Impact of Mother's Secondary Education on Severe Acute Respiratory Infection (ARI) Among Under-Five Children

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ABSTRACT
The aim of this study is to find the effect of the mother's education on the prevalence of severe Acute Respiratory Infections (ARI) among under-five children in Bangladesh. This study uses a large nationally representative dataset from Bangladesh, the Bangladesh Demographic and Health Survey (BDHS) 2004. A child was considered to have experienced severe ARI if the mother reported that the child had a cough in the last two weeks preceding the survey date along with all of the three symptoms (i) short, rapid breathing; (ii) difficulty in breathing; (iii) chest in-drawing. Prevalence of severe ARI is higher among children born to mothers with primary or less education compared to children of mothers completing secondary or higher education (5.0 and 8.1 percent respectively). Bivariate logistic regression (adjusting for clustering) shows that household poverty (lower than 60% asset score), children's lower age, sex of child if boy, malnutrition (lower weight/height, lower rates of Vitamin A supplementation), mother's lower age at childbirth, mother's lower education are risk factors for severe ARI among under-5 children in Bangladesh. However, using multivariate logistic regression, the effect of household poverty becomes insignificant meaning that higher severe ARI among poor children is due to the mother's lack of education. Therefore, improving mother's education could have significant salubrious effects on severe ARI in children in the developing world, reducing childhood deaths and will assist us in achieving the Millennium Development Goals (MDGs).

Keyword: Risk factor, severe ARI, childhood, maternal education, Bangladesh.

Introduction

The relation between parental education and acute and respiratory infections (ARI) in children has been explored in other parts of the world (Kristensen and Olsen, 2006; Etiler, Velipasaoglu and Aktekin, 2002) but remains relatively unexplored in the context of Bangladesh. Child health is an important indicator for describing the mortality conditions, progress in health, and the overall social and economic well being of a country (Huq and Tasnim, 2008). This is essential for Bangladesh in light of its growing population of children whose primary care givers will be their mothers, and also due to the initiatives undertaken by national and international NGO's, development organizations etc. to improve the socioeconomic status of women across Bangladesh. It is in this context that the present study is important because the findings may have important implications for addressing prevention of ARI in the current development context of Bangladesh.

Acute respiratory infections (ARI) represent one of the major health problems in under-five children living in developing countries. Among the total under-five deaths in developing countries, nearly one fifth are directly attributed to ARI (Kristensen and Olsen, 2006; Williams et al., 2002; Victora, 1999, World Bank, 1993; Denny and Loda, 1986). According to Hadi (2003), half of the ARI deaths in under-five children could be reduced through early detection and appropriate treatment. Williams et al. (2002) have established that ARI's are one of leading

causes of childhood mortality, causing around 1.6 – 2.2 million deaths globally in children under 5 years old each year. While in early childhood upper respiratory tract infections are the most common illnesses, lower respiratory disease accounts for the majority of severe or chronic illness (Zar and Mulholland, 2003) and account for nearly a third of all deaths of children under five in many countries (Rashid et al. 2001). ARI are a source of significant morbidity and carry a considerable economic burden (von Linstow et al. 2008).

ARI is globally spread, although it has differing impacts between developing and developed nations. In both developing and developed countries, most children under 5 years of age experience between 4 to 6 episodes of ARI annually (WHO, 2006). Whereas in the industrialized nations 1% to 3% of the deaths in children under 5 years of age are due to pneumonia, in developing nations pneumonia is responsible for 10% to 25% of deaths in children under 5 years of age. Health services access can serve to explain this disparity, due to the fact that ARI is one of the principle reasons for medical consultations and hospitalizations in the developing countries. Pneumonia is resonsible for 30% to 60% of the medical consultations and 20% to 40% of hospital admissions in children under 5 years of age (Benguigue et al., 1999).

