Assessing clustering of malnourished children in developing countries

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Background

Child growth or nutrition is most widely used indicator of child health around the world. It is not only a reflection of past health insults but an important indicator for future health trajectories (UNICEF 1998). In the developing countries, around 230 million children under the age of five years are chronically malnourished or underweight[1] and responsible for more than half of the child deaths (Poel, *et al*. 2007). Apart from being a proximate determinant of childhood death and morbidity, malnutrition is significantly associated with the functional impairment in adult life (Schroeder and Brown 1994). Moreover, the cumulative effect of malnutrition on health, education and productivity makes it one of the main vehicles that drive for the intergenerational transmission of poverty and inequality, especially among the poor and the vulnerable, where the prevalence of malnutrition is highest.

The causes of malnutrition have multifaceted and interrelated and often operate at various levels from the child to the mother, household and community level (Nyovani, *et al.*, 1999). At the individual level, under nutrition arises from inadequate dietary intake and illness, and often interrelated to form a repeated cycle that can have fatal consequences. At mother level, it may arise due to inadequate food or ignored medical assistance during pregnancy. At the household level, the intermediate cause of malnutrition includes inadequate access to food, poor sanitation, insufficient health care and inadequate child care (UNICEF, 1998). At the community level, lack of availability of health facilities, community health workers that can help to improve the nutritional status of children through better health care and education.

Based on above discussion the aim of this study is to assess the extent of clustering of malnourished or underweight children in the developing world. Following the explanation of "death clustering" provided by Ronsmans (1995), Das Gupta (1990), Guo (1993), clustering is defined here as the expression of heterogeneity in the risk of child malnutrition between subgroups of the population. Clustering of underweight children can also be defined in terms of, for example, counting the number of women of different families whose more than one child is underweight.

[1] Malnourishment and underweight have been used interchangeably in this study.

Data and methods

The data used in this study were taken from the various waves of Demographic and Health Survey (DHS) from selected Asian (Bangladesh, India, Jordan, Kazakhstan, Nepal, Peru, Turkey) and African (Benin, Burkina Faso, Cameroon, Chad, Cote D'Ivoire, Egypt, Ethiopia, Ghana, Guinea, Kenya, Lesotho, Madagascar, Malawi, Mali, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Tanzania, Uganda, Zambia, Zimbabwe) countries. These surveys are designed to collect nationally representative health and welfare data for women of reproductive age (15-49), their children and their households. The DHS survey is suitable for comparative studies as these surveys collect a similar core set of data in each country. For the analysis purpose, we have pooled all available surveys from 1990 to 2012 of each mentioned country, which includes a total of 700,507 women interviewed from 638,620 households.

Outcome variable

Under nutrition among young children is generally determined through measurement of height, weight and age. Most commonly used indices derived from these measurements are stunting- low height for age, wasting- low weight for height and underweight- low weight for age. This study is specifically concerned with the information collected on one indicator of nutritional status i.e. low weight for age as this measurement can be used as a composite indicator to reflect both acute and chronic malnutrition or under nutrition. Vella *et al.* (1992), suggest that, out of three indices, weight for age is a better predictor of children at higher risk of death than height for age (stunting) or weight for height (wasting). Using the WHO recommended standards, information on underweight was expressed in standard deviation units (Z-scores) from the median of the reference population and children whose weight for age was found below minus two standard deviations (-2SD) from the median of the reference population were classified as underweight in the study.

Other demographic and socioeconomic variables

A number of demographic and socioeconomic factors controlled in the pooled dataset of countries where age of child (less than 12 months, 12-24 months, 25-36 months, 37 months & above), sex of child (female, male), preceding birth interval (≤24 months, >24 months), mother's age at birth (≤20 years, 21-30 years, ≥31 years), maternal educational level (No education, primary, secondary, higher education), medical assistant during pregnancy (no, yes), household wealth quintile (poorest, poorer, middle, richer, richest), place of residence (rural, urban).

Statistical techniques

Above mentioned data have been analyzed using bi-variate and multivariate statistical techniques. Bivariate techniques have been used to examine the extent of clustering of underweight children at individual, household and community level. Further, multivariate logistic regression was applied in order to examine the effects of health status of previous children on the health status of the index child before and after adjusting socioeconomic and demographic variables. Analysis has been performed using STATA 12.0.

Findings

The extent of clustering of child malnutrition at individual, household and community level has been presented in table 1 (A) (B) & (C). Individual level clustering of child malnutrition is the concentration of malnourished children among mothers. Results show that more than half of underweight children were born to 72 percent of women who have given birth to only 1 child. There were 42 percent underweight children from 28 percent women who have given birth to more than 2 children. Also, very small proportion of women (0.6 percent) contributing to 10 percent of underweight children (table 1 (A)).

The number of children born per family ranges from 1 to 12 and the mean number of children per family was 1.41. A substantial amount of clustering of malnourished children was observed at household level. Around 86 percent of underweight children have come from the 12 percent households with only 1 underweight child and 14 percent of the underweight children were from only 1 percent households with 2 or more underweight children. Further, 34 percent households with 2 or more children had more than half of the underweight children.

At community level, 67 percent underweight children belong to a community having 1-20 children and rest one third underweight children were from the community having more than 21 children. All together, almost a quarter of communities accounted for more than one underweight child, which is 79 percent of the total.

