Socio-economic Inequality in Under-Five Child Mortality: A Statistical Approach to Determine Development Edge in Bangladesh

Sifat Sharmin and Md. Israt Rayhan

Institute of Statistical Research and Training (ISRT), Dhaka University, Dhaka-1000, Bangladesh

Abstract

Socio-economic inequality in under-five child mortality (U5CM) is one of the crucial predicaments for the human development of Bangladesh. The objective of the study is to assess and quantify the magnitude of socioeconomic inequalities in U5CM and vaccination coverage in Bangladesh. The study utilized data from the Bangladesh Demographic and Health Surveys,2007 (BDHS 2007) that contains information on 6058 live births among which 339 children died before reaching age five and compared it with BDHS 2004 data to identify the inequality scenario over the study period . Two inequality measures were used: poorest-richest ratio and concentration index. Analysis on socio-economic inequalities revealed that under-five children of poorest class were 46 percent more likely to die than those of the richest class. Inequality also existed in vaccination status, in poorest class which was 1.31 times lower compared with richest class. The figures were better than those of 2004(67% and 2.3 times lower respectively). In conclusion, this study showed a clear mortality gradient across socioeconomic classes, although these inequalities improved in 2007 in comparison with 2004. Appropriate interventions that could produce rapid gains in child survival may trim down the existing socio-economic inequalities.

I. Introduction

How worth is life? Most of us would forfeit a great deal to save a single child. Yet somehow on a global scale, our priorities have become blurred. Every day, on average more than 26,000 children under the age of five die around the world[1]. Nearly all of them live in the developing world or, more precisely, in 60 developing countries. About 9.7 million children died before their fifth birthday (2006)[1].

Bangladesh has been able to reduce U5CM rate at 65 per thousand live births in mid-year 2007[1]. However, Bangladesh is committed to reduce U5CM to 44 per thousand live births in 2015 (one-third of U5CM of 133 per thousand live births of 1990, mid year 1991) to meet Millennium Development Goal 4 for child survival (MDG 4).

The World Health Report 2003 posed an important question: how does inequality and equity affect the progress towards the MDG 4? Several studies have been carried out to find the answer of this question.

Minujin et al (2004)[2] carried out a study showing an overall improvement in child survival, eight of 14 countries showed a widening gap in child mortality between the richest and poorest wealth quintiles. In most of the countries, immunization and other child-survival interventions are delivered disproportionately to the richest quintile, while the poorest groups are the last to have access to new health initiatives. Moser et al (2005)[3] found that there were large and relentless inequalities in under 5 mortality within many low and lower middle income countries and showed that improvements in national under 5 mortality, in line with the MDG, did not necessarily bring about decreasing inequalities in mortality between the poorest and least poor in the society. It has been observed that the reduced effectiveness of interventions delivered to the most disadvantaged children only served to increase the survival gap and inequity between high- and low-risk groups within a community[4].Fenn et al (2007)[5] commenced that in all countries, they considered (excluding Haiti) inequities in neonatal mortality and intervention coverage were evident across wealth groups with more deaths and less coverage in the poorest, compared with the richest quintile. Ahmed et al. (2004)[6] illustrated that although there was some progress in reducing the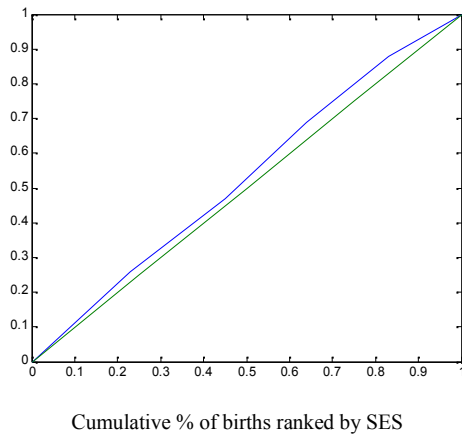 infant mortality rate since the independence of Bangladesh in 1971, the health of the disadvantaged section of the population (in terms of geographical location, socioeconomic status, gender, etc) has not improved as much as it has for the better-off groups. Razzaque et al (2007)[7] examined socioeconomic inequalities of neonatal, infant and child mortality in Bangladesh and concluded that usual health intervention programs (non-targeted) did not reduce poor-rich gap, rather the gap increased initially and might decrease in long run if the program is very intensive.

