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Antibiotic Use for Acute Respiratory Infections in Children Under Five: A Study of Practices and Implications in Bangladesh

Dr. Mahmuda Rahman Dipu[1*], Dr. Juwel Das[1], Dr. Palash Halder[1], Dr. Bijoy Paul[1]

[1]Assistant Professor, Department of Pediatrics, Brahmanbaria Medical College Hospital, Bangladesh

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***Corresponding author:** Dr. Mahmuda Rahman Dipu
Assistant Professor, Department of Pediatrics, Brahmanbaria Medical College Hospital, Bangladesh

Abstract **Original Research Article**

Background: Acute respiratory infections (ARIs) are a primary cause of morbidity and mortality in children under five, particularly in low- and middle-income countries such as Bangladesh. Despite the viral nature of most ARIs, antibiotics are often prescribed, contributing to antibiotic resistance—a critical public health issue. Understanding the patterns and drivers of antibiotic use for ARIs in children is essential for developing strategies to combat misuse and resistance. ***Objective:*** This study aims to examine the prevalence and determinants of antibiotic use for ARIs among children under five in Bangladesh, assessing both healthcare provider and parental influences on prescribing practices. ***Methods:*** Using data from the 2014 Bangladesh Demographic and Health Survey (BDHS), we analyzed the antibiotic treatment patterns for ARIs in children under five. The survey utilized a two-stage cluster sampling method and included interviews with mothers to capture demographic, socioeconomic, and healthcare access information, as well as ARI symptoms and antibiotic use details. Statistical analyses were conducted to identify factors associated with antibiotic prescription. ***Results:*** Of 2,146 children under five with ARI symptoms, 38.7% received antibiotics. Antibiotic use was more prevalent in rural areas (41%) compared to urban settings (31.3%) and among children treated by unqualified practitioners (47.1%) rather than healthcare professionals (37.5%). Antibiotic prescriptions were influenced by parental education levels, geographic divisions, and healthcare access. Sources listed as "Others," which include alternative suppliers, showed the highest prevalence of antibiotic usage (76%). Factors like child malnutrition did not significantly impact antibiotic use, though severe wasting was associated with lower antibiotic prescriptions. ***Conclusion:*** This study highlights a high rate of antibiotic use for ARIs in children under five in Bangladesh, largely driven by socioeconomic factors, healthcare accessibility, and traditional prescribing practices. Efforts to reduce inappropriate antibiotic use must focus on improving diagnostic capacities, healthcare provider training, and public awareness to mitigate the public health risks associated with antibiotic resistance.

Keywords: Acute respiratory infections, antibiotics, children under five, Bangladesh, antibiotic resistance, healthcare access, prescribing practices.

INTRODUCTION

Acute respiratory infections (ARIs) remain one of the leading causes of illness and mortality in children under five worldwide, with a particularly high impact in low- and middle-income countries, including Bangladesh. These infections, ranging from mild respiratory tract infections to severe conditions like pneumonia, are responsible for significant morbidity among young children [1-3]. Despite advancements in healthcare, managing ARIs effectively remains a challenge, especially in resource-limited settings where accessibility to quality care, diagnostics, and treatment protocols can vary. Antibiotics are frequently prescribed to treat ARIs in children, though the appropriate use of these medications remains a critical issue, as the majority of ARIs are viral and do not benefit from antibiotic therapy [4].

In Bangladesh, antibiotics are often used as a primary treatment for ARIs in children, reflecting both a lack of diagnostic clarity and entrenched prescribing practices. This overreliance on antibiotics poses multiple risks, not only to individual patients but also to public health at large. Misuse and overuse of antibiotics for viral ARIs contribute to the growing problem of antibiotic resistance, which diminishes the effectiveness of these drugs for bacterial infections [5-7]. The situation is exacerbated by factors such as limited access to

diagnostic tools, cultural practices, parental expectations, and a shortage of healthcare resources that can help in discerning bacterial from viral infections [8].

