Economic Inequality and Child Stunting in Bangladesh and Kenya: An Investigation of Six Hypotheses

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International organizations are broadening their focus on the developing world to extend beyond economic growth and poverty reduction to questions of equity. The World Bank (2005) stresses the importance of equity in promoting economic development and reducing poverty, citing interactions between economic and social inequalities and a country's markets and institutions. The United Nations Development Programme (UNDP 2010) emphasizes the apparent connection between reducing inequality and improving health and education. And the United Nations Children's Fund (UNICEF 2010a) argues that an equity-focused approach that targets the most deprived children and communities would accelerate progress toward the health-based Millennium Development Goals.

At the same time, various forces are reshaping communities and social structures in the developing world. Increasing rural-to-urban migration, both within and between countries, is contributing to the growth of slums and an increase in the number of urban poor. Fertility rates have declined rapidly in the developing world, but rural households continue to have much higher rates than urban households, thereby reinforcing inequalities between these areas. The poorest people in the least developed countries are also the most vulnerable to natural disasters and armed conflicts, both of which often displace people and disrupt social and economic arrangements for extended periods of time (UNICEF 2010b; United Nations Population Fund 2011). Thus, even as policy interest in inequalities within developing countries is increasing, key factors that influence those inequalities are shifting.

A substantial body of research, mainly in developed countries, has examined whether economic inequality is related to individual health outcomes (see Deaton 2003; Lynch et al. 2004; Subramanian and Kawachi 2004; Wilkinson and Pickett 2006). The empirical results have been inconclusive, with the strongest evidence for such a relationship being found within the United States when income inequality is measured at the state level. Studies within other countries generally have not supported such a relationship (Lynch et al. 2004; Subramanian and Kawachi 2004; cf. Wilkinson and Pickett 2006). In this article I consider the relationship between economic inequality and an important measure of young children's health—stunting—in two developing countries, Bangladesh and Kenya.

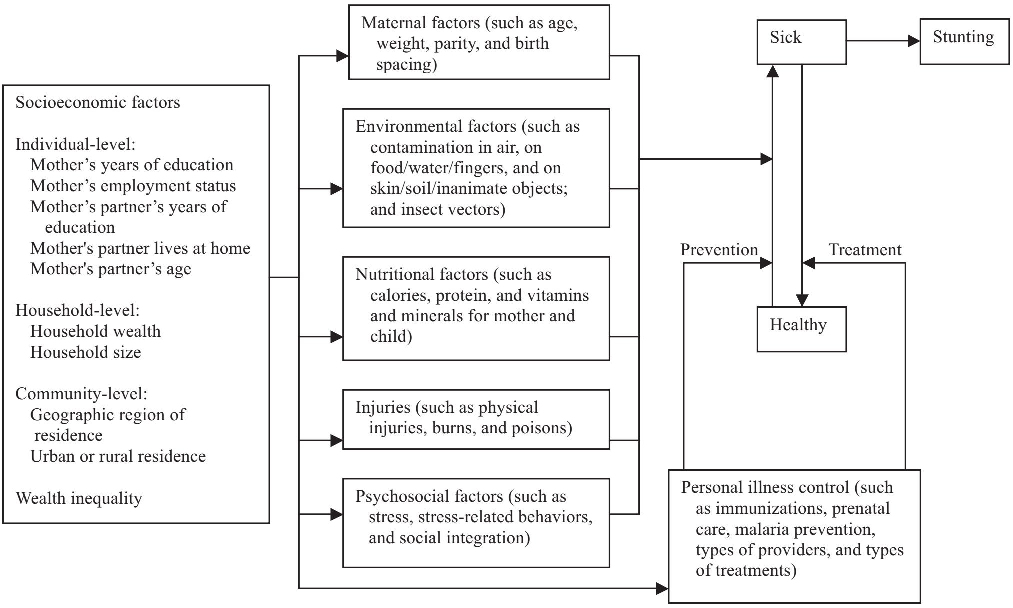
My approach differs from, and potentially improves upon, prior work in several respects. First, it directly tests six alternative hypotheses for how the distribution of economic status within a society may be related to individual health. Second, instead of income, it measures household economic status according to a wealth index, which is more stable over time and a more reliable measure for poor households in developing countries (Rutstein and Johnson 2004; see also Deaton 2003; Filmer and Pritchett 2001). Third, it considers three alternative geographic definitions of a society—the community of people that is the relevant reference group for an individual. Finally, it selects socioeconomic covariates based on an established framework for studying child growth faltering in developing countries.

Child stunting

A child younger than 5 years old is considered to be stunted when his or her height is more than 2 standard deviations below an international reference median for children his or her age. Stunting is one of three measures of child growth faltering and is an indicator of the broader health problem of malnutrition, which is responsible for half of the 10 million deaths annually among children younger than 5 years old in developing countries (UNICEF 2007). Of the three growth faltering measures—stunting, underweight, and wasting—stunting most demonstrably indicates chronic undernutrition. From 1992 to 2007, the stunting rate of children younger than 5 years old decreased significantly in Bangladesh from 63 percent to 36 percent, while it increased slightly in Kenya from 33 percent to 35 percent (UNICEF 2009).

A child's growth is potentially affected by many social, economic, environmental, and biological factors. Mosley and Chen (1984) integrated the most critical of these factors into a framework for studying child growth faltering and mortality in developing countries. I apply a modified version of the Mosley/Chen framework to analyze the relationship between wealth inequality and stunting in Bangladesh and Kenya. Figure 1 displays this modified framework, showing the categories of factors and the specific socioeconomic variables used in this article, including the key socioeconomic factors that I analyze: household wealth and wealth inequality.

FIGURE 1 Analytical framework for studying child stunting in Bangladesh and Kenya



SOURCE: Adapted from Mosley and Chen (1984).

Poverty and economic inequality in Bangladesh and Kenya

Bangladesh and Kenya are located in the two regions, South Asia and sub-Saharan Africa, that are poorest by almost any measure, including the highest percentages of people living in poverty (income below $2 per day) and in extreme poverty (income below $1.25 per day). Bangladesh has a much higher poverty rate than Kenya based on the $2 a day measure (81 percent vs. 40 percent), but a lower rate based on the countries' national poverty lines (40 percent vs. 46 percent). The two countries also have similar income per capita (in purchasing-power-parity US dollars): $1,440 for Bangladesh and $1,580 for Kenya (World Bank 2010). However, Kenya has an income/consumption Gini index of .48, compared with .33 for Bangladesh (World Bank 2011).[1] Thus, the two countries are similarly poor, but Kenya has much greater economic inequality. This contrast between the two countries magnifies a similar contrast between their respective regions and, together with the fact that both countries are among the most populous in their regions, makes comparison between them instructive.