It is believed that under-five mortality and socioeconomic condition is appreciably related in Bangladesh and plays very important role in high U5CM rate. The usual intervention programs (for example, vaccination) are also momentously allied with socioeconomic status. This study analyses survey data on mortality among children aged under five years to investigate the distribution of U5CM in diff social classes and inequality in vaccination coverage and also performs comparison between 2004 and 2007 data to investigate whether inequality improves or not during the study period in Bangladesh since the distribution of U5CM and inequalities present in vaccination coverage are not studied well in Bangladesh.

II. Material and Methods

Data: This study used data from Bangladesh Demographic and Health Survey, 2007 (BDHS, 2007)[8], the most recent year for which data on U5CM were available, that serves as a source of population and health data for policymakers and the research community. The fieldwork, commenced on 24 March 2007, was completed on 11 August 2007[8]. A large number (10,996) of completed interviews with ever-married (age 10-49 years) woman for the 2007 BDHS was conducted. The data file contains information on 6058 live births among which 5719 children were alive up to their 5th birthday and 339 children died before reaching age five. The data file consists of information on background characteristics, such as age, education, religion, etc., socioeconomic information, marriage, reproductive history, family-planning methods, antenatal and delivery care, breastfeeding practices, vaccination and health of under-five children, causes of death of under-five children, and so on[8].

We also analyzed 2004 BDHS data in the same way for comparison with that of BDHS 2007 data.

Design and analysis: The study measured two statistical indicators of inequality. *One* was the poorest-richest ratio which is the ratio comparing the rate prevailing in the richest class with the rate in the poorest class. The *second* measure used was the concentration index, calculated by the method of Kakwani et al. (1980)[9] .Concentration curves are used to identify whether socioeconomic inequality in under-five child mortality exists. The concentration index which is directly related to the concentration curve, does quantify the degree of socioeconomic related inequality in under-five child mortality and vaccination status (Kakwani, Wagstaff, & van Doorslaer 1997; Wagstaff, van Doorslaer, and Paci 1989)[9, 10]. The difference in U5CM rate between the two extreme socioeconomic classes was also computed as another measure of inequality[11].

Definition of concentration index (C.I): The concentration index is defined with reference to the concentration curve. It is defined as twice the area between the concentration curve and the line of equality (the 45-degree line). So, in the case in which there is no socioeconomic-related inequality, the concentration index is zero. The convention is that the index takes a negative value when the curve lies above the line of equality, indicating that the variable is higher amongst the poor and a positive value when it lies below the line of equality implying that the health variable is disproportionately concentrated on rich. It also indicates the share of the total amount of any variable that needs redistributing in a particular way from rich to poor (or vice versa) to achieve equality.

Formally, the concentration index is defined as

$$C = 1 - 2\int_{0}^{1} L_h(p)\,dp \qquad \text{............... (1)}$$

Equation (1) defines the concentration index(C) [9] as 1 minus twice the area under the concentration curve. The index is bounded between –1 and 1. C=1 if richest person has the entire health variables and -1 if poorest person has all of the health variables. The sign of the concentration index

indicates the direction of any relationship between health variable and position in the living standard distribution. The magnitude reflects both the strength of relationship and the degree of variability in the health variable. The larger it is in size, the higher the degree of inequality[9].

Point estimate of the concentration index: The concentration index for t=1, ..., T groups are easily computed in a spreadsheet Program using the following formula (Fuller and Lury 1977):

$$C = (P_1 L_2 - P_2 L_1) + (P_2 L_3 - P_3 L_2) + ... + (P_{T-1} L_T - P_T L_{T-1}) \quad \text{........... (2)}$$

Where p_t is the cumulative percentage of the sample ranked by economic status in group t and L_t is the corresponding concentration curve ordinate[9] in equation (2). C is the concentration index used for determining the relationship between household's socioeconomic characteristics and inequalities of access to vaccination intervention and to health outcomes in Bangladesh (according to the method suggested by Koolman & Van Doorslaer (2004)) [12].

All data analysis were done using the 'SPSS' 16 statistical software. Besides 'SPSS' Microsoft Word, was used. MATLAB programming language used to draw the concentration curve.