The inappropriate use of antibiotics in managing ARIs among children is an area that demands close scrutiny. In Bangladesh, studies indicate that antibiotics are prescribed in a large proportion of ARI cases despite the minimal role bacteria play in causing these infections [9-11]. This trend not only leads to unnecessary medication exposure in children but also drives up healthcare costs and risks adverse drug effects. Additionally, the overprescription of antibiotics can promote the spread of antibiotic-resistant bacteria, which poses a long-term threat to global health, as resistant infections become increasingly difficult and costly to treat.

Efforts to address this issue must consider both the healthcare provider and parental perspectives. Healthcare providers, influenced by a lack of rapid diagnostic tools and pressure from families, may default to antibiotic prescriptions as a precaution. On the other hand, parents and caregivers often expect quick relief for their children's symptoms, which can lead to an expectation for antibiotics as a quick-fix solution. This study explores these dynamics in the context of Bangladesh, where a high incidence of ARIs in children under five necessitates a balanced approach to treatment that safeguards both immediate and future health.

Objective

This research aims to examine the patterns of antibiotic use for ARIs in children under five in Bangladesh, identifying the factors influencing prescription practices and assessing the implications for health outcomes and antibiotic resistance.

METHODOLOGY

We analyzed data from the Bangladesh Demographic and Health Survey (BDHS) 2014, conducted between June and November 2014 and published in March 2016. This survey, a nationally representative cross-sectional household survey, is carried out approximately every five years by the National Institute of Population Research and Training under the Ministry of Health and Family Welfare. The BDHS dataset, like other Demographic and Health Surveys (DHS) conducted across LMICs, is publicly available to researchers upon request, with detailed data collection tools and study methodology outlined in the survey report and on the DHS website. The survey utilized a two-stage cluster sampling method, selecting 600 enumeration areas (EAs) with probability proportional to size in the first stage and then systematically sampling 30 households per EA. This approach led to surveys conducted in 18,000 residential households, of which 17,300 households were successfully interviewed, representing 0.05% of total households in Bangladesh. Among these, 18,245 ever-married women aged 15–49 were approached, with 17,863 providing consent and completing interviews, achieving a 98% response rate. Mothers were asked about recent illness episodes in their children under five, specifically any symptoms of cough, fever, runny nose, or diarrhea within the two weeks before the survey. If they responded "yes," they were further questioned about treatment details, including the treatment location, facility type, and drugs used.

RESULTS

The data from Table 1 show that out of 2,146 children under five years of age who reported symptoms of acute respiratory infection (ARI) in the two weeks preceding the survey, 829 children (38.7%) received antibiotics. The likelihood of antibiotic use varied by demographic and sociodemographic factors. For example, children in rural areas had a significantly higher prevalence of antibiotic use (41%) compared to those in urban areas (31.3%). Parental education also appeared to play a role, with children of fathers and mothers who attained only primary education more likely to receive antibiotics than those whose parents had higher education. Additionally, children in the Sylhet division showed a notably higher prevalence of antibiotic use (50.4%) compared to other divisions. Interestingly, the data reveal a higher antibiotic usage among children seen by unqualified or traditional practitioners (47.1%) than those who were prescribed antibiotics by healthcare professionals (37.5%). The private sector was the most common source for antibiotic acquisition, although the "others" category, which includes alternative sources, showed the highest prevalence of antibiotic usage at 76%. Factors like child malnutrition did not show a significant impact on antibiotic use, with well-nourished, stunted, and wasted children receiving antibiotics at similar rates.

Table-1: Demographic and Sociodemographic Characteristics, Child Malnutrition Status, Antibiotic Prescribers, and Drug Sources for Children Exhibiting ARI Symptoms in the Two Weeks Prior to the Survey, and the Prevalence of Antibiotic Use