Trends in poverty and economic inequality in these countries are also of interest. From 1992 to 2005, the national poverty rate decreased in Bangladesh from 59 percent to 40 percent, and increased slightly in Kenya from 45 to 46 percent. Over the same period, income/consumption inequality decreased in Kenya from a Gini index of .57 to .48, but increased in Bangladesh from .28 to .33 (World Bank 2011). Thus, Kenya is becoming more equal but is making no progress in reducing poverty, while Bangladesh is becoming both less poor and less equal.

Recent World Bank (2008, 2009) country assessments provide detailed analyses of poverty and inequality in these countries. Key factors in Bangladesh's success in reducing poverty include stable economic growth, urbanization, lower fertility rates, greater remittances from migrants living abroad, and increased labor force participation and educational attainment, especially among women. The main factor in Bangladesh's increasing income/consumption inequality is a growing disparity between the economically strong eastern regions and the lagging western regions, resulting from differences in infrastructure, access to export markets, remittances from abroad, household endowments, and exposure to major cyclones and floods. Key obstacles to reducing poverty in Kenya include a lengthy economic recession during the 1990s, widespread unemployment and informal-sector employment at inadequate wages, regional variation in economic activity, the continuing burden of malaria and HIV, land inequality, and government corruption. The World Bank concluded that the apparent decrease in income/consumption inequality in Kenya since 1992 as measured by the Gini index misses both the fact that the Gini index actually increased slightly from 1997 to 2005 and the growing disparity between the wealthiest and poorest deciles.

The relationship between economic inequality and individual health

Preston (1975) and Rodgers (1979) first theorized that the relationship between individual income and individual health within countries may be nonlinear and that, as a result, a transfer from a wealthier individual to a poorer individual could produce a net health gain for the population, resulting in a negative relationship between population income inequality and population health. Wilkinson (1992, 1994, 1996) took a further step by postulating a negative effect of population income inequality on individual health. Wilkinson's income inequality hypothesis has prompted considerable disagreement about whether income inequality is an important determinant of individual health or, instead, whether income inequality is related to population health only because of a nonlinear relationship between individual income and individual health. Four of the six hypotheses that I test below assess relationships between various measures of economic inequality and individual health; the other two hypotheses test for nonlinear relationships between household economic status and individual health.

Of the more than 100 empirical analyses of the relationship between income inequality and some measure of health, almost all have focused on developed countries, perhaps because of data availability. Because this literature has been exhaustively reviewed elsewhere (Lynch et al. 2004; Subramanian and Kawachi 2004; Wilkinson and Pickett 2006), I present only their general conclusions and implications. In particular, one finds significant, but diminishing, support for a relationship between population income inequality and population health across developed countries, consistent support for a relationship between state-level income inequality and both state-level and individual health within the United States, and little support for a relationship between societal income inequality and health in other countries.

The more important lessons from prior studies, however, may relate to methodological issues. First, studies are often limited by their data quality (Deaton 2003; Judge, Mulligan, and Benzeval 1997; Lynch et al. 2004); this article overcomes the lack of high-quality data on income inequality by using more reliable wealth inequality measures. Second, study results are often sensitive to the level of geographic aggregation (Blakely, Lochner, and Kawachi 2002; Krieger et al. 2002; Subramanian and Kawachi 2004; Wilkinson and Pickett 2006, 2007); this article considers and compares results derived from three different geographic definitions of community. Third, study results are also often sensitive to the choice of inequality measure (Karlsson et al. 2010; Lynch et al. 2004; Weich, Lewis, and Jenkins 2002); this article tests six alternative hypotheses for how the distribution of wealth within a country may be related to individual health. Fourth, studies should control for the appropriate socioeconomic covariates based on theoretical considerations (Lynch et al. 2004; Subramanian and Kawachi 2004; Wilkinson and Pickett 2006); this article makes that determination based on an established framework for studying child stunting in developing countries. Fifth, studies should either allow for the possibility of a time lag between exposure to societal economic inequality and its effects on individual health or choose variables that minimize the need to do so (Blakely and Woodward 2000; Lynch et al. 2004; Mellor and Milyo 2003; Subramanian and Kawachi 2004); this article uses a growth faltering outcome among children younger than 5 years old and a measure of wealth inequality that is relatively stable over time to minimize that need. Finally, studies should account for the possibility of reverse causation from health to economic status (Deaton 2003); this article also limits that possibility by using a health outcome among young children (e.g., Finch 2003).

Two principal mechanisms have been proposed to explain a relationship between economic inequality and individual health outcomes: a psychosocial mechanism and a neomaterial mechanism (Lynch et al. 2004). The psychosocial mechanism focuses on individual perceptions of and responses to inequality. Its proponents argue that, in more unequal societies, there is greater differentiation among social classes, and individuals are more aware of their relative deprivation, which causes them to experience chronic stress and to be less integrated in society. Chronic stress has detrimental effects on health both directly and indirectly through stress-related behaviors such as smoking, drinking, drug use, and failure to exercise. Being less integrated in society further increases stress and has other detrimental effects on health. Similarly, maternal stress affects child health (Wilkinson 1992, 1994, 1996, 2006; Wilkinson and Pickett 2006, 2007).

The neomaterial mechanism emphasizes the direct importance of material goods and services to explain poorer health outcomes in more unequal societies. Governments that are more tolerant of the continuing existence of deprived groups in society also make fewer infrastructure improvements available to these groups. These deprived households also have more difficulty in accessing services provided primarily through public infrastructure and in purchasing goods provided primarily through private markets. The insufficient supply and use of these neomaterial factors produce detrimental effects on individual health (Daly et al. 1998; Lynch et al. 2004; Lynch et al. 2000; Lynch and Kaplan 1997).

Part of the disagreement about the relationship between population income inequality and individual health has resulted from the ambiguous formulation of the hypothesis. In that regard, Wagstaff and van Doorslaer (2000) presented the most significant variations of these hypotheses and modeled the implied health functions at the population, community, and individual levels. In this article, I investigate the relationship between economic inequality and stunting in Bangladesh and Kenya by testing six of the nine hypotheses modeled by Wagstaff and van Doorslaer; the other three cannot be evaluated meaningfully with data from only two countries because they use population-based measures. My goal is to determine whether these data support the predominant hypothesis in the literature, the income inequality hypothesis, and whether any other hypothesis is better supported by these data.

