JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

COMBATING CHILD MORBIDITY: STRATEGIES AGAINST PNEUMONIA AND DIARRHOEA

[1]Umaima Ismail, [2]Dr. Melisha Khatun, [3]Dr. ZarAfshan Fakhr
[1] Research Scholar, Aliah University, Kolkata, [2] Assistant Professor, Department of Economics, Kolkata, [3] Online Adjunct Instructor, University of the People, Pasadena, California
[1]Department of Economics, [1]Aliah University, Kolkata, India

Abstract: The two most common causes of morbidity and mortality for children under-five are still pneumonia and diarrhea, especially in environments with few resources. Knowing how common these health problems are and the potential factors that go along with them is essential to addressing them. The purpose of this study was to evaluate the prevalence and contributing factors of diarrhea and pneumonia in children under-five in the North 24 Parganas district of West Bengal, both in rural-urban regions. To find correlations between certain risk variables and the incidence of disease, a cross-sectional survey was carried out and logistic regression analysis was employed. The findings revealed higher prevalence rates and greater exposure to risk influences such as undernutrition, non-exclusive breastfeeding, incomplete vaccination, poor hygiene, unsafe drinking water and household tobacco smoke in rural areas compared to urban ones. These factors showed statistically significant associations with both pneumonia and diarrhoea. The study concludes that targeted public health interventions, particularly in rural settings, are essential. Strategies should include promoting maternal education, ensuring exclusive breastfeeding, complete immunization and improving sanitation and hygiene practices to reduce the disease burden and bridge rural-urban health disparities.
Index Terms: **Pneumonia, Diarrhoea, