

ACUTE RESPIRATORY INFECTION AND ITS DETERMINANTS FOR BANGLADESHI UNDER-5 CHILDREN

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ABSTRACT

The aim of the study is to identify the prevalence of acute respiratory infection (ARI) and its influential factors for the under-five Bangladeshi children using the Bangladesh Demographic and Health Survey 2004 data. Bivariate cross-tabulation analysis is adopted to find the associated significant variables with child acute respiratory infections and then a multiple logistic regression model is developed using those significant variables to determine the predictors. Proportion test was also done for pair-wise comparison. One-fifth children were found suffering from ARI, while incidence rate was 16.56 per 1000 children per day. Prevalence of ARI was found significantly higher among the infants & toddlers and children belonging to Barisal & Chittagong divisions, acutely malnourished & adolescence mothers, poor socio-economic households. Multiple logistic regression analysis shown that sex, age and malnutrition status of children, regional settings, household wealth status, age of mothers and their educational status were the significant predictors of children ARI.

Keywords: Acute Respiratory Infection (ARI), Household Wealth Status, Child & Maternal Nutrition, Mothers' Education, Multiple logistic regressions.

INTRODUCTION

Acute respiratory infections (ARIs) comprise a composite and diverse group of diseases caused by a great number of etiological agents, and affecting any side of the respiratory tract. ARI is the most important cause of acute illnesses and one of the leading causes of infant and young child mortality, accounting for about two million deaths each year (Kieny & Girard, 2005; Mizgerd, 2008). ARI is one of the vital causes of disability-adjusted life-years lost (94.6 millions, 6.3% of total) in developing countries (Williams *et al.*, 2002). The consequence of high prevalence of acute respiratory infections (ARIs) is not only be a sign of high child mortality in the short term but also over the long term decreased work capacity, increased risk of adult morbidity and early death.

In several studies it is found that about one-fifth of total deaths under-five children in developing countries occur due to ARI (Kristensen & Olsen, 2006; Williams *et al.*, 2002; Victora, 1999; Denny & Loda, 1986). In developing countries mortality rate caused by ARI is 10-50 times higher than in developed countries (WHO, 1999). Upper respiratory infections (URIs) are very frequent but seldom life-threatening, however lower respiratory infections (LRIs) are responsible for more severe illnesses such as influenza, pneumonia, tuberculosis, and bronchiolitis that are the leading contributors to ARI's mortality

(Scott *et al.*, 2008; Zar & Mulholland, 2003) and account for nearly one-third deaths of children under five in many countries (Rashid *et al.*, 2001). A recent study also estimated the incidence of ARIs among children under 5 years as 0.29 and 0.05 episodes per child-year in developing and industrialized countries respectively and these episodes translates into 151 million and 5 million new episodes each year respectively (Rudan *et al.*, 2008). The vulnerability of ARI is higher in Africa and Asia than the other parts of the world and this figure in 2000 about 1.9 million (95% CI: 1.6-2.2 million) children died from ARI throughout the world of which 70% were in Africa and Southeast Asia - Bangladesh, Indonesia and Nigeria (56 million each), India (43 million), China (21 million), Pakistan (10 million) (Williams *et al.*, 2002).

The children are most vulnerable to morbidity during their first few years of life. Most of the children under-five years of age are experienced with 4-6 episodes of ARI annually, responsible for 10 to 25 percent deaths in developing countries like Bangladesh (WHO, 2006). In Bangladesh morbidity and mortality are extremely high, especially among young children and mothers (BBS, 1987; Chowdhury, 1988; Schulz & Csele, 1990). In rural area of Bangladesh, ARI is a major cause of child morbidity (Zaman *et al.*, 1997). According to ICDDR'B, 2003, ARIs including pneumonia remain major causes of child mortality in Bangladesh. Baqui *et al.* (1998) found 25 percent of all childhood deaths due to ARIs

and estimated that 400 children were dying each day in Bangladesh. They also observed that higher percentages of infant deaths (approximately 40 percent) were associated with ARIs.