Only a few studies have tested hypotheses other than the income inequality hypothesis in developing countries. Karlsson et al. (2010) analyzed the absolute income, relative income, and income inequality hypotheses in considering the relationship between income and self-assessed health among individuals aged 40–79 in 21 (mostly developed) countries in all five world regions. They found strong support for the absolute income hypothesis, but less evidence for it in poorer countries; strong support for the relative income hypothesis at the regional level in poorer countries, but less evidence for it in richer countries; and support for the income inequality hypothesis in richer countries, but not in poorer countries. Chen and Meltzer (2008) analyzed the relative income and income inequality hypotheses in considering the relationship between income and adult obesity or hypertension in China. They found some evidence to support both hypotheses in rural communities, but no evidence for either hypothesis in urban communities. As they observed, urban China has better infrastructure and economic conditions than rural China and thus may be less typical of other developing countries. And Salti (2010) used a relative deprivation measure based on Yitzhaki (1979) to study the relationship between income and mortality among adults in South Africa. She tested several types of reference groups, including provinces, and found a significant positive relationship among both men and women between mortality and the relative deprivation measure within provinces.

Data and methods

Many of the hypotheses tested below rely on the concept of community, for which I use three different geographic definitions. The broadest definition is the geographic region: Bangladesh has six regions (divisions) and Kenya has eight regions (provinces). The narrowest definition of community is the geographic district. Bangladesh has 64 districts (zila) and, at the time of this survey, Kenya had 72 districts (wilaya); however, the study samples included data for only 63 districts in Bangladesh and 69 districts in Kenya.

The intermediate definition of community divides each geographic region according to the type of residence, so that communities consist of households in the same type of residence in the same region. I refer to these communities as subregions. There are four classifications for the type of residence: large city, small city, town, and rural. Five regions in Kenya have no large cities, and one region in Kenya is entirely a large city. Thus, there are potentially 24 subregions in Bangladesh and 24 in Kenya; however, the study samples included data for only 22 subregions in Bangladesh and 19 in Kenya.

Researchers (e.g., Elbers, Lanjouw, and Lanjouw 2003) have noted two primary concerns about estimating inequality measures for small geographic areas from survey data. First, the data may not be fully representative for these areas if the surveys are stratified over larger areas. Second, there may be too few observations for some small areas to generate statistically reliable estimates. These concerns are relevant here to the calculation of inequality measures for subregions and districts, and I discuss them further below.

Study populations

Data were collected in the Demographic and Health Surveys (DHS) conducted in Bangladesh in 2004 and Kenya in 2003. The sampling design for the Bangladesh survey, a multistage cluster sample based on the 2001 census, was designed to produce representative estimates for each of the country's six divisions (National Institute of Population Research and Training et al. 2005). The sampling design for the Kenya survey, a two-stage cluster sample based on the 1999 census, was designed to produce representative estimates for each of the country's eight provinces (Central Bureau of Statistics et al. 2004).

The children's recode datasets included observations on 6,908 and 5,949 children younger than 5 years old in Bangladesh and Kenya, respectively. Excluding observations with data missing for variables used in this article, the study samples included 5,767 children in Bangladesh and 4,018 in Kenya. The excluded observations represented (a) children who had died prior to the survey, (b) children who either were not measured during the survey or whose measurements were flagged as being erroneous, and (c) children with data missing for one or more of the socioeconomic variables used here. I further discuss these excluded observations below.

Because the wealth index described below was standardized at the household level, I used the household recode datasets to compute community wealth means and inequality measures. These datasets included observations on 10,500 households in Bangladesh and 8,561 households in Kenya.

Description of variables

The outcome variable, s*tunted*, is a binary variable indicating whether the child's height was more than 2 standard deviations below the international reference median for children his or her age. Although stunting is commonly used as an outcome variable in DHS-based studies, researchers have noted two concerns with the measure. First, DHS guidelines specify that children younger than 24 months should be measured lying down, whereas older children should be measured standing up, but survey takers often disregard these guidelines. In these surveys, method-of-measurement error rates for children younger than 24 months were 2 percent in Bangladesh and 17 percent in Kenya, and the error rates for older children were 2 percent in Bangladesh and 12 percent in Kenya. DHS sometimes (e.g., Pullum 2008) recommends subtracting 1 centimeter from the measured height of children 24 months old and older who were incorrectly measured lying down. Second, the World Health Organization (WHO 2006) has described as inadequate the international child growth standards that it had previously recommended for use and that were used in these surveys, and it has recommended new standards. I performed supplemental analyses using both the recommended height adjustment for children who were improperly measured and the new child growth standards; neither differed from the main results presented here in any significant respect.

I composed all wealth-related variables that were needed to test the various hypotheses, using the wealth index included in the DHS datasets. The DHS wealth index is constructed using a factor analysis procedure, based on the work of Filmer and Pritchett (1999, 2001). DHS collects data on many standard-of-living indicators for each household, including whether a household owns various assets and has access to various social resources. To compute the wealth index, each indicator is standardized within each country, factor coefficients are calculated for each indicator, and a wealth index value is calculated for each household based on these coefficients and whether the household owns or has access to each indicator. Finally, the index is standardized within each country to a mean of 0 and a standard deviation of 1 (actually, 100,000 in the DHS data; Rutstein and Johnson 2004). A list of the indicators that were used to construct the DHS wealth indexes for Bangladesh and Kenya is shown in Table 1.

A wealth index overcomes most of the difficulties associated with income- and consumption-based measures, which are often reported unreliably, especially for poor households in developing countries (Rutstein and Johnson 2004; see also Deaton 2003; Filmer and Pritchett 2001). A wealth index directly assesses a household's long-term economic status, but it also serves as a proxy for short-term measures of economic status such as income and consumption (Filmer and Pritchett 2001). In that regard, wealth-based measures are weak proxies for consumption, but they can still be effective proxies in demographic surveys because of the large sample sizes and because individual consumption is so variable that even weak proxies are acceptable (Montgomery et al. 2000).

To derive Gini indexes from the DHS wealth index, I adjusted the index values so that all values were positive by adding 133,333 to the wealth index values in each country. This adjustment affected only the calculation of the Gini index and did not affect the regression results for any of the other wealth-related variables. To simplify the interpretation, I divided these ad-

TABLE 1 Indicators used to construct the DHS wealth index for Bangladesh and Kenya

Bangladesh	Kenya
Whether household has electricity	Whether household has electricity
Source of household drinking water	Source of household drinking water
Type of household toilet or latrine	Type of household toilet or latrine
Type of household cooking fuel	Type of household cooking fuel
Main household roof material	Type of household waste disposal
Main household wall material	Main household roof material
Main household floor material	Main household floor material
Whether household has almirah or wardrobe	Whether household has radio
Whether household has table	Whether household has television
Whether household has chair or bench	Whether household has telephone or mobile phone
Whether household has watch or clock	Whether household has refrigerator
Whether household has cot or bed	Whether household has bicycle
Whether household has radio	Whether household has motorcycle
Whether household has television	Whether household has car or truck
Whether household has bicycle	Whether household has solar power
Whether household has motorcycle	Whether household owns land
Whether household has sewing machine	
Whether household has telephone	
Whether household owns land	
Whether household has at least one domestic worker	

justed values by 100,000, so that each country's adjusted wealth index has a mean of 1⅓ and a standard deviation of 1.