Infants have the highest risk of pneumonia in their first three months of life. Nearly 70-75% of all deaths in infants are due to pneumonia. Exposure to chilling is also a risk factor for pneumonia. In both developing and developed countries, cigarette smokers and children of smokers are more susceptible to pneumonia than those not exposed to cigarette smoke. Indoor air pollution is also strongly suspected of being an important contributor to ARI child death (World Bank, 1993). These are the environmental risk factors of ARI. Victora (1999) in his study added a few socio-economic (particularly low income, parental low educational levels and place of residence), demographic (age, birth spacing and gender of child), nutritional and behavioral (including low birth weight, malnutrition, and lack of breast-feeding), and environmental (crowding, biomass-burning stoves) factors as the risk factors. Boys are more likely to suffer than girls, and infants are more vulnerable to suffer from ARI compare to toddler and child (Victora, 1999).

Previous literature from Bangladesh on child health has tended to concentrate on outcomes of nutrition (Dancer, Rammohan, and Smith, 2008; Abdullah et al. 2007), and studies which have examined the relation between mother's education and child health have focused on diarrhea (Alam et al. 2001), malnutrition (Abdullah et al. 2007), and household wealth status (Hong, Banta and Betancourt, 2006). ARI in children has been previously studied in the context of Bangladesh (Rashid et al. 2001; Rahman et al. 1996; Huq et al. 1990) but no attempt was made to establish a link with mother's education.

ARI in Bangladesh

Knowledge of the causal distribution of deaths among children is scarce in most of the developing world due to an absence of accurate vital registration systems and very few deaths attended by a qualified physician. In order to understand the distribution of causes of death for children, interview-based diagnoses (verbal autopsies) have been used in the last three BDHS (1993/94, 1996/97, 2004). The verbal autopsy used in the BDHS 1993/94 showed that approximately one-quarter of deaths among children under-five years were associated with acute lower respiratory infection (Baqui et al., 1998). The same method found that 18.2% children

under-five died due to ARI during the period 1992-96 (Baquie et al., 2001) and 21.1% during the period 2000-04 (Arifeen et al., 2005). Percentage of ARI patients taken to a health facility for treatment increased from 1993 to 1996 that declined from 1996 to 2004 (NIPORT, 2005). Studies on ARI have tended to concentrate on mortality and cause of death (NIPORT, 2005; Arifeen et al, 2005; Baqui et al., 2001; Baqui et al., 1998). However, these studies did not attempt to determine the risk factors of ARI.

Methods

Data

This study is a cross sectional study. The data for this study come from the 2004 Bangladesh Demographic and Health Survey (BDHS 2004) that contains a nationally representative sample of 11,440 ever-married women of age 10-49 years and their children born 0-59 months prior to the survey date. The unit of analysis is the child. In order to reduce the recall bias in the BDHS survey, information regarding Antenatal Care (ANC), Post Natal Care (PNC), immunization, diseases etc. was asked only for the children of age less than 60 months. Therefore, a file was created for the sample of children of age 0-59 months including all variables of household and mother. A list of 6,498 surviving children (weighted) was obtained from that file. Excluding missing, non-eligible (visitors in household), and non-response cases for the questions related to ARI and child nutrition (height and weight without flagged), a final sample size of 5,425 children was obtained for this study. These 5,425 children came from 4,463 mothers.

Variables

Dependent Variable

In this study, the dependent variable is severe ARI, coded as 1 if the child suffered from severe ARI in the two weeks prior to the survey date and 0 otherwise. A child was considered as having experienced ARI if the mother reported that the child had a cough in the last two weeks preceding the survey date along with **all** of three symptoms of: (i) short, rapid breathing; (ii) difficulty in breathing; (iii) chest in drawing (NIPORT, 2005).

Independent Variables

Independent variables were chosen based on prior knowledge of determinants of child morbidity and mortality and ARI in general. The primary interest of this analysis was in exploring the impact of mother's education on child severe ARI (SARI). In addition, other potential control and confounding variables such as age of child, sex of child, wasting status of child (measured by height/weight), vitamin A supplementation of child in last six months, mother's age, mother's BMI, mother's education, and household poverty were included. Most of the variables included in the study were included based on previous studies (Arifeen et al., 2001; Victors, 1999; Chhabra et al., 1997).