ARI is one of the important child survival related indicators, which will provide critical input to the monitoring of progress towards the child survival related goals and strategies - the World Fit for Children Declaration and Plan of Action, the Millennium Development Goals (UNICEF/WHO, 2004). In Bangladesh, a number of policies are implemented to improve child health and nutrition since 1993, but the health status of children is still near to the ground. In order to reduce the child mortality, child morbidity as well as child ARI, the most common symptom of child morbidity, should be reduced. Williams *et al.*, (2002) exemplified that if the number of death due to ARI increases, the childhood mortality increases tremendously. To reduce the prevalence of ARI, it is necessary to study the differentials and determinants of child ARI which will help us to set up appropriate programs. The study aims to render useful policy recommendations regarding acute respiratory infection of children by examining factors that influence their health outcomes. This exclusive and widespread study makes an effort to provide constructive information to the policy makers and planners for formulating health policies in reducing child morbidity and as well as child mortality in Bangladesh.

METHODS

The study utilizes the nationwide data of Bangladesh Demographic and Health Survey (BDHS, 2004). The analysis of the study has been done using data of 6498 children under five years of age.

Variables: A child is considered as experienced with ARI if it is reported that the child enclosed a cough along with any of the three symptoms - (i) short or rapid breathing; (ii) difficulty in breathing; (iii) chest in drawing during the last two weeks prior to the survey.

The study considers several socio-economic, demographic and health related variables as the independent variables to study the differentials and the determinants of child ARI. Child nutritional status was measured considering three anthropometric indices – height-for-age, weight-for-age, weight-for-height Z-scores. A child is considered as malnourished if any of the three Z-scores were less than -2.0, i.e., a child is considered as malnourished

either she/he is stunted, or wasted, or underweight. Mothers body mass index (BMI) was constructed to determine mother's nutritional status as (a) acutely malnourished ($<18 \text{ kg m}^{-2}$) and (b) nourished ($\geq 18 \text{ kg m}^{-2}$).

METHODOLOGY

Bivariate cross-tabulation analysis is adopted to find the significant variables which are associated with child acute respiratory infection. Chi-square test is performed to see the existence of interrelationship among the categories of two qualitative variables in this study. Proportion test was also done for pair-wise comparison. A logistic regression model has been developed using those significant variables to determine the predictors of child ARI.

RESULTS

In 2004 more than one-fifth Bangladeshi children under five years of age experienced with the episode of ARI during the last 15 days of the survey. Table 1 shows the trends in the percentage of children experienced with ARI for all of the BDH Surveys to focus the picture of the vulnerability of ARI at a glance. The findings show a huge variation in prevalence of ARI. There is no increasing or decreasing pattern but it reveals that around 20 percent children suffered from ARI during last two decades which is a great concern for Bangladeshi children health. This variation in the proportion of children with ARI may be occurred due to the time variation in data collection. It is noted that a few of the ARI experienced children seek a health facility. This indicates that either the guardians are unable to identify ARI or ignore the disease due to lack of knowledge regarding the long term impact of ARI.

Bivariate analysis shows that the prevalence of ARI was significantly higher among the male children than that of female children. The proportion of male children experienced with ARI was about 22%, while it was 19.6% for female children during the last two weeks preceding the survey (Table 2). Multivariate logistic regression analysis also indicates that the male children are more susceptible to be suffered from ARI compared to female children. The odds ratio of being experienced with ARI was found 1.157 (CI: 1.018-1.315) for male children compared to the female children (Table 3).

Infants are more vulnerable of several diseases like diarrhea, ARI, fever and other chronic diseases. The study found that the prevalence of ARI were more

frequent among the infants compare to the children aged more than 12 months (from pair-wise comparison). After 1st year of life, the prevalence of ARI significantly decreased with the increase of child age (Table 2). Like bivariate analysis, multivariate analysis also shows that the risk of being suffering from ARI decreased chronologically with the increase of child age. It is observed that children of age 12-23 months were about 25 percent less likely to be suffered from ARI (OR: 0.74, CI: 0.58-0.96), while the risk was about 55 percent less for the children of 36-59 months (OR: 0.43-0.45, CI: 0.33-0.57) as compared to the children aged less than six months.