Household wealth is the adjusted wealth index value. *Community wealth Gini index* is the Gini index of household wealth inequality (adjusted for sampling weights) within each region, subregion, and district. *Mean community wealth* is the mean household wealth (adjusted for sampling weights) within each region, subregion, and district. *Percentile rank of household wealth in community* is calculated by ranking all households by wealth within each region, subregion, and district and dividing each household's rank by the total number of households within each such region, subregion, or district to obtain a fractional value between 0 and 1 for each household. *Percentile rank of mean community wealth in population* is calculated by ranking each region, subregion, and district by mean household wealth (adjusted for sampling weights) and dividing that rank by the total number of those regions, subregions, or districts to obtain a fractional value between 0 and 1 for each region, subregion, or district.

I selected the other socioeconomic independent variables based on the modified Mosley/Chen framework. *Mother's education* is a count variable measured in years. *Mother's employment status* is a binary variable indicating whether the mother was employed outside the household. *Mother's partner's education* is a count variable measured in years. *Mother's partner lives at home* is a binary variable indicating whether the partner of the child's mother lived with the mother. *Mother's partner's age* is a count variable measured in years. (The mother's own age is considered a proximate factor that directly affects children's health, rather than a socioeconomic factor that affects children's health only indirectly, and it is therefore not included in this study.) *Household size* is a count variable for the total number of members of the household.

Table 2 summarizes the sample values of the independent variables used in this article (adjusted for sampling weights). Bangladesh has greater wealth inequality (higher Gini indexes) within all definitions of community. In contrast, Kenya has greater wealth inequality between communities, as evidenced by the greater standard deviations of its mean community wealth values across all definitions of community. The mean values for household wealth and mean community wealth in both countries are lower than the mean value of the adjusted wealth index of 1⅓. This result is due to adjustment for sampling weights and to the fact that households with young children are poorer on average than the population as a whole.

Statistical methods

I used logistic regressions to calculate odds ratios, 95 percent confidence intervals, and significance levels based on 90, 95, and 99 percent confidence intervals. I adjusted the standard errors to account for the clustering of households within sampling units. I also adjusted for the unequal sampling probabilities with the sample weights provided in the DHS datasets.

TABLE 2 Means, percent distribution, and standard deviations of independent variables in DHS samples

	Bangladesh, 2004			Kenya, 2003		
Variable	%	Mean	(SD)	%	Mean	(SD)
Wealth-related independent variables						
Household wealth		1.158	(0.877)		0.972	(0.810)
Community wealth Gini index						
Within regions		0.386	(0.023)		0.344	(0.055)
Within subregions		0.316	(0.025)		0.271	(0.066)
Within districts		0.331	(0.050)		0.273	(0.080)
Mean community wealth						
Within regions		1.213	(0.158)		1.125	(0.493)
Within subregions		1.186	(0.500)		1.055	(0.621)
Within districts		1.182	(0.448)		1.048	(0.615)
Difference between household wealth and mean community wealth						
Within regions		–0.055	(0.867)		–0.153	(0.619)
Within subregions		–0.028	(0.725)		–0.083	(0.488)
Within districts		–0.024	(0.764)		–0.076	(0.521)
Percentile rank of household wealth in community						
Within regions		0.478	(0.278)		0.477	(0.284)
Within subregions		0.510	(0.288)		0.498	(0.288)
Within districts		0.494	(0.284)		0.482	(0.285)
Percentile rank of mean community wealth in population						
Within regions		0.620	(0.322)		0.558	(0.223)
Within subregions		0.275	(0.284)		0.342	(0.239)
Within districts		0.544	(0.304)		0.568	(0.284)
Other socioeconomic independent variables						
Mother's education		3.6	(3.7)		6.6	(3.8)
Mother's employment status						
Not working	82.9			37.7		
Working	17.1			62.3		
Mother's partner's education		4.0	(4.3)		7.8	(4.1)
Mother's partner lives at home						
No	8.9			19.1		
Yes	91.1			80.9		
Mother's partner's age		35.1	(8.0)		36.1	(9.1)
Household size		6.5	(3.0)		6.0	(2.3)

NOTE: N = 5,767 for Bangladesh; N = 4,018 for Kenya.

Results and discussion

For each of the six hypotheses I examine, the first model includes only the wealth index equivalents of the income measures in Wagstaff and van Doorslaer's individual health function for the hypothesis. The second model adds the other individual- and household-level socioeconomic factors from the modified Mosley/Chen framework. I included models with second powers of the wealth terms for each hypothesis and models with terms measuring interactions among different wealth terms for all hypotheses with more than one wealth term. These terms were significant only for the income inequality hypothesis, so I do not present these models for the other hypotheses. I also included a model with mean community wealth as a covariate for the income inequality hypothesis even though it is not part of the individual health function for that hypothesis, because prior studies have often included a measure of mean economic status (e.g., Blakely, Lochner, and Kawachi 2002).

All models also control for the child's age (using a quartic function based on the age in months), sex, religion, and, in Kenya, ethnicity (Bangladesh has negligible ethnic diversity). I also tested the impact of adding indicator variables for the region and for urban or rural residence for all hypotheses to control for unobserved geographic factors (Mellor and Milyo 2002, 2003). These indicator variables affected the results in only a few cases, which I describe below.

Although I tested all models with community-based wealth measures using each of the three community definitions discussed above, I present only the results for the subregion definition for most hypotheses. The results with the other two community definitions were generally similar. The greatest differences in results among the various community definitions occurred with respect to the income inequality hypothesis.

The income inequality hypothesis—community-level version

The community-level version of the income inequality hypothesis argues that individual health is affected not only by individual economic status, but also by the level of economic inequality in the individual's community. Thus, it has the following individual health function: $h_i = f_I(y_i, I_c)$, where h_i is the health status of individual i, f_I is the individual health function, y_i is the economic status of individual i, and I_c is community economic inequality.

The results for Bangladesh, presented in Table 3, vary by definition of community. With the largest community definition, the results generally support the hypothesis, as the odds ratio for the Gini index term is significant and larger than 1 in the basic model (Model 1), after the other socioeconomic factors are added (Model 2), and even when the household wealth term is allowed to be nonlinear (Model 3), indicating significantly greater odds of stunting in regions with greater wealth inequality. However, with the other two community definitions, the results do not support the hypothesis. Within subregions, the odds ratio for the Gini index term is significant (at the 10 percent level) only in the model that controls for urban or rural residence (not presented in the table), and it is smaller than 1 in all models without nonlinear or interaction terms. Within districts, the odds ratio for the Gini index term is again larger than 1, but it is not significant in any of the models.