Characteristics	Children under 5 years of age who had symptoms of ARI		Children of age under 5 years who took antibiotic for symptoms of ARI				
	No of children who had symptoms of ARI	Percentage of children who had symptoms of ARI	No of children who received antibiotics	Percentage of children who received antibiotics	Prevalence of receiving antibiotic	95% CI	P value
Overall	2146	100	829	100	38.7	(35.4 to 42.0)	
Age of mother (year)							
Median (IQR: 25th, 24 (21–29) 25 (21–30) 75th)							
15–19	336	15.7	125	15.1	37.1	(31.4 to 43.2)	0.756
20–24	762	35.5	283	34.2	37.2	(32.7 to 41.9)	
25–29	541	25.2	207	25.0	38.3	(32.7 to 44.3)	
30–34	351	16.4	146	17.6	41.5	(32.6 to 51.0)	
35–39	118	5.5	51	6.2	43.6	(31.4 to 56.6)	
40–44	24	1.1	12	1.5	52.4	(31.9 to 72.1)	
45–49	14	0.7	4	0.5	31.6	(10.3 to 64.8)	
Age of father (year)							
Median (IQR: 25th, 75th)	32 (28–38)		32 (28–39)				
≤24	124	5.8	46	5.5	37.0	(28.1 to 46.9)	0.181
25–29	519	24.2	180	21.7	34.7	(29.6 to 40.3)	
30–34	490	22.8	177	21.3	36.0	(31.0 to 41.4)	
35–39	502	23.4	212	25.5	42.2	(35.2 to 49.5)	
40–44	268	12.5	100	12.1	37.4	(30.9 to 44.3)	
45–49	136	6.3	65	7.8	47.6	(34.0 to 61.7)	
50–54	52	2.4	21	2.6	40.9	(26.7 to 56.7)	
≥55	55	2.6	29	3.5	52.5	(39.3 to 65.3)	
Age of child (months)							
Median (IQR: 25th, 75th)			27(13–42) 29 (14–43)				
<6	178	8.3	64	7.7	36.0	(26.2 to 47.2)	0.254
6–11	308	14.3	95	11.5	31.0	(24.3 to 38.5)	
12–23	482	22.5	180	21.7	37.3	(32.2 to 42.6)	
24–35	414	19.3	161	19.4	38.9	(33.0 to 45.1)	
36–47	405	18.9	173	20.8	42.6	(36.5 to 48.9)	
48–59	357	16.7	157	18.9	43.9	(33.0 to 55.4)	
Sex of child							
Male	1133	52.8	425	51.3	37.5	(33.4 to 41.8)	0.425
Female	1012	47.2	404	48.7	39.9	(35.4 to 44.6)	
Place of residence							
Urban	520	24.2	163	19.6	31.3	(26.3 to 36.8)	**0.006**
Rural	1625	75.8	666	80.4	41.0	(37.2 to 44.9)	
Wealth index							

Characteristics	Children under 5 years of age who had symptoms of ARI		Children of age under 5 years who took antibiotic for symptoms of ARI			
	No of children who had symptoms	Percentage of children who had symptoms of ARI	No of children who received antibiotics	Percentage of children who received antibiotics	Prevalence of antibiotic receiving	95% CIP value
Poorest	502	23.4	203	24.5	40.5	(34.8 to 46.5) 0.459
Poorer	390	18.2	163	19.6	41.6	(35.0 to 48.6)
Middle	466	21.7	186	22.5	40.0	(33.1 to 47.2)
Richer	412	19.2	147	17.8	35.8	(29.9 to 42.1)
Richest	375	17.5	129	15.6	34.5	(28.3 to 41.2)
Divisions						
Barisal	138	6.4	57	6.8	41.0	(33.0 to 49.5)

				0.070		
Chittagong	506	23.6	171	20.6	33.8	(28.3 to 39.8)
Dhaka	657	30.6	247	29.8	37.6	(31.5 to 44.1)
Khulna	138	6.4	47	5.6	33.8	(26.5 to 42.0)
Rajshahi	216	10.1	83	10.1	38.5	(32.0 to 45.5)
Rangpur	232	10.8	94	11.4	40.7	(34.0 to 47.8)
Sylhet	258	12	130	15.7	50.4	(38.6 to 62.1)
Father education						
No education	572	26.7	221	26.6 0.547	38.6	(31.2 to 46.5)
Primary	653	30.5	274	33.1	42.0	(34.9 to 49.5)
Secondary	637	29.7	235	28.3	36.8	(32.5 to 41.5)
Higher	281	13.1	99	12.0	35.3	(28.8 to 42.5)
Father occupation						
Agriculture	557	26	224	27.0 0.868	40.2	(34.7 to 45.9)
Unskilled and semiskilled worker	982	45.8	377	45.4	38.4	(33.8 to 43.2)
Professional work	112	5.2	42	5.0	37.4	(28.2 to 47.5)
Businessmen	443	20.7	171	20.6	38.7	(32.6 to 45.1)
Others	50	2.3	16	1.9	31.8	(21.0 to 45.0)
Mother education						
No education	367	17.1	144	17.3 0.853	39.2	(30.9 to 48.1)
Primary	650	30.3	262	31.6	40.3	(34.4 to 46.4)
Secondary	939	43.8	355	42.8	37.8	(33.6 to 42.1)
Higher	190	8.9	69	8.3	36.2	(28.2 to 45.1)
Mother occupation						
Not working	1588	74.0	615	74.2 0.902	38.7	(34.8 to 42.8)
Working	557	26.0	214	25.8	38.4	(33.8 to 43.2)
Child alnutrition status						
Stunted						
Severe	263	87	98	12.4 0.746	37.1	(28.6 to 46.6)
Moderate	538	254	219	27.9	40.7	(34.6 to 47.0)
Well Nourished	1217	1677	469	59.7	38.5	(34.6 to 42.7)
Wasted						
Severe	204	10.1	20	2.5 **0.048**	22.7	(13.1 to 36.3)
Moderate	528	26.1	105	13.4	41.2	(33.9 to 49.0)
Well Nourished	1286	63.7	661	84.1	39.4	(35.9 to 43.1)

Characteristics	**Children under 5 years of age who had symptoms of ARI**		**Children of age under 5 years who took antibiotic for symptoms of ARI**				
	No of children who had symptoms of ARI	**Percentage of children who had symptoms of ARI**	**No of children who received antibiotics**	**Percentage of children who received antibiotics**	**Prevalence of receiving antibiotic**	**95% CI**	**P value**
Severe	204	10.1	74	9.4	36.2	(25.0 to 49.1)	0.813
Moderate	528	26.1	210	26.7	39.8	(35.0 to 44.9)	
Well Nourished	1286	63.7	502	63.8	39.0	(35.0 to 43.1)	
Drug prescribed							
Healthcare professional/worker							
Yes	733	34.1	275	33.1	37.5	(31.1 to 44.3)	0.649

No	1413	65.9	555	66.9	39.3	(35.7 to 42.9)	
Unqualified/traditional practitioner							
Yes	970	50.8	457	55.2	47.1	(42.9 to 51.4)	**0.022**
No	938	49.2	371	44.8	39.5	(34.0 to 45.2)	
Drug sources							
Public sector							
Yes	234	10.9	103	12.4	43.9	(36.3 to 51.8)	0.176
No	1912	89.1	727	87.6	38.0	(34.5 to 41.7)	
NGO sector							
Yes	18	0.9	11	1.3	59.6	(30.2 to 83.4)	0.147
No	2126	99.1	818	98.7	38.5	(35.4 to 41.7)	
Private sector							
Yes	1511	70.7	615	74.3	40.7	(36.5 to 45.1)	0.056
No	628	29.3	213	25.7	33.9	(29.1 to 39.1)	
Others							
Yes	90	4.2	68	8.2	76.0	(62.9 to 85.6)	<**0.001**
No	2055	95.8	761	91.8	37.0	(33.6 to 40.6)	

The analysis of factors associated with antibiotic use for ARI episodes in children under five in Bangladesh indicates that certain demographic, socioeconomic, and healthcare access variables play significant roles. Rural residence was notably associated with higher antibiotic use (aOR: 1.6, p=0.004), while divisions, such as Sylhet, had a higher likelihood but were not statistically significant. Wealth quintiles showed no consistent trend across antibiotic use, while severe wasting in children was significantly associated with lower antibiotic use (aOR: 0.5, p=0.037). Unqualified or traditional practitioners were more likely to prescribe antibiotics (uOR: 1.4, p=0.022), though this was not highly significant in adjusted models. Antibiotics from private sources were significantly less associated with prescriptions (aOR: 0.5, p<0.001), but sources listed as "Others" had a markedly higher likelihood of antibiotic use (aOR: 5.3, p<0.001).

Table-2: Analysis of Bivariable and Multivariable Factors Associated with Antibiotic Use for ARI Episodes in Children Under Five in Bangladesh

	Received antibiotic for ARI episode			
	uOR (95% CI)	**p-value**	**aOR (95% CI)**	**p-value**
Mother age (year)*				
15–19 (ref)	1			
20–24	1.0 (0.7 to 1.4)	0.988	0.9 (0.7 to 1.3)	0.732
25–29	1.1 (0.7 to 1.5)	0.777	0.9 (0.6 to 1.4)	0.789
30–34	1.2 (0.8 to 1.9)	0.432	1.1 (0.6 to 1.7)	0.829
35–39	1.3 (0.7 to 2.3)	0.364	1.0 (0.5 to 1.9)	0.959
40–44	1.9 (0.8 to 4.6)	0.177	2.0 (0.7 to 5.8)	0.218
45–49	0.8 (0.2 to 3.1)	0.727	1.0 (0.3 to 3.9)	0.960
Age of father (year)†				
≤24	1			
25–29	0.9 (0.6 to 1.5)	0.682	0.7 (0.4 to 1.2)	0.203
30–34	1 (0.6 to 1.5)	0.855	0.8 (0.5 to 1.3)	0.353
35–39	1.2 (0.8 to 2)	0.381	1 (0.6 to 1.7)	0.928
40–44	1 (0.6 to 1.7)	0.952	0.7 (0.4 to 1.4)	0.352
45–49	1.6 (0.8 to 3.1)	0.221	1.2 (0.6 to 2.4)	0.675
50–54	1.2 (0.5 to 2.7)	0.701	0.8 (0.3 to 2)	0.617
≥55	1.9 (0.9 to 3.7)	0.07	1.6 (0.7 to 3.7)	0.251
Age of child (month)‡				
<6(ref)	1			
6–11	0.8 (0.5 to 1.4)	0.428	0.8 (0.5 to 1.4)	0.531
12–23	1.1 (0.6 to 1.8)	0.841	1.1 (0.7 to 1.9)	0.661
24–35	1.1 (0.7 to 2.0)	0.662	1.3 (0.7 to 2.3)	0.352
36–47	1.3 (0.8 to 2.2)	0.276	1.4 (0.8 to 2.4)	0.189
48–59	1.4 (0.6 to 3.1)	0.414	1.6 (0.8 to 3.2)	0.161
Sex§				
Female(ref)	1			
Male	0.9 (0.7 to 1.2)	0.425	1.0 (0.7 to 1.3)	0.756