Table 2 shows that there was no significant variation in the prevalence of ARI among the children according to place of residence. The proportions of children experienced with ARI were found about 19% and 21% respectively in urban and rural area of Bangladesh. However, the prevalence of ARI was found significantly varied with the regional settings. Among the divisions, in *Barisal* and *Chittagong* the incidence of ARI was found significantly higher than the others (Table 2). Pair-wise comparisons indicate that the prevalence of ARI was significantly higher in *Barisal* division (26.7%) than that of *Dhaka* division (18.8%). Logistic regression analysis also indicates that the children of *Barisal* division had highest risk (OR: 1.554, CI: 1.185-2.037) of being experienced with ARI, followed by *Chittagong* division (OR: 1.401, CI: 1.18-1.67), *Khulna* division (OR: 1.278, CI: 1.02-1.60) compared to the children of *Dhaka* division.

The episode of ARI among children under-five was found significantly associated with mothers' age (Table 2). Children of adolescent mothers were found significantly more experienced with ARI (27.8%) compared to others and it is observed that there was no significant difference in the prevalence of ARI for the children of mothers aged over 20 years. Multivariate analysis also shows that the risk of ARI was 35 percent significantly higher among the children of adolescent mother (OR: 1.345, CI: 1.09-1.66) as compared to children of mothers aged 30+ years (Table 3).

Bivariate analysis indicates that the episode of children ARI was more frequent in the households having moderate and poor wealth conditions compared to the wealthy households. The proportions of experienced children with ARI preceding the survey were more than 22% for the middle and poor households while the proportion

was significantly lower for the rich households (15.2-17.5%). From logistic regression analysis, it is also observed that children belonging to poorer and poorest households were 1.40 (CI: 1.10-1.78) and 1.29 (CI: 1.01-1.65) times more susceptible to be suffered from ARI compared to the children of richest households.

Educated mothers are usually more concern about their children's disease like diarrhea, ARI, and other infectious diseases. So it is expected that the children of educated mothers have lower episode of ARI. In the present study, it is also found that illiterate and less educated (under primary) mothers' children were more experienced with ARI compared to those of higher educated mothers.

About one-fifth and one-fourth children belonging to mothers having no education and incomplete primary education were experienced with ARI respectively. In comparison to the children of secondary & higher educated mothers, the children of incomplete primary educated mother had highest risk (OR: 1.906, CI: 1.357-2.676) of being experienced with ARI, followed by illiterate mothers' children (OR: 1.543, CI: 1.098-2.168).

The prevalence of ARI was found significantly higher (23.1%) among the children of acutely malnourished mothers (BMI <18.5) than the children of nourished mothers (19.6%). However, maternal nutrition status was not found as significant predictors of child ARI in logistic regression analysis.

Receiving status of vitamin-A capsule was found significantly associated with child ARI. The study found that significantly lower proportion children who received vitamin-A capsule (18.5%) had ARI than the children who did not receive vitamin-A (26.7%). Logistic regression analysis also revealed that the children who did not receive vitamin-A had 1.28 times higher risk than their counterparts.

In bivariate analysis, malnourished children were found significantly more experienced with ARI (22.7%) than the nourished children (18.9%). Also in logistic regression analysis, it is observed that malnourished children had 40% higher risk of being suffering from ARI than their counterparts (CI: 1.21-1.62). The findings of the study depicts after controlling all other factors, child nutritional status has a significant influence on child ARI.

DISCUSSION AND CONCLUSION

Acute Respiratory Infection is one of the most important factors of child morbidity and mortality in Bangladesh. One-fifth children under five years of age had ARI which is a great concern for the Bangladeshi children. The study found that male children had higher risk of being experienced with ARI. Chatterjee (2007) and Victora (1999) also found the similar results. Morbidity due to respiratory illness is higher for the younger children (Gladstone *et al.*, 2008). The present study found that the infants, the most vulnerable group among the under five children, more experienced with ARI than the others. However, the risk of being affected by ARI reduces with the increase of age. These results suggest taking more attention to the children in their first year of life.