The difference in results by community size is consistent with Wilkinson and Pickett's (2007) hypothesis that income inequality is a more important determinant of health across larger geographic areas. The difference could also be due to data limitations. These survey data are fully representative only at the regional level, and, as noted above, researchers have raised concerns about estimating smaller-area inequality measures from survey data.

With the two larger community definitions in Bangladesh, there is evidence of a significant nonlinear relationship between community wealth inequality and stunting (Model 4). Using the community definition of a subregion, I divided these communities into terciles based on the Gini index, representing low, medium, and high wealth inequality, and repeated the Model 2 analysis within each tercile. The odds ratio for the Gini index term is highly significant and smaller than 1 within the low wealth inequality tercile (OR = 8.8 e–9),[2] showing a beneficial relationship with increased wealth inequality within this tercile. Within the medium and high wealth inequality terciles, the odds ratio for the Gini index term is larger than 1, but insignificant (medium: OR = 3.8 e+6; high: OR = 353. Thus, although there is some evidence of a U-shaped relationship between wealth inequality and stunting, the only significant relationship is among subregions with low wealth inequality, and that relationship is contrary to the income inequality hypothesis.

Using the two smaller community definitions in Bangladesh, there is evidence of a significant interaction between household wealth and community wealth inequality (Model 5). To examine this interaction, I repeated the Model 2 analysis within household wealth quintiles using the community definition of a subregion. The relationship between community wealth inequality and stunting is not significant within the three poorest wealth quintiles (quintile 1: OR = 14.6; quintile 2: OR = 0.95; quintile 3: OR = 3.43), but the odds ratio for the Gini index term is highly significant and smaller than 1 within the two richest wealth quintiles (quintile 4: OR = 7.5 e–4; quintile 5: OR = 8.9 e–5). Thus, this result fails to support the income inequality hypothesis among poorer households and suggests that among richer households, children are healthier in subregions with greater wealth inequality.

The results for Kenya in this version of the income inequality hypothesis are presented in Table 4. In Kenya, the odds ratio for the Gini index term is never significant either in the basic model (Model 1) or when the other socioeconomic factors are included (Model 2). With the largest community definition, the odds ratio for the Gini index term is significant (at the 10 percent level) only in the model with the additional control for mean com-

TABLE 3 Income inequality hypothesis (community-level version): Adjusted odds ratios and 95 percent confidence intervals for stunting in Bangladesh

Independent variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Community defined as region						
Household wealth	0.58*** [0.53, 0.63]	0.65*** [0.58, 0.72]	0.58*** [0.44, 0.78]	0.65*** [0.58, 0.72]	0.36 [0.09, 1.42]	0.64*** [0.58, 0.72]
Household wealth squared			1.03 [0.96, 1.10]			
Community wealth Gini index	76.4** [2.08, 2808]	46.6** [1.32, 1649]	43.1** [1.23, 1517]	6.4 e–48* [1.3 e–95, 3.22]	9.65 [0.04, 2562]	14.7 [0.28, 784]
Community wealth Gini index squared				1.5 e+63** [5.27, 4.1 e+125]		
Interaction of wealth and Gini index					4.47 [0.14, 146]	
Mean community wealth						1.35 [0.73, 2.50]
Community defined as subregion						
Household wealth	0.58*** [0.54, 0.64]	0.66*** [0.59, 0.73]	0.58*** [0.44, 0.78]	0.63*** [0.57, 0.70]	2.36** [1.07, 5.20]	0.58*** [0.51, 0.65]
Household wealth squared			1.03 [0.97, 1.10]			
Community wealth Gini index	0.16 [0.01, 3.39]	0.08 [0.004, 1.71]	0.09 [0.004, 1.83]	1.9 e–34*** [6.9 e–60, 5.2 e–9]	12.01 [0.14, 1027]	0.16 [0.01, 2.97]
Community wealth Gini index squared				1.0 e+49** [3.7 e+10, 2.9 e+87]		
Interaction of wealth and Gini index					0.02*** [0.001, 0.20]	
Mean community wealth						1.37*** [1.14, 1.65]

Community defined as district						
Household wealth	0.59*** [0.54, 0.64]	0.66*** [0.59, 0.74]	0.58*** [0.43, 0.78]	0.66*** [0.59, 0.74]	1.10 [0.64, 1.89]	0.60*** [0.54, 0.67]
Household wealth squared			1.04 [0.97, 1.11]			
Community wealth Gini index	1.40 [0.26, 7.65]	1.17 [0.22, 6.35]	1.12 [0.20, 6.12]	1.2 e+4 [2.4 e–4, 6.4 e+11]	6.17 [0.46, 82.3]	1.60 [0.30, 8.69]
Community wealth Gini index squared				7.9 e–7 [2.2 e–18, 2.8 e+5]		
Interaction of wealth and Gini index					0.21* [0.04, 1.05]	
Mean community wealth						1.34** [1.06, 1.68]

*p < .10. **p < .05. ***p < .01.
NOTE. N = 5,767. All models are also adjusted for the child's age, sex, and religion. All models except Model 1 are also adjusted for the other socioeconomic independent variables (mother's education, mother's employment status, mother's partner's education, mother's partner lives at home, mother's partner's age, mother's partner's age squared, household size, and household size squared). X e+y = $X \cdot 10^{y}$ and X e–y = $X \cdot 10^{-y}$.

TABLE 4 Income inequality hypothesis (community-level version): Adjusted odds ratios and 95 percent confidence intervals for stunting in Kenya

Independent variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Community defined as region						
Household wealth	0.61*** [0.52, 0.71]	0.75*** [0.63, 0.89]	0.97 [0.63, 1.50]	0.71*** [0.60, 0.85]	0.59 [0.29, 1.20]	0.68*** [0.57, 0.81]
Household wealth squared			0.92 [0.81, 1.04]			
Community wealth Gini index	0.39 [0.04, 3.86]	0.67 [0.08, 5.88]	0.41 [0.05, 3.64]	9.5 e–7 [2.3 e–14, 38.5]	0.11 [4.0 e–4, 32.8]	41.6* [0.63, 2741]
Community wealth Gini index squared				7.5 e+10 [3.1 e–4, 1.8 e+25]		
Interaction of wealth and Gini index					2.06 [0.26, 16.1]	
Mean community wealth						1.78** [1.12, 2.82]
Community defined as subregion						
Household wealth	0.60*** [0.52, 0.70]	0.74*** [0.63, 0.86]	0.94 [0.60, 1.46]	0.67*** [0.56, 0.80]	0.88 [0.59, 1.33]	0.59*** [0.49, 0.72]
Household wealth squared			0.93 [0.82, 1.05]			
Community wealth Gini index	0.37 [0.05, 3.06]	0.47 [0.07, 3.39]	0.41 [0.06, 2.91]	4.0 e–7** [1.6 e–12, 0.10]	1.31 [0.07, 24.5]	2.20 [0.21, 23.4]
Community wealth Gini index squared				3.6 e+11** [38.5, 3.3 e+21]		
Interaction of wealth and Gini index					0.45 [0.07, 2.69]	
Mean community wealth						1.52*** [1.16, 1.97]