The most important variable in this analysis is an index of poverty. In the absence of income or consumption data, BDHS 2004 used household assets to construct a wealth index using principal components analysis (Rutstein and Johnson, 2004, NIPORT, 2005). The wealth or household asset index was classified into five quintiles i.e. richest, richer, middle, poorer, and poorest. After exploratory analysis, it was found that the top two quintiles were no different from each other in terms of their risk of severe ARI. Similarly, no difference was found between the bottoms three quintiles in terms of severe ARI risk. Thus the quintiles were dichotomized into two categories:

the poor (the bottom three quintiles) with the reference category being the rich or well off (the top two quintiles).

Childhood malnourishment and maternal BMI were operationalized using standard anthropometric measures of height and weight. The standard measurements were based on the U.S. National Center for Health Statistics (NCHS) standard, recommended by the World Health Organization (WHO). Standard normal (Z score) was calculated for each variable. Details can be found in NIPORT (2005). Other independent variables are self-explanatory.

Analysis

Logistic regression analysis using a standard statistical package (STATA 8) was used to estimate the effect of key explanatory variables on severe ARI among the children after controlling for the effect of other confounding variables. Odd ratios adjusted for clustering were estimated with 95% confidence intervals (CI) for the odd ratios were calculated. Models were tested sequentially in stages to explore the mechanisms by which poverty and the education level of the mother affects severe ARI in children.

Results

Table 1a shows that children from lower socioeconomic households (the lower three quintiles) were more likely to suffer from severe ARI than their counterparts in higher economic (the top two quintiles) households (8.14% vs 4.98%); {OR: 1.69; 95% C.I. 1.297—2.213)}. Table 1b, shows that severe ARI prevalence among the poorest three quintiles is about the same and not significantly different from each other. Similarly severe ARI prevalence among the richest two quintiles (while lower than the poorer quintiles) is also not different from each other (these results were confirmed by statistical tests of differences between groups). Thus as noted above in the methods section the five quintiles were dichotomised into Poor (the lowest three quintiles comprising the bottom 60%) and the "Well-Off" (the top two quintiles comprising the top 40%).

Table 1: Differences in severe ARI prevalence by education of mother and household asset

Quintiles	No. of children	Prevalence of severe ARI among the children (%)
Mother's Highest educational level		
Primary or less education	3825 (70.5)	8.14
Secondary+[†]	1600 (29.5)	4.98
Household asset		
Poorest	1428 (26.3)	8.17
Poor	1150 (21.2)	8.73
Middle	1046 (19.3)	6.89
Rich	931 (17.2)	6.7
Richest	870 (16.0)	4.53
Poor (below 60%)	3624 (66.8)	7.98
Well off (Top 40%)	1801 (33.2)	5.65
Total	5425 (100.0)	7.21

Table 2 represents the unadjusted odds ratios for different risk factors for childhood severe ARI other than mothers education. The age of the child is an important biological risk factor for

severe ARI with the risk substantially declining as children become older. Boys are more likely to have severe ARI than girls in this sample. Other child characteristics that were significant risk factors were childhood malnourishment as measured by (i) weight/ height and (ii) access to Vitamin A supplementation in the last six months of the study. Maternal factors that were important included: (i) maternal age; (ii) maternal BMI; (iii) maternal education. Children to poor families have significantly higher risk of severe ARI.

Table 2: Unadjusted odds ratio of severe ARI for selected SES variables other than household poverty, Bangladesh 2004

	Unadjusted	95% CI	
	Odds ratio	lower	upper
Mother's education status			
Primary or less education	1.69	1.294	2.213
Secondary+†	1		
Children's age in months			
<12	1.78	1.350	2.343
12-23	1.70	1.299	2.236
24-59†	1		
Sex of children			
Boy	1.29	1.033	1.610
Girl†	1		
Wasting children (wt/ht)			
Yes	1.53	1.167	1.994
No†			
Taken Vitamin A in last 6 months			
No	1.53	1.182	1.973
Yes†			
HH socio-economic status			
Poor	1.45	1.125	1.864
Well-off	1		
Mother's BMI (kg/m^2)			
<18.5	1.71	0.929	3.152
18.5-24.9	1.38	0.771	2.486
25+†			
Mothers age			
<20	1.81	1.347	2.425
20+†			