Type of place of residence				
Urban (ref)	1			
Rural	1.5 (1.1 to 2.0)	**0.005**	1.6 (1.2 to 2.1)	**0.004**
Divisions**				
Barisal (ref)	1			
Chittagong	0.7 (0.5 to 1.1)	0.161	0.6 (0.4 to 1.0)	0.055
Dhaka	0.9 (0.6 to 1.3)	0.528	0.9 (0.5 to 1.5)	0.621
Khulna	0.7 (0.5 to 1.2)	0.220	0.7 (0.4 to 1.2)	0.161
Rajshahi	0.9 (0.6 to 1.4)	0.657	0.8 (0.5 to 1.2)	0.250
Rangpur	1.0 (0.6 to 1.5)	0.961	0.7 (0.4 to 1.2)	0.188
Sylhet	1.5 (0.8 to 2.6)	0.205	1.3 (0.7 to 2.2)	0.438
Wealth quintile††				
Poorest (ref)	1			
Poorer	1.0 (0.7 to 1.5)	0.793	1.1 (0.8 to 1.6)	0.556
Middle	1.0 (0.7 to 1.4)	0.900	1.0 (0.6 to 1.7)	0.869
Richer	0.8 (0.6 to 1.2)	0.269	0.9 (0.6 to 1.3)	0.629
	Received antibiotic for ARI episode			
	uOR (95% CI)	**p-value**	**aOR (95% CI)**	**p-value**
Richest	0.8 (0.5 to 1.1)	0.187	0.8 (0.5 to 1.3)	0.341
Father education‡‡				
No education(*ref*)	1			
Primary	1.2 (0.7 to 1.9)	0.558	1.1 (0.7 to 1.8)	0.597
Secondary	0.9 (0.6 to 1.4)	0.705	0.9 (0.6 to 1.4)	0.793
Higher	0.9 (0.6 to 1.4)	0.536	0.9 (0.5 to 1.5)	0.675
Father occupation§§				
Agriculture (ref)	1			
Unskilled and semiskilled worker	0.9 (0.7 to 1.2)	0.603	1.0 (0.7 to 1.4)	0.978
Professional work	0.9 (0.5 to 1.4)	0.625	0.9 (0.5 to 1.7)	0.855
Businessmen	0.9 (0.6 to 1.4)	0.733	1.0 (0.7 to 1.6)	0.835
Other	0.7 (0.4 to 1.3)	0.230	1.0 (0.5 to 2.0)	0.987
Mother education				
No education (ref)	1			
Primary	1.0 (0.7 to 1.5)	0.807	1.0 (0.6 to 1.6)	0.988
Secondary	0.9 (0.6 to 1.4)	0.791	0.9 (0.6 to 1.5)	0.816
Higher	0.9 (0.5 to 1.5)	0.628	0.9 (0.5 to 1.7)	0.767
Mother occupation***				
Not working (ref)	1			
Working	1.0 (0.8 to 1.3)	0.902	0.9 (0.7 to 1.2)	0.608
Child nutrition status				
Stunted†††				
Well nourished (ref)	1			
Moderate	1.1 (0.8 to 1.5)	0.576	1.1 (0.8 to 1.5)	0.428
Severe	0.9 (0.6 to 1.4)	0.753	1.0 (0.6 to 1.5)	0.898
Wasted‡‡‡				
Well nourished (ref)	1			
Moderate	1.1 (0.8 to 1.5)	0.654	1.0 (0.7 to 1.5)	0.838
Severe	0.5 (0.2 to 0.9)	**0.024**	0.5 (0.2 to 1.0)	**0.037**
Underweight§§§				
Well nourished (ref)	1			
Moderate	1.0 (0.8 to 1.3)	0.785	1.1 (0.8 to 1.4)	0.596
Severe	0.9 (0.5 to 1.5)	0.672	1.0 (0.5 to 2.0)	0.886
Drug prescriber				
Healthcare professional /worker				
No (ref)	1			
Yes	0.9 (0.7 to 1.3)	0.649	0.9 (0.6 to 1.4)	0.756
Unqualified/traditional practitioner****				
No (ref)	1			

Yes	1.4 (1.0 to 1.8)	**0.022**	1.3 (1.0 to 1.8)	0.083
Drug sources				
Public sector††††				
No (ref)	1			
Yes	1.3 (0.9 to 1.8)	0.176	1.2 (0.8 to 1.9)	0.344
	Received antibiotic for ARI episode			
	uOR (95% CI)	**p-value**	**aOR (95% CI)**	**p-value**
NGO sector‡‡‡‡				
No (ref)	1			
Yes	2.4 (0.7 to 7.8)	0.159	2.1 (0.7 to 6.1)	0.188
Private sector§§§§				
No (ref)	1			
Yes	1.3 (1.0 to 1.8)	0.056	0.5 (0.3 to 0.7)	**<0.001**
Others				
No (ref)	1			
Yes	5.4 (2.8 to 10.4)	**<0.001**	5.3 (2.7 to 10.4)	**<0.001**

DISCUSSION

Our findings, drawn from a nationally representative dataset, reveal that nearly 40% of children under five with symptoms of acute respiratory infections (ARIs) in Bangladesh are given antibiotics. Extrapolating this to Bangladesh's population of 16.5 million under-five children, we estimate that around 4.5 million children experience ARI symptoms annually, of which approximately 1.7 million are treated with antibiotics. This high level of antibiotic use is inconsistent with clinical practice guidelines, including the Integrated Management of Childhood Illness (IMCI) protocols, which discourage routine antibiotic use for ARIs without bacterial indicators. This practice not only imposes financial strain on families and health systems but also risks accelerating antibiotic resistance in Bangladesh [11].

