Spatial Analysis of Childhood Malnutrition in Bangladesh

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INTRODUCTION

Recent statistics show that child mortality has decreased remarkably in most parts of the developing world in the past two decades. However, improving health and well-being of the surviving children continues to be a challenge. This project examines the prevalence of chronic malnutrition among children under five, a robust measure of child health, in Bangladesh with respect to spatial-contextual factors such as urban/rural residence, elevation level of the community, and population density or pressure in the larger administrative unit.

Figure 1: Infant Mortality Rates in South Asian Region (2000)

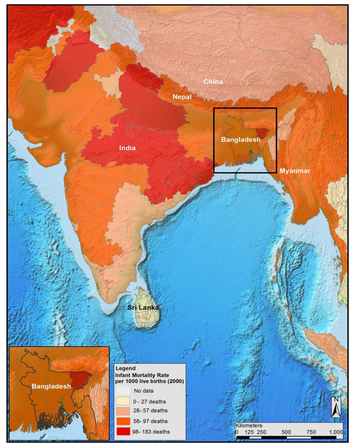
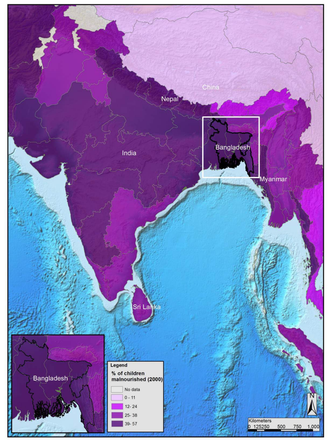


Figure 2: Child Malnutrition in South Asian Region (2000)

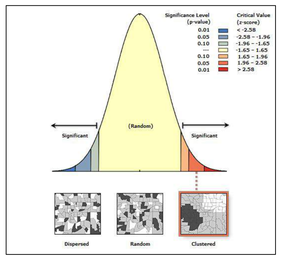


BACKGROUND/HYPOTHESES

Bangladesh has witnessed a substantial decline in child deaths with under- 5 mortality decreasing from 143 (per 1000 live births) in 1990 to 86 in 2010, but child health status has barely improved with 36% (compared to 43% in 2000) of children reported as malnourished according to the latest statistics (Demographic and Health Survey 2011). Research suggests that place, which encompasses one's geographic and social location, is an important determinant of health. Based on past studies, I propose the following three hypotheses:

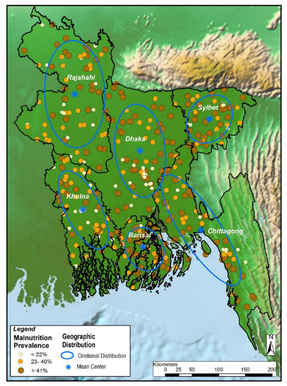
- *Urban children have better nutritional status than rural children* (Smith et al. 2005).
- *Children living in or near areas with high population density/pressure are more likely to be malnourished than those in sparsely populated areas* (Root 1997).
- *Communities at higher elevation have lower prevalence of childhood malnutrition than those at lower elevation.* (Haines et al. 2003)

Figure 3: Moran's *I*: Spatial Autocorrelation



Global Moran's I Summary	
Moran's Index:	**0.020301**
Expected Index:	-0.002778
Variance:	0.000120
z-score:	**2.107231**
p-value:	**0.035098**

Figure: 4: Directional Distribution and Mean Center of Chronic Malnutrition by Administrative Divisions



The prevalence rate of chronic malnutrition in the surveyed communities is 40.2 percent with variations across regions. The Moran's *I* index is statistically significant at 0.05 level, indicating that there is less than 5% chance that the observed clustering of malnutrition rates is a result of chance. Figure 4 shows directional trend of chronic malnutrition by division with respective mean centers. The figure suggests that the directional distribution of malnutrition rates varies by administrative division.

DATA AND METHODS

Data: I used nationally representative data from 2007 Demographic and Health Survey (N= 6,150) to calculate percent of children malnourished (height-for-age index) for each of the 361 surveyed communities. Each child is nested within a geo-referenced community, which includes between 18- 45 sampled households. In addition, the data set includes elevation data for the communities. Data for population density come from the 2011 Bangladesh Census.

Methods:

- Moran's *I:* Spatial autocorrelation analysis to check whether the observed patterns of childhood malnutrition exhibit some level of statistically significant clustering.
- Geographic distributions: Standard deviational ellipses and estimates of mean center for each of the 6 administrative divisions to examine the variations in malnutrition prevalence rates across the country.
- Kernel density: Kernel density map to visualize areas with high magnitude of chronic malnutrition. The density map is also overlaid on other maps representing rural/urban location, population density, and elevation level of communities.