Community defined as district						
Household wealth	0.63*** [0.55, 0.71]	0.77*** [0.67, 0.89]	0.95 [0.61, 1.47]	0.79*** [0.68, 0.91]	0.82 [0.61, 1.09]	0.69*** [0.57, 0.84]
Household wealth squared			0.94 [0.83, 1.06]			
Community wealth Gini index	1.08 [0.37, 3.18]	1.72 [0.57, 5.18]	1.65 [0.55, 5.00]	972** [2.06, 4.6 e+5]	2.18 [0.45, 10.6]	1.92 [0.63, 5.89]
Community wealth Gini index squared				1.0 e–5** [2.4 e–10, 0.45]		
Interaction of wealth and Gini index					0.78 [0.25, 2.44]	
Mean community wealth						1.21* [0.98, 1.50]

*p < .10. **p < .05. ***p < .01.
NOTE. N = 4,018. All models are also adjusted for the child's age, sex, religion, and ethnicity. All models except Model 1 are also adjusted for the other socioeconomic independent variables (mother's education, mother's employment status, mother's partner's education, mother's partner lives at home, mother's partner's age, mother's partner's age squared, household size, and household size squared). X e+y = $X \cdot 10^{y}$ and X e–y = $X \cdot 10^{-y}$.

munity wealth (Model 6). With the two smaller community definitions, the odds ratio for the Gini index term is significant only in some of the models that include indicator variables for region or for urban or rural residence (not presented in the table).

With the two smaller community definitions in Kenya, there is evidence of a significant nonlinear relationship between community wealth inequality and stunting (Model 4). As with Bangladesh, to understand this nonlinearity, I repeated the Model 2 analysis within terciles. The odds ratio for the Gini index term is significant and smaller than 1 within the low wealth inequality tercile (OR = 7.4 e–6), but it is not significant within the medium or high wealth inequality terciles and it is smaller than 1 within the medium tercile (OR = 6.9 e–8) and larger than 1 within the high tercile (OR = 10.1). Thus, as in Bangladesh, there is some evidence of a U-shaped relationship between wealth inequality and stunting, but the only significant relationship is among subregions with low wealth inequality, and the relationship is contrary to the income inequality hypothesis.

These results provide little support for the community-level version of the income inequality hypothesis. Only one of the six sets of models considered—using the community definition of region in Bangladesh—consistently supports the hypothesis. In most cases when the odds ratio for the Gini index term is significant, it indicates a beneficial relationship between greater wealth inequality and stunting, which is contrary to the hypothesis.

The absolute income hypothesis

The absolute income hypothesis argues that the entire relationship between population economic inequality and population health is due to a nonlinear relationship between individual economic status and individual health. This nonlinearity is reflected in the increasing, concave-shaped individual health function for the hypothesis: $h_i = f_I(y_i);\ f_I' > 0\ \ f_I'' < 0$. The hypothesis argues that there is no direct effect of economic inequality on individual health.

The results of this study, presented in Table 5, do not support this hypothesis, as the odds ratio of the squared household wealth term is never significant in either country. In Bangladesh, the curve has the correct shape—the odds of stunting decrease as household wealth increases and increase as the square of household wealth increases. In both countries, however, the results are most consistent with a linear relationship between household wealth and stunting (which is highly significant in both countries when the squared term is not included).

The lack of stronger support for the absolute income hypothesis in these countries may not be surprising considering their low levels of per capita income and wealth. Thus, even the relatively wealthy in these countries are still poor by world standards and are likely to fall below the wealth thresh-

TABLE 5 Adjusted odds ratios and 95 percent confidence intervals for stunting in Bangladesh and Kenya

Independent variable	Bangladesh Model 1	Bangladesh Model 2	Bangladesh Model 3	Kenya Model 1	Kenya Model 2	Kenya Model 3
Absolute income hypothesis[a]						
Household wealth	0.51*** [0.39, 0.66]	0.58*** [0.43, 0.77]		0.73 [0.47, 1.13]	0.94 [0.61, 1.46]	
Household wealth squared	1.04 [0.97, 1.11]	1.04 [0.97, 1.11]		0.95 [0.84, 1.07]	0.93 [0.83, 1.06]	
Relative income hypothesis (community-level version)[a, b]						
Difference between household wealth and mean community wealth	0.53*** [0.49, 0.58]	0.60*** [0.53, 0.68]	0.72*** [0.60, 0.86]	0.47*** [0.39, 0.56]	0.62*** [0.51, 0.74]	0.69*** [0.56, 0.87]
Household wealth			0.80*** [0.68, 0.94]			0.86** [0.74, 1.00]
Deprivation hypothesis[c]						
Household wealth	0.62*** [0.55, 0.69]	0.72*** [0.64, 0.81]		0.64*** [0.53, 0.76]	0.81** [0.66, 0.99]	
Relative position hypothesis (individual-in-community version)[a, b]						
Household wealth	0.69*** [0.60, 0.78]	0.75*** [0.65, 0.85]		0.71*** [0.62, 0.81]	0.82*** [0.71, 0.94]	
Percentile rank of household wealth in community	0.55*** [0.39, 0.78]	0.56*** [0.39, 0.82]		0.56*** [0.41, 0.77]	0.68** [0.49, 0.95]	
Relative position hypothesis (community-in-population version)[a, b]						
Household wealth	0.54*** [0.49, 0.59]	0.60*** [0.53, 0.68]		0.47*** [0.39, 0.56]	0.60*** [0.49, 0.72]	
Percentile rank of mean community wealth in population	1.59*** [1.16, 2.20]	1.52** [1.10, 2.11]		3.51*** [1.95, 6.33]	2.68*** [1.49, 4.82]	

*p < .10. **p < .05. ***p < .01

NOTE: All models are also adjusted for the child's age, sex, religion, and, for Kenya, ethnicity. Models 2 and 3 are also adjusted for the other socioeconomic independent variables (mother's education, mother's employment status, mother's partner's education, mother's partner lives at home, mother's partner's age, mother's partner's age squared, household size, and household size squared).

[a]N = 5,767 for Bangladesh; N = 4,018 for Kenya. [b]Community is defined as subregion. [c]Sample includes only nonpoor households: N = 3,346 for Bangladesh; 1,552 for Kenya.

old at which individual health exhibits significantly diminishing returns for increases in individual wealth.