† reference category

Multivariate Analysis

Model 1 in Table 3 demonstrates that children from poor families have 46% higher odds of suffering from severe ARI compared with children from richer families after controlling for the effects of age and sex. In Model 2 when measures of child malnourishment as proxied by (wasting=weight for height) and vitamin A supplementation are included, the odds ratio of severe ARI declines which implies that some of the excess risk of severe ARI among children in poor households is due to the higher likelihood of these children suffering from increased wasting (i.e. lower weight/height) and decreased levels of vitamin A supplementation. In Model 3 when controls for maternal nutritional status as proxied by mother's body mass index (BMI)

and maternal age are added, the odds ratio for severe ARI further declines but still significant. This suggests that some of the excess risk of severe ARI among the poor is due to these children having a higher likelihood of being born to malnourished mothers. However, model 1 to model 3 shows that after controlling the effect of most common risk factor of ARI among children, children in poor families are still suffering significantly more from severe ARI compare to children to well-of families.

Table 3: Logistic regression models of the odds ratio of severe ARI among children age 0-59 months

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7 (Final model)
Mother's Highest educational level							
Primary or less education				1.80***	1.77***	1.86***	1.79***
Secondary+†				1	1	1	1
Socio-economic status							
Poor	1.46**	1.42**	1.36*				1.12
Well off†	1	1	1				1
Children's age							
<12	1.80***	1.58*	1.47*	1.89***	1.67**	1.55*	1.56*
12-23	1.73***	1.60***	1.51***	1.76***	1.64***	1.52**	1.52**
24-59†	1	1	1	1	1	1	1
Sex of children							
Boy	1.30*	1.29*	1.29*	1.32*	1.31*	1.32*	1.31*
Girl†	1	1	1	1	1	1	1
Wasting present in Children							
No†		1	1		1	1	1
Yes		1.45**	1.42**		1.47**	1.44**	1.43**
Children have taken Vitamin A in last 6 months							
Yes†		1	1		1	1	1
No		1.27	1.23		1.25	1.21	1.20
Mother's BMI (kg/m^2)							
<18.5			1.24			1.16	1.11
18.5-24.9†			1.11			1.06	1.03
25.0+			1			1	1
Mother's age							
<20			1.54**			1.72***	1.70***
20+†			1			1	1

† reference category;
ζ significant at p<.10, * significant at p<.05, ** significant at p<.01, *** significant at p<.001

In model 4 to model 6 in Table 3, same procedure was follows to test where household wealth status was replaced by mother's education status. Model 4 states that children from less educated (primary or less) mothers have 80% higher odds of suffering from severe ARI compared with children from educated (secondary or higher) after controlling for the effect of child age and sex. In Model 5 when measures of child malnourishment as proxied by (wasting=weight for height) and vitamin A supplementation are included, the odds ratio of severe ARI declines. This decline in the odds ratio implies that some of the excess risk of severe ARI among children in less educated mother is due to the higher likelihood of these children to suffer from increased wasting (i.e. lower weight/height) and decreased levels of vitamin A supplementation. This result

indicates that child malnutrition is also a factor of mothers' education. In Model 6 when controls for maternal nutritional status as proxied by mothers body mass index (BMI) and maternal age are added, the odds ratio for severe ARI increases from 1.77 to 1.86 and still significant. This suggests that risk of severe ARI among children to lower educated mother is even more. However, model 4 to model 6 shows that after controlling the effect of most common risk factor of ARI among children, children to less educated mother are still suffering significantly more from severe ARI compare to children to higher educated mother. Model 6 also suggested that there is inter relationship between women's age, malnutrition and education.

Finally, in Model 7 (final model), when both mother's education and poverty was included in the model, it was found that children of less educated families have a 79% higher risk of severe ARI compare to children to higher educated families. In this model, poverty became insignificant meaning that there is a relationship between women's education and household poverty where children of poor families suffer more from severe ARI due to mother's education. This result is supported by Henry et al. (2004) where they found that mother's education (not father's education), along with household assets or land ownership is the best predictor of child health. Apart from mother's education, teenage child bearing is a risk factor (OR=1.7) of severe ARI, and early marriage and early motherhood is a reason for lower education of the mother. Other risk factors are children's lower age, sex of child if boy and childhood malnutrition.

