
<td>0.18</td>
<td>0.15</td>
</tr>
<tr>
<td>n</td>
<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
<td>118</td>
</tr>
</tbody>
</table>
Discussion

- This analysis helps characterize the full extent of a country’s “nutritional poverty”, allowing improved tests of the correlation between malnutrition and various influences such as per-capita income, education and urbanization.

- Previous measures of malnutrition used specific thresholds to indicate underweight and overweight, resulting in a loss of information about changes in the proportion of the population at other levels of z scores.

- Clinical and distributional measures appear to move together in the same direction, although there are instances when distributional and conventional trends differ as in the case of Bangladesh, Turkey and Tanzania.

- Simple regressions underscore the importance of examining development related variables besides income as these can directly act upon and improve nutritional status.
Conclusions

- Non-parametric approaches reveals the extent to which a population deviates from a reference distribution at every bodyweight.

- Since health risks vary with changes in z scores throughout the range of normal as well as in the extremes, our measure offers a more sensitive indicator with which to summarize existing survey data and test for the determinants of nutritional status at the country level.
Further Research

- Expand dataset to include more countries & years and adults

- Use these measures to determine the country level factors that may influence nutritional status such as education, urbanization, gender inequality and income.

- Check for changes in rankings based on distributional and conventional
Further Research

- Check for stochastic dominance

- Tests for statistical significance of FGT measures across countries and over time

- Take panel nature of data into account using Fixed effects models.