Figure 5: Kernel Density Map of Chronic Malnutrition

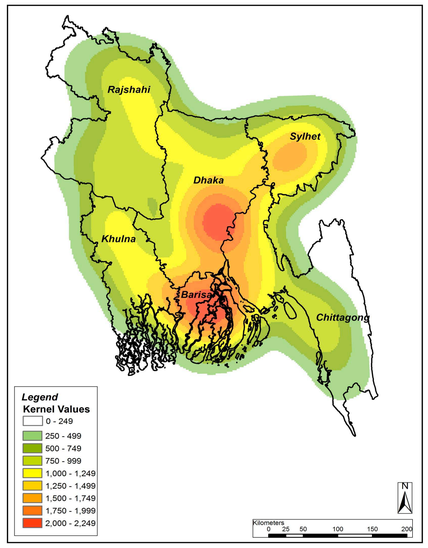
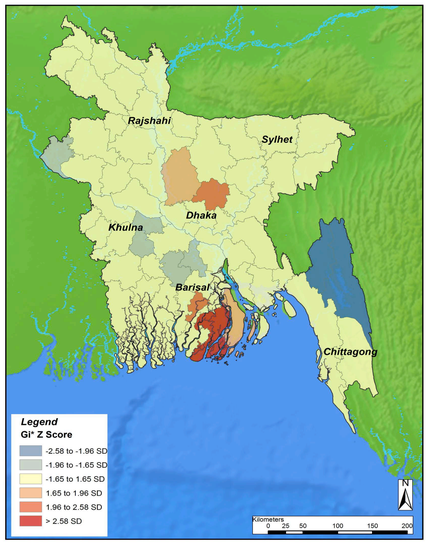


Figure 6: Hot Spot Analysis (Getis-Ord Gi*) of Chronic Malnutrition



FINDINGS

- Chronic malnutrition is rampant in Bangladesh with the large number of study communities having average (40.2%) or above average chronic malnutrition rates.
- As the kernel density map (Figure 5) depicts, the high magnitude of chronic malnutrition is concentrated in Barisal, Dhaka and Sylhet divisions.

- Figure 6 identifies statistically significant hot spots (red) and cold spots (blue) of chronic malnutrition using Getis-Ord Gi* statistic. The results are similar to kernel density map, but this analysis only identifies hot spots in Barisal and Dhaka, and not in Sylhet.
- The cold spots with relatively lower malnutrition rates are in Khulna and Rajshahi.

Distribution of Chronic Malnutrition by Urban/Rural Residence

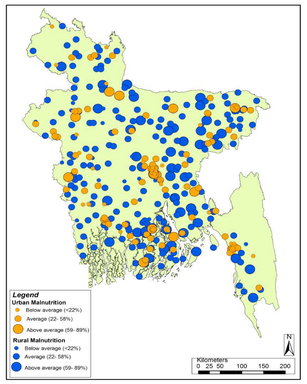


Figure 7: Urban/Rural residence

Urban children appear to have better nutritional health than their rural counterparts. However, there are some exceptions such as higher malnutrition rates in urban communities in Dhaka division, where there is a large slum population.

Figure 8: Population Density

There is no clear pattern of distribution of chronic malnutrition by population density/pressure. But, Dhaka has both high population density and larger concentration of chronic malnutrition.

Distribution of Chronic Malnutrition by Population Density

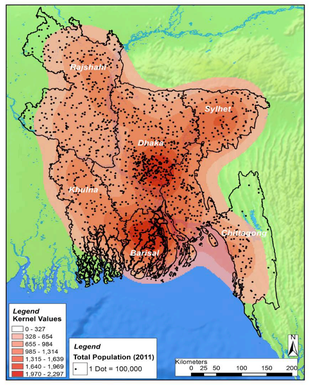
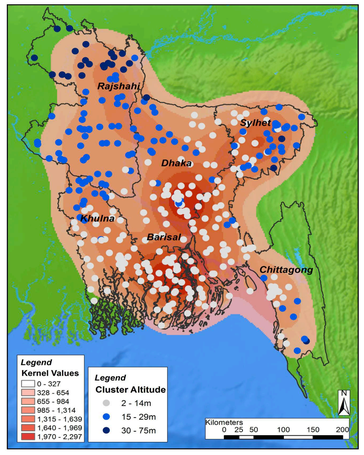


Figure 9: Community Elevation

There is compelling evidence that larger proportion of children living in low-lying areas are chronically malnourished than those living in higher elevation areas. Food and water insecurity as well as loss of shelter due to frequent flooding may account for higher prevalence of chronic malnutrition in low elevation communities.

Distribution of Chronic Malnutrition by Elevation



CONCLUSION/DISCUSSION

- Spatial analysis of chronic malnutrition reveals that attributes of a place play an important role in shaping health and well-being of children, with some areas experiencing higher prevalence of childhood malnutrition than others.
- Elevation level appears to have a strong influence on chronic malnutrition with low-lying areas having higher rates of malnutrition than those in higher altitudes. Rural or urban residence also appears to shape nutritional status of children with urban children faring slightly better, with the exception of Dhaka. On the other hand, rates of malnutrition does not appear to vary distinctly by population pressure or density.
- This project contributes to the growing empirical and spatial understanding of child health inequalities in developing countries, and has important program and policy implications.

REFERENCES AND DATA SOURCES

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