The relative income hypothesis—community-level version

The community-level version of the relative income hypothesis argues that individual health is affected by the difference between the individual's economic status and the mean economic status in his or her community. Thus, it has the following individual health function: $h_i = f_I(y_i - y_c)$, where y_c is mean community economic status.

The results for this hypothesis, using the community definition of a subregion, are presented in Table 5. The results strongly support the hypothesis, as the odds ratio for the wealth difference term is always highly significant and smaller than 1. This result withstands controls for region and for urban or rural residence in both countries. The results were similar for the other community definitions. Even when an additional control for household wealth is added (Model 3), the wealth difference term remains highly significant, demonstrating a significant additional contribution of relative household wealth within the community. In fact, the difference between household wealth and mean community wealth is a stronger predictor of stunting than household wealth itself in both countries.

Thus, although the results from the income inequality hypothesis suggested that the overall distribution of wealth within the community is not associated with stunting, the household's position relative to the mean of that distribution is associated with stunting. If stress is a key psychosocial factor, this outcome may occur because households compare themselves with an average household within their community, and not with the richest or poorest households. It could also result from costs of and access to material resources being determined by average households within a community, rather than by the richest or poorest households.

The deprivation hypothesis

The deprivation hypothesis argues that individual health is affected by the extent to which an individual's economic status falls below some threshold, such as the poverty line. The implication is that household wealth does not significantly affect health for richer households. Thus, the following individual health function applies: $h_i = f_I(g_i, z)$, where g_i is the gap (if any) between the economic status of individual i and the poverty line, z.

This hypothesis then would require both (a) a negative relationship between household wealth and stunting for households below the poverty line and (b) no relationship between household wealth and stunting for households above the poverty line. The tests of the absolute income hypothesis described above already established the former relationship in both countries; the key question is whether household wealth is significantly related to stunting for households above the poverty line. Table 5 presents these results, using the wealth index values corresponding to the national poverty rates in each country (40 percent in Bangladesh and 46 percent in Kenya; World Bank 2010). The results do not support the deprivation hypothesis, as the odds ratio of the household wealth term is always highly significant and smaller than 1 in these nonpoor households. Other analyses, using the wealth index values corresponding to the $1.25 a day and $2 a day poverty rates, produced similar results, although the wealth term was insignificant in some models for Bangladesh with the $2 a day poverty rate, which limited the sample to the wealthiest 18.7 percent of households. These results indicate that household wealth remains strongly related to stunting in nonpoor households under most definitions of poverty, which is consistent with the linear relationship between household wealth and stunting shown in the tests of the absolute income hypothesis above. This study does not consider other definitions of economic deprivation or multidimensional measures of poverty, which might yield different results.

The relative position hypothesis—individual-in-community version

The individual-in-community version of the relative position hypothesis argues that, when individual economic status is held constant, individuals who rank higher within their community will be healthier than those who rank lower. Thus, it has the following individual health function: $h_i = f_I(y_i, R_{i,c})$, where $R_{i,c}$ is the individual's ranking in the community wealth distribution. The implication is that only the ordering of households within the relevant community matters, not the magnitude of the gaps between those households.

The results presented in Table 5, using the community definition of a subregion, strongly support the hypothesis. Both the household wealth and the percentile rank terms are highly significant in both models for both countries. However, the percentile rank term is consistently less significant than the household wealth term, in contrast to the results for the relative income hypothesis discussed above. Also, controlling for urban/rural residence eliminates the significance of the percentile rank term in Kenya. Thus, the additional impact of the household's percentile rank within the community in Kenya may relate largely to differences between urban and rural areas. The results were generally similar for the other two community definitions in both countries, except that the percentile rank terms were not significant in either country using the community definition of a region after I added the other socioeconomic covariates. The lack of significance within regions is again likely due to urban/rural differences and the difficulty of directly comparing households in relatively poor rural areas with households in relatively wealthy urban areas within the same region.

The results for this hypothesis are similar to those for the relative income hypothesis. However, the relationship between stunting and the household's percentile rank in the community is more fragile than its relationship with the difference between household wealth and mean community wealth. Therefore, stunting appears to be related to the magnitude of wealth differences between households and not merely to the ranking of households by wealth within a community.

The relative position hypothesis—community-in-population version

The community-in-population version of the relative position hypothesis argues that, holding individual economic status constant, individuals who live in wealthier communities will be healthier than those who live in poorer communities. Thus, it has the following individual health function: $h_i = f_I(y_i, R_{c,p})$, where $R_{c,p}$ is the community's ranking by mean economic status within the population.

Table 5 presents the results of models testing this version, using the community definition of a subregion. As expected, the household wealth odds ratios are highly significant and smaller than 1 in both countries. However, the percentile rank odds ratios are all larger than 1 and highly significant, indicating that living in a richer community is associated with greater odds of stunting, which is contrary to the result predicted by this version of the hypothesis. In both countries, the percentile rank term is insignificant (but still larger than 1) when controlling for urban/rural status; thus, the importance of this term may relate partly to differences between urban and rural areas. The results are similar for the other community definitions, where the odds ratio for the percentile rank term is consistently larger than 1. But the term is not significant for the other community definitions in Bangladesh; this difference in the results may again show the importance of urban/rural differences, because most districts and regions include both urban and rural areas, whereas subregions do not.

Although the results for this version of the hypothesis may seem unexpected, they agree with the results for the relative income hypothesis. In both cases, when household wealth is held constant, households in richer communities experience greater odds of stunting than those in poorer communities. These results apply to both poor and wealthy households and are consistent with both of the mechanisms (psychosocial and neomaterial) discussed above, at least insofar as poor households are concerned (the mechanisms generally do not focus on the effects on wealthy households). Poor households in richer communities may have adverse psychosocial consequences because of increased awareness of their relative deprivation and may benefit less from the community's social capital than they would if they were nearer the average community wealth. Also, although education is controlled for, poor households in richer communities may suffer from reduced access to other public and private resources.

Additional analyses

I performed three additional checks of the robustness of my results. The first related to the excluded observations discussed above. I repeated the analyses (a) assuming that all of the children who died prior to the survey had been stunted, (b) using Heckman selection models to control for the possibility that the missing data for children who were not measured or whose measurements were erroneous may be related to the independent variables, and (c) omitting the variables relating to the mother's partner, which accounted for almost all of the missing data on socioeconomic variables. These three approaches to addressing the excluded observations, individually or cumulatively, did not affect the results discussed above, except that some support was found for the income inequality hypothesis in Kenya with the community definition of a district. Even then, however, the Gini index term was significant only at the 5 percent or 10 percent level, depending on the covariates included, and there was still no support for the income inequality hypothesis in Kenya with the other two definitions of community. Therefore, this result does not alter the conclusion that these data provide little support for the income inequality hypothesis in these countries.