Results from multivariate logistic regression analysis have been presented in table 2. Two different models have been applied in order to examine the effects of health status of previous child/ children on nutritional status of the index child before and after adjusting for demographic and socioeconomic characteristics. Model-I shows the significant effects of nutritional status of previous child on nutritional status of the index child before adjusting for other predictors. The odds were 3.74 (95% confidence intervals (CI): 3.56-3.94) for index child to be malnourished if any of the previous child of women was malnourished. When other predictors were included in the analyses, the resulting odds have been reduced a bit (Model-II). Further, the age of the child and preceding birth interval also show significant effects on health

status of children. Children of age 12-24 months and >25 months were 0.86 times and 0.56 times, respectively, less likely to be underweight compared to neonatal. The presence of malnourished children decreases when the preceding birth interval was more than 2 years. The odds for children to be underweight also reduce with the high educational level of the mother. Mother's who had medical assistance during pregnancy were 0.81 times (95% confidence intervals (CI): 0.78-0.84) less likely to have underweight children compared to those who did not receive medical assistance. Children belong to richer or richest wealth quintiles were less likely to be underweight. Also, children from rural areas were 1.17 times more likely to be underweight in comparison with children from urban areas.

Summary

The present study examines the extent of childhood malnutrition clustering using the data of different rounds of Demographic and Health Survey (DHS) surveys of selected Asian and African countries conducted during 1990-2012. The study found strong evidence of clustering of malnourished among mothers, households and communities. In the overall sample, a significant proportion of malnourished children were concentrated within a small fraction of women, households and communities. Further, the study found a significant effect on the health status of pervious children of health status of the index child. The findings of the study have serious policy implications. The study also suggests for further research in order to explore the factors responsible for such clustering.

Table 1: Distribution of women, families and community according to the number of children and the number of underweight children per women, families and community

(A)

Number of children born/Per woman	Number of children Underweight/Per woman					% children	% Underweight
	0	1	2	3 or more	Total		
1	348544	38822	0	0	**387366**	**54.9**	**57.6**
2	116653	19851	2698	0	**139202**	**39.5**	**37.5**
3	10029	2028	467	63	**12587**	**5.4**	**4.7**
4 or more	359	75	28	3	**465**	**0.3**	**0.2**
Total	**475585**	**60776**	**3193**	**66**	**539620**	**100.0**	**100.0**
% children	**87.0**	**12.0**	**1.0**	**0.0**	**100.0**		
% Underweight	**0.0**	**90.2**	**9.5**	**0.3**	**100.0**		

(B)

Number of children born/Per Family	Number of children Underweight/Per Family							% children	% Underweight
	0	1	2	3	4	5 or more	Total		
1	298679	32207	0	0	0	0	**330886**	**47.0**	**47.8**
2	115452	19684	2793	0	0	0	**137929**	**39.2**	**37.5**
3	17528	4274	1004	158	0	0	**22964**	**9.8**	**10.0**
4	3227	1157	342	71	7	0	**4804**	**2.7**	**3.1**
5 or more	1213	453	188	48	14	3	**1919**	**1.4**	**1.5**
Total	**436099**	**57775**	**4327**	**277**	**21**	**3**	**498502**	**100.0**	**0.0**
% children	**85.3**	**13.0**	**1.5**	**0.1**	**0.0**	**0.0**	**100.0**		
% Underweight	**0.0**	**85.8**	**12.8**	**1.2**	**0.1**	**0.0**	**100.0**		

(C)

Number of children born/Per community	Number of underweight children/Per community						% children	% Underweight
	0	1	2-10	11-20	21-30	Total		
1-20	32986	12045	11038	9	0	**56078**	**72.1**	**66.8**
21-40	1264	1269	4060	165	2	**6760**	**25.2**	**30.0**
41-60	33	38	265	33	2	**371**	**2.4**	**2.9**
61 or more	3	3	22	2	2	**32**	**0.3**	**0.3**
Total	**34286**	**13355**	**15385**	**209**	**6**	**63241**		
% children	**40.2**	**21.8**	**37.0**	**1.0**	**0.0**	**100.0**		
% underweight	**0.0**	**19.8**	**76.0**	**4.0**	**0.2**	**100.0**		

Table 2: Results from logistic regression analysis showing the effects of health status of previous child/children on nutritional status of the index child

Background characteristics	Odds Ratio (β)	95% Confidence Intervals [Lower-Upper]	Odds Ratio (β)	95% Confidence Intervals [Lower-Upper]
Health status of any previous children				
Not underweight®	1.000		1.000	
Underweight	3.749***	[3.56-3.94]	3.365***	[3.19-3.54]
Sex of the index child				
Male®			1.000	
Female			0.990	[0.95-1.02]
Age of the index child				
< 12 months®			1.000	
12-24 months			0.869***	[0.84-0.89]
25 months and above			0.564***	[0.53-0.59]
Preceding birth interval				
≤24 months®			1.000	
>24 months			0.841***	[0.81-0.86]
Mother's age at birth				
< 20 years®			1.000	
21-30 years			0.896***	[0.85-0.93]
31 years and above			0.812***	[0.76-0.86]
Mother's educational status				
Not educated®			1.000	
Primary			0.546***	[0.52-0.56]
Secondary			0.487***	[0.46-0.51]
Higher education			0.334***	[0.29-0.37]
Medical assistance during pregnancy				
No®			1.000	
Yes			0.818***	[0.78-0.84]
Wealth quintiles				
Poorest®			1.000	
Poorer			0.972	[0.92-1.01]
Middle			1.032	[0.98-1.08]
Richer			0.322***	[0.16-0.67]
Richest			0.662***	[0.29-0.73]
Place of residence				
Urban®			1.000	
Rural			1.170***	[1.12-1.22]