III. Results

The relationship between socioeconomic status and under-five mortality is summarized in Table.1. The data presented indicated that under-five mortality was higher in the poorest class and lower for the rest of the classes. The data revealed that children of the poorest class were 46% more likely to die before reaching their fifth birthday than those of the richest. The gradient of under-five mortality was not consistent between the second and the third socioeconomic class. If the socioeconomic status of the poorest households were improved to the level of the richest, about 25 lives (rate difference) per 1,000 under-five children could be saved. However, the value (-.0587) of the concentration index showed that the concentration curve L(p) laid above the line of equality
.

Table. 1. Child mortality by socioeconomic status [9]

SES	Number of births	Relative % of births	Cumulative % of births	Number of deaths	Relative % of deaths	Cumulative % of deaths	U5CM rate	C.I
Poorest	1368	23%	23%	87	26%	26%	63.6	-.0089
Poorer	1312	22%	45%	72	21%	47%	54.88	.0097
Middle	1173	19%	64%	74	22%	69%	63.1	-.0095
Richer	1149	19%	83%	66	19%	88%	57.44	-.05
Richest	1056	17%	100%	41	12%	100%	38.82	0.0
Total	6058			340				-0.0587
Poorest-richest ratio							1.64	
C.I								-0.0587

Dhaka Univ. J. Sci. 58(2): 201-204, 2010 (July)

203

Cumulative % of births ranked by SES

Fig. 1. Health Concentration curve: A picture of child mortality by socioeconomic status.

Table. 2. indicates that there exists a large difference in under-five child mortality between the two extreme socioeconomic classes. Under-five child mortality rate in the poorest socioeconomic class was found to be 1 percent higher than that of the middle socioeconomic class. On the other hand, under-five child mortality rate in the richest socioeconomic class was estimated to be 39 percent lower than that of the middle socioeconomic class, which was also 39 times higher than the difference between the middle and the poorest social class, implying the distribution of U5CM was not symmetric. This analysis revealed that a high degree of inequality in under-five child mortality was present among the socioeconomic classes. It also indicated that the distance in under-five child mortality between middle and richest socioeconomic class was higher than the distance between middle and poorest socioeconomic class.

This may be due to the fact that the richest people enjoy much more facilities compared to people belongs to any other socioeconomic classes.

The relationship between socioeconomic status and vaccination coverage is presented separately in the Table. 3. The results indicated that non-vaccination is associated with the lower socioeconomic class. The poorest-richest ratio of non-vaccination of 1.31 revealed that there exist

Table. 2. Computation of difference in under-five mortality rate between the two extreme socioeconomic class [11]

Socioeconomic status	U5CM rate(per 1000 live births)	% of median	Distance between median and class
Poorest	63.6	101	1
Poorer	54.88	87	
Middle	63.1	100	
Richer	57.44	91	
Richest	38.82	61	39

inequality between the poorest and the richest in terms of non-vaccination in Bangladesh. However, the value (-0.044) of the concentration index showed that the concentration curve L(p) laid above the line of equality and also indicated that 3.3%(approximately 3%) of the total amount of health variable(vaccination coverage) needs redistribution from rich to poor to achieve equality.

Table. 3. Vaccination status by socioeconomic conditions [9]

SES	Numb-er of births	Relative %of births	Cumulative % of births	Number of children never vaccinated	Relative %of children never vaccinated	Cumulative %of children never vaccinated	%of quintile children never vaccinated	C.I
Poorest	1368	23%	23%	32	21%	21%	2.34	.0182
Poorer	1312	22%	45%	44	28%	49%	3.35	-.0031
Middle	1173	19%	64%	31	20%	69%	2.64	-.0095
Richer	1149	19%	83%	29	19%	88%	2.52	-0.05
Richest	1056	17%	100%	19	12%	100%	1.79	0.0
Total	6058							-0.044
Poorest-richest ratio							1.31	
C.I								-0.044

When BDHS 2007 data were compared with BDHS 2004 data (Table 4) the value of the concentration index decreased by half for both under-five child mortality and vaccination coverage.

Table. 4. Comparison of C.I between 2004 and 2007 BDHS data

Year	2004	2007
Concentration index for under five child mortality	-0.105	-0.0587
Concentration index for vaccination status	-0.167	-0.044

IV. Discussion

Reducing inequalities in health and health care is now a key objective of health systems nationally and internationally. There has been a recent upsurge of interest in socio-economic inequalities in health with the reformed pledge of governments and international organizations to improve the health of the poor because several studies have revealed wide socio-economic differences in rates of mortality among children[6, 13, 14]. Therefore, an attempt was made to examine the socio-economic inequalities in health in 2007 in Bangladesh with special reference to under-five child vaccination coverage in an effort to quantify the inequalities.