Usually, the adolescent mothers are less conscious about their child health due to limited knowledge about how to take care a child (Sugar, 1976). The study also explored that children of adolescent mothers were more susceptible for ARI than those of older and experienced mothers. This finding recommend to extend the age at marriage and to provide sufficient knowledge regarding nutrition and child health, prevention against ARI and other diseases to the mothers especially adolescent mothers.

Mothers' education had a significant influence in reducing ARI. Lower prevalence of ARI among the children of educated mothers indicates that educated mothers are more conscious about the health of their

children through different experiences that lead to higher immunity among the children. Under-five children born to lower educated mothers were at higher risk of being experienced with ARI than those born to educated mothers. These results are supported by several studies in Bangladesh (Azad & Rahman, 2009).

This study established that socio-economic condition has a significant influence on the episode of ARI. The children belonging to lower socio-economic households were in greater risk of being experienced with ARI compared to the children born in higher socio-economic households. This indicates to reduce the vulnerability of ARI; the variation in socio-economic conditions should be abridged. Regional setting was also found as a significant predictor of child ARI in Bangladesh. It is necessary to take proper attention to the children of *Barisal* and *Chittagong* divisions.

Health and nutrition is an important factor for the well being of the children. The study found child malnutrition and vitamin-A supplementation as significant risk factors for the incidence of child ARI. These findings were also found by Ahmed *et al.* (2005). The risk of being experienced with ARI was higher for the malnourished children and for the children who did not receive vitamin-A. The findings indicate that to save the children from the susceptibility of ARI, parents should be more conscious about their children health and nutrition. Moreover, government should promote the existing vitamin-A supplementation programs in this regard.

Table 1. Trends in the Prevalence and Treatment of ARI for under-5 children, Bangladesh 1993-2007

Survey	Percentage with ARI ¹	Total No. of Children	Percentage of those with ARI taken to a health facility	Number of children with ARI	Survey Time
1993-94	24.0	3535	28.0	848	17 Nov 1993 -12 Mar, 1994.
1996-97	12.8	5654	32.9	724	2 Nov 1996 - 11 Mar 1997.
1999-2000	18.3	6430	27.2	1177	09 Oct – 09 Nov, 1999
2004	20.8	6498	20.3	1350	1 Jan - 25 May, 2004.
2007	13.0	5719	30.2	743	24 Mar - 11 Aug, 2007

¹ Refers to cough with either rapid or difficult breathing or chest in drawing.

Source: Mitra *et al* 1994; Mitra *et al* 1997; NIPORT 2001; NIPORT 2005; NIPORT 2009

Table 2. Calculation of Incidence Rate of ARI per thousand children per day

Survey	Total number of Children with ARI	Total Number of Children Without ARI	Total Survival Time in days (Col. 2*7+col. 3*15)	Incidence Rate Per 1000 per day (Col. 2/Col. 4)*1000
(Col. 1)	(Col. 2)	(Col. 3)	(Col. 4)	(Col. 5)
1993-94	848	2687	43554	19.47
1996-97	724	4930	74088	9.77
1999-2000	1177	5253	81781	14.39
2004	1350	5148	81522	16.56
2007	744	4975	74858	9.94