Our findings are aligned with other studies from low- and middle-income countries (LMICs), where 30-40% of childhood ARI cases receive antibiotics [12]. However, our study's antibiotic use rate is lower than that observed in a recent cross-sectional study across eight LMICs, which reported an 80% antibiotic prescription rate for under-five children with respiratory symptoms. Differences in study definitions may account for this discrepancy; unlike that study, our broader ARI definition included milder cases without respiratory distress, potentially reducing our antibiotic use estimate [13]. Additionally, our community-based survey focused on children treated outside of formal healthcare facilities, whereas the other study included healthcare visits, which generally involve more severe cases and thus higher antibiotic use. Consistent with this, hospital-based research in Bangladesh has shown that over 70% of under-five children with ARIs receive antibiotics when hospitalized.

Our analysis also highlights the higher antibiotic exposure in rural areas, where under-five children with ARIs are 60% more likely to receive antibiotics compared to their urban counterparts. This disparity may be due to the limited availability of trained healthcare providers in rural regions, which fosters a reliance on unqualified practitioners, such as unlicensed vendors and traditional healers. Prior studies have noted similar trends in rural areas of other LMICs, where local healthcare providers often lack formal qualifications, and antibiotics are readily dispensed without a prescription. In Bangladesh, medicine vendors are frequently the initial point of contact in rural areas, and a significant portion of antibiotic use stems from these unregulated sources. Addressing inappropriate antibiotic use in these areas will require policy-level interventions, such as enhancing community education, regulating over-the-counter sales, and expanding access to qualified healthcare providers [14].

Interestingly, our study found that private healthcare facilities in Bangladesh were 50% less likely to dispense antibiotics for childhood ARIs compared to public facilities and NGOs. This finding diverges from previous research, which shows mixed results regarding antibiotic prescription rates across public and private sectors in LMICs. It's important to note that the private healthcare sector in Bangladesh is highly diverse, including both formally registered clinics and unregulated practitioners. The lower antibiotic use in the private sector observed here became significant only after controlling for the impact of informal healthcare providers and the patient's place of residence. Higher out-of-pocket expenses at private facilities may also contribute, as these settings attract wealthier families, allowing for more thorough consultations and, potentially, more confidence in viral diagnoses that don't require antibiotic treatment.

Finally, nutritional status—whether stunted, wasted, or underweight—showed no significant association with antibiotic use for ARIs in our study. This finding contrasts with prior research suggesting that malnutrition is linked to increased ARI incidence and

severity, particularly lower respiratory tract infections, which often warrant antibiotics [15]. However, it's possible that this lack of association in our data could be influenced by other sociodemographic factors, such as parental education or household conditions. Although antibiotics are lifesaving when appropriately prescribed, overuse and misuse pose risks, including adverse reactions and disruptions to developing gut microbiota, underscoring the need for targeted interventions to ensure judicious antibiotic use in early childhood.

CONCLUSION

In conclusion, the study reveals that antibiotic use for acute respiratory infections (ARI) in children under five years of age in Bangladesh is influenced by various demographic, socio-economic, and healthcare factors. A higher prevalence of antibiotic use was observed in rural areas, particularly in the Sylhet division, and among children of parents with lower educational levels. Furthermore, unqualified or traditional practitioners were more likely to prescribe antibiotics compared to healthcare professionals. Interestingly, private healthcare sources were the most common for acquiring antibiotics, yet the "others" category, which includes alternative sources, showed the highest rates of antibiotic use. Although child malnutrition status did not show a significant association with antibiotic use, severe wasting was notably linked with lower antibiotic use. These findings highlight the need for targeted interventions to address inappropriate antibiotic use, particularly in rural areas and among less educated populations, and to improve healthcare practices across different prescribing sources.

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