The investigation has exposed that there are large and persistent inequalities in U5CM within different socioeconomic classes. The poorest had the highest mortality rate compared to the richest classes. Similarly, it also revealed that there are noteworthy differences in under-five child vaccination status that favor the richest of the society, although these inequalities are found to decrease in 2007 BDHS data in comparison to 2004 BDHS data. In general, it is the poor who suffers from the highest under-five child mortality rate and who are in greatest need of interventions to prevent childhood mortality.

In Bangladesh, U5CM rate has decreased over the years in spite of existing high socioeconomic inequalities. The reduction in inequalities observed in the present study in 2007 correlated with the reduction of U5CM rate in 2007. Inequalities in health impact across the social classes indicating that the health systems are consistently inequitable, providing more and higher quality services to the well-off than to the poor. The study pointed out the truth that the health sector strategies in Bangladesh that reached poorer classes were below the requirement.

In achieving a reduction in under-five mortality, in line with the MDG 4, the improving inequalities in U5CM between the poorest and the richest group in Bangladesh in 2007 over 2004 must be addressed further to reach optimum level that may indicate as an important policy implication of this study. The findings might assist programme providers and policy-makers to recognize inequalities in the vaccination system to improve the under-five mortality status among the poorest people in Bangladesh. We believe that monitoring U5CM among different socioeconomic groups is of the utmost importance for proper implementation health care services to this vulnerable but most precious group of population.

----

1.   UNICEF, 2008; The state of the world's children.

2.   Minujin A., and E. Delamonica, 2004; Socio-economic inequalities in mortality and health in the developing world. Demographic Research; Special Collection 2: Article 13:329-54.

3.   Moser K. A., D. A. Leon, and D. R. Gwatkin, 2005; How does progress towards the child mortality millennium development goal affect inequalities between the poorest and least poor? Analysis of Demographic and Health Survey data. British Medical Journal; 331:1180-2.

4.   Tugwell P., D. de Savigny, G. Hawker, and V. Robinson, 2006; Applying clinical epidemiological methods to health equity: the equity effectiveness loop. British Medical Journal; 332: 358-61.

5.   Fenn B., B. R. Kirkwood, Z. Popatia, and D. J. Bradley, 2007; Inequities in neonatal survival interventions: evidence from national surveys. Archive Disease child Fetal Neonatal Edition; 92: 361-6.

6.   Ahmed S. M., A. Bhuiya, AKM Masud Rana, A. Hadi, S. Mahmud, and A. Salam, 2004; Monitoring the status of health equity in Bangladesh: the BHEW survey 2002. Equity Watch paper no. 3.

7.   Razzaque A., P. K. Streatfield, and D. R. Gwatkin, 2007; Does health intervention improve socioeconomic inequalities of neonatal, infant and child mortality? Evidence from Matlab, Bangladesh. International Journal for Equity in Health; 6:4.

8.   NIPORT, Mitra and Associates and ORC Macro, 2007; Bangladesh demographic and health survey 2007.National Institute of Population Research and Training(NIPORT), Mitra and Associates and ORC Macro.

9.   Kakwani N., A. Wagstaff, and E. van Doorslaer, 1997; Socioeconomic inequalities in health: measurement, computation, and statistical inference. Journal of Econometrics; 77:87-103.

10. Wagstaff A., P. Paci, and E. van Doorslaer, 1991; On the measurement of inequalities in health. Social Science & Medicine; 33:545-57.

11. Rahman PK M., 1984; Poverty Issues in Rural Bangladesh. University Press Limited. Page: 42-43.

12. Koolman, X., and E. van Doorslaer., 2004; On the Interpretation of a Concentration Index of Inequality. Health Economics; 13: 649–56.

13. Wagstaff A., 2000; Socioeconomic inequalities in child mortality: Comparisons across nine developing countries. Bulletin of the World Health Organization; 78:19–29.

14. Wagstaff A., 2002; Poverty and health sector inequalities. Bulletin of the World Health Organization; 80:97-105.

Cumulative % of deaths

Cumulative % of deaths

Cumulative % of deaths