Discussion

Models 1 through 6 shows that mother's lower education and household poverty are significant risk factors for children with severe ARI. But when mother's education level was included in the final model, household poverty became insignificant meaning that poor children had higher risk due to lower education of mother. So it is important to improve the education level of the mother. Educated mothers are aware about the health of their children through different experiences that lead to higher immunity among the children. Another significant risk factor was the mothers' lower age. However, there is a inter relationship between women's early marriage and lower education level. Early marriage and early child bearing leads to school drop out which is a major cause of lower educational levels among women in Bangladesh. Other risk factors were childhood malnutrition (wasting), lower age and sex of child. However to some extent of the risk of child lower age can be explained by lower education of mother meaning that some of the extra risk of severe ARI among infants and toddlers can be reduced if mother has secondary or higher education.

Like other studies, this study also revealed that boys have significantly higher chance of these diseases than girls (Victora, 1999). This may be genetic or there may be higher reporting for boys due to gender bias where mothers may be considering it more serious for boys or it is considered less serious for girls. Regarding immunization, supplementation of vitamin A is not a risk factor which may be due to the success of the Bangladesh immunization program where over 70% of children are fully immunized, and over 90% are partially immunized (NIPORT, 2005).

There is a triangular relationship between household poverty, women's early marriage and education. Poverty leads to early marriage among women in Bangladesh. This leads to early childbearing, chronic malnourishment and drop out from school among women in Bangladesh. Most of the earlier studies revealed that household poverty is a significant risk factor of ARI among children in Bangladesh. This study also revealed that like other study, poverty is an individual risk factor for severe ARI among children in Bangladesh. However, this higher chance of this disease is due to lower educational levels among women in Bangladesh.

Limitations

The most important limitation of this study is it's cross sectional design that precludes the ability to disentangle cause and effect. For example it is hard to know if child malnourishment (proxied by weight/height) is an outcome or cause of ARI. With regard to severe ARI definition, this study relies on self-reported symptoms without any laboratory or radiographic evidence. Thus it is possible that misclassification may occur. However knowledge is an important factor to identify the severity of ARI, and less educated mother may have the higher possibility of reporting more ARI with severe symptoms. These may lead to information bias with more severe ARI cases among the lower educated mothers.

Categorization of poor vs non-poor may also have resulted in misclassification with the most likely possibility being that some of the poor (in terms of consumption capability) were labelled as rich due to non-liquid asset ownership. This kind of misclassification would result in decreasing the relative risk of severe ARI for the poor versus the rich. The lack of information about various key risk factors (e.g. childhood immunity, crowding, air pollution, access to and knowledge about health care services) in the data set made it difficult to construct a true picture.

Conclusion

The findings of this study clearly revealed that under five children born to lower educated mothers are at a significantly higher risk of severe ARI than children born to educated mothers in Bangladesh. The second important risk factor is the mother's lower age that is also related to lower educational level of mothers. Household lower socio-economic status is an important risk factor of childhood ARI in developing countries like Bangladesh. However household poverty is not a significant risk factor of severe ARI where poor children suffer more from this disease due to mother's lower education. As noted above increasing educational participation of girls in secondary schools in Bangladesh should have a positive effect on better awareness of the need for appropriate medical intervention in ARI. In addition to broad based interventions to increase maternal education, efforts to provide targeted health care information about ARI to mothers need be strengthened.

The significant adverse effect of low maternal age on childhood severe ARI risk underscores the need for increasing age at marriage and childbearing through both media awareness campaigns and legal avenues. Bangladesh has the lowest median age at marriage (15 years) and childbearing in the region although the legal framework is in place (age at marriage legally=18 years). In recent years the government is providing free education and also incentives among females to increase female literacy in Bangladesh. Due to this policy female enrolment in

secondary schools has dramatically increased (now one of the highest in South Asia) and this should start to have a positive impact on increasing age at marriage and consequently childbearing (Rahman O, 2004). So women's higher education will reduce the chance of severe ARI directly and indirectly through increasing age at marriage and age at childbearing. Therefore to increase early marriage and childbearing, improvements in child health (both for severe ARI and malnutrition) are important to improve women educational levels.

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