The second robustness check related to the concerns about using survey data to estimate inequality measures for small areas. Surveys in both countries were stratified at the regional level, so the inequality estimates for subregions and districts may not be reliable because of a lack of representativeness and, in some cases, because of an insufficient number of observations. Although some researchers have followed Elbers, Lanjouw, and Lanjouw's (2003) methodology of combining census data with survey data to estimate inequality measures for small areas, others (Tarozzi and Deaton 2009) have questioned the reliability of this approach. I addressed this issue, in part, by repeating all of the analyses with samples limited to subregions and districts that had data for at least 100 households; this technique addressed concerns about sample size, but not about representativeness. These analyses with the limited samples did not differ significantly from the main analyses with the full samples discussed above.

The third robustness check related to the fact that the wealth inequality variables used in the tests of the hypotheses above differed from one another in two important respects. The variance of these terms differed significantly, as Table 2 indicates, and the variables were measured at different levels, with two variables measured at the household level and the other two measured at the community level. To address the difference in variance, I calculated the effects of a 1 standard deviation increase in each of the wealth inequality terms on the odds of stunting in these countries. The results of these calculations were consistent with the findings discussed above, with the largest effects for the relative income hypothesis in both countries. A 1 standard deviation increase in household wealth relative to the community mean was associated with a 30–32 percent decrease in the odds of stunting in Bangladesh and a 16–21 percent decrease in those odds in Kenya. To address the difference in measurement levels, I repeated the analyses for the two hypotheses that include wealth inequality variables measured at the community level, but used multilevel logistic regressions with bootstrapped standard errors to explicitly model the hierarchical data structure. Again, the results from these multilevel models did not alter the conclusions with respect to these hypotheses—little support for the income inequality hypothesis and findings contrary to the community-in-population version of the relative position hypothesis—or the overall conclusion that these data provide strongest support for the relative income hypothesis in both countries.

Conclusion and implications

Using survey data from Bangladesh and Kenya, with economic status measured by a wealth index and with three alternative geographic definitions of community, I analyzed six competing hypotheses for how economic inequality may be related to child stunting. Four of the six hypotheses propose relationships between various measures of economic inequality and individual health; the other two propose nonlinear relationships between individual economic status and individual health. I found little support for these last two hypotheses—the absolute income hypothesis and the deprivation hypothesis. Of the four hypotheses that assess various measures of economic inequality, I found little support for the predominant income inequality hypothesis and no support for the version of the relative position hypothesis that considers the community's position within the population. I did find support for the other version of the relative position hypothesis, which considers the individual's position within the community, but this result did not withstand controls for urban/rural residence in Kenya.

I found the strongest support for the relative income hypothesis. The difference between a household's wealth and the community's mean household wealth has a highly significant negative relationship with stunting in both countries. This relationship is robust to controls for all other socioeconomic factors considered, for the household's geographic region, and for the urban/rural status of the household. Moreover, even when an additional control for household wealth is added, the difference between household wealth and mean community wealth is a stronger predictor of stunting than household wealth itself in both countries. Although little prior research has considered the relative income hypothesis, especially in developing countries, these results are largely consistent with the studies by Karlsson et al. (2010), Chen and Meltzer (2008), and Salti (2010) discussed above.

The policy implications from this study of Bangladesh and Kenya involve issues of targeting, as the results suggest that the greatest risks of child stunting occur in the poorest households within communities, rather than in the poorest households within the population as a whole or in the poorest households in the most unequal communities. Although UNICEF (2010a) argued for a focus on the most deprived children and communities, it left open the precise means of identifying those children and communities. Of the targeting approaches discussed in Coady, Grosh, and Hoddinott's (2004) review for the World Bank, these results indicate that benefits for children's health programs in these two countries might be maximized through a household assessment approach, using either a proxy means test similar to the wealth index or community-based targeting to the poorest households within communities, possibly combined with other targeting approaches. Of course, the present study sheds no light on the costs of such targeting—the administrative costs of ascertaining household wealth levels alone might well outweigh the additional benefits (Mkandawire 2005). Further, community-based targeting might not reach the poorest households within communities because of ethnic and gender biases and other distortions (Coady, Grosh, and Hoddinott 2004; Mkandawire 2005).

Regardless of whether universal or targeted delivery approaches are used, however, this study raises a deeper concern about the evaluation of social programs intended to reach the poor. Coady, Grosh, and Hodinott followed conventional methodology for assessing shortfalls in targeted transfer programs by estimating the proportion of program benefits received by the poorest 10 percent, 20 percent, or 40 percent of the population. Similarly, the World Bank's Reaching the Poor studies summarized in Gwatkin, Wagstaff, and Yazbeck (2005) used population percentiles to estimate benefit/incidence ratios and concentration indexes for the health, nutrition, and population programs that were being evaluated; Ashford, Gwatkin, and Yazbeck (2006) describe this evaluation process in some detail. But my results imply that, at least for children's health programs in these two countries, assessments should instead be based on community standards—a household below the designated population percentile in a relatively poor community might benefit less from the program than a household above that population percentile in a relatively wealthy community. Similar results from studies in other developing countries discussed above reinforce this concern and suggest that, at a minimum, program evaluators should consider how sensitive their results are to their choice of reference group.

The research implications from this study are clearer. First, instead of analyzing only the income inequality hypothesis as most prior studies have done, future studies should consider alternative hypotheses for how the economic distribution in a community or population may be related to individual health outcomes. In particular, researchers should consider whether the difference between a household's economic status and the average economic status in the household's community may better predict the health outcomes of interest and, in doing so, should consider other measures of three key terms: average, economic status, and community.

Second, future research should attempt to determine pathways between community economic inequality and individual health outcomes, focusing both on broad mechanisms relevant to health outcomes generally, such as the psychosocial and neomaterial mechanisms discussed above, and on specific mediating factors relevant to the particular health outcome in question. This work should be grounded in theory, since it is difficult to identify these pathways using quantitative analysis alone (see MacKinnon 2008; Ravallion 2009). This type of research might support or eliminate certain variables or categories of variables as important mediators of the relationship between economic inequality and individual health outcomes, so that policymakers can design and evaluate programs that are most likely to be effective.

Notes

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1 Gini indexes are the most commonly used measure of area-level economic inequality. A Gini index potentially ranges from 0 (in an area where all people or households have equal incomes, consumption, or wealth) to 1 (in an area where the richest person or household has all the income, consumption, or wealth). It is calculated as twice the area between a Lorenz curve (plotting the cumulative percent of the total income, consumption, or wealth in an area associated with each additional percentile of an area's population) and a diagonal line of perfect equality.

2 This article uses scientific e notation to present very large and small numbers. Thus, $X\ e{+}y = X \cdot 10^{y}$ and $X\ e{-}y = X \cdot 10^{-y}$.

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