Table 3. Differentials of Child ARI, Bangladesh 2004

Associated Factors	Prevalence of ARI		Total	Chi-square	P-value
	No	Yes			
Sex of child					
Female	80.4	19.6	3204	5.588	0.018
Male	78.1	21.9	3294		
Age of child					
<6	71.6	28.4	682	111.708	0.000
6-11	70.4	29.6	591		
12-23	75.1	24.9	1262		
24-35	79.8	20.2	1305		
36-47	84.3	15.7	1332		
48-59	85.0	15.0	1283		
Current age of mother's					
30+ years	80.3	19.7	1598	37.366	0.000
25-29 years	80.8	19.2	1634		
20-24 years	80.6	19.4	2222		
<20 years	72.2	27.8	1044		
Place of residence					
Urban	80.7	19.3	1284	2.109	0.146
Rural	78.8	21.2	5215		
Region of residence					
Dhaka	81.2	18.8	2004	30.167	0.000
Chittagong	75.6	24.4	1424		
Rajshahi	81.5	18.5	1450		
Barisal	73.3	26.7	386		
Khulna	78.4	21.6	694		
Sylhet	80.7	19.3	540		
Wealth index					
Richest	84.8	15.2	1074	43.28	0.000
Richer	82.5	17.5	1170		
Middle	77.9	22.1	1265		
Poorer	75.9	24.1	1351		
Poorest	77.0	23.0	1637		
Mother's educational status					
Secondary & higher	87.5	12.5	457	38.795	0.000
Complete primary	80.6	19.4	2183		
Incomplete primary	74.8	25.2	1410		
No education	79.0	21.0	2447		
Mothers' Body Mass Index (BMI)					
Normal (≥ 18.5 kg/m ²)	80.4	19.6	4023	11.192	0.001
Thinness (<18.5 kg/m ²)	76.9	23.1	2397		
Received Vitamin-A by children					
Yes	81.5	18.5	4666	53.741	0.000
No	73.3	26.7	1823		
Nutritional status of children					
Nourished	81.1	18.9	2562	12.50	0.000
Malnourished	77.3	22.7	3416		
Total	79.2	20.8	6498		

Table 4. Determinants of Child ARI, Bangladesh 2004

Associated Factors	Multiple Logistic Regression Analysis				
	β	P-value	Odds Ratio	CI of Odds Ratio	
				Lower CI	Upper CI
Sex of child					
Female*	--	--	--	--	--
Male	0.146	0.026	1.157	1.018	1.315
Age of child					
<6*	--	--	--	---	---
6-11	-0.101	0.451	0.904	0.695	1.176
12-23	-0.307	0.023	0.736	0.584	0.959
24-35	-0.512	0.000	0.599	0.456	0.787
36-47	-0.807	0.000	0.446	0.337	0.591
48-59	0.839	0.000	0.432	0.326	0.573
Current age of mother's					
30+ years*	--	--	--	--	--
25-29 years	0.001	0.991	1.001	0.832	1.205
20-24 years	-0.042	0.645	0.959	0.802	1.147
<20 years	0.296	0.006	1.345	1.090	1.660
Region of residence					
Dhaka*	---	--	--	---	---
Chittagong	0.337	0.000	1.401	1.175	1.672
Rajshahi	-0.838	0.684	0.962	0.798	1.159
Barisal	0.441	0.001	1.554	1.185	2.037
Khulna	0.246	0.033	1.278	1.019	1.602
Sylhet	0.071	0.588	1.074	0.830	1.388
Wealth index					
Richest*	---	--	--	---	---
Richer	-0.002	0.985	0.998	0.782	1.272
Middle	0.217	0.075	1.242	0.978	1.576
Poorer	0.333	0.007	1.395	1.096	1.777
Poorest	0.253	0.042	1.288	1.009	1.645
Mother's educational status					
Secondary & higher*	---	--	--	---	---
Complete primary	0.546	0.037	1.414	1.021	1.958
Incomplete primary	0.645	0.000	1.906	1.357	2.676
No education	0.434	0.012	1.543	1.098	2.168
Mothers' BMI					
Normal (≥ 18.5 kg/m ²)*	---	--	--	---	---
Thinness (<18.5 kg/m ²)	0.076	0.268	1.079	0.943	1.233
Received Vitamin-A by children					
Yes*	--	--	--	--	--
No	0.253	0.003	1.288	1.087	1.525
Nutritional status of children					
Nourished*	--	--	--	--	--
Malnourished	0.336	0.000	1.399	1.209	1.618

Here, * indicates the reference category.

Hosmer and Lemeshow Test Statistic=3.129 (p-value=0.926).

Thus the findings of the study suggest taking proper attention to the infants and toddlers, providing adequate knowledge regarding childcare to the adolescent mothers, encouraging mothers to bear child after 20 years of age, strengthening existing girl's education programs, reducing household socio-economic inequality and emphasize to the existing

programs on child health and nutrition to reduce the incidence of child ARI and hence to reduce the childhood death due to ARI. Special health and nutrition interventions should be undertaken for the children of *Barisal* and *Chittagong* divisions in order to reduce vulnerability of ARI in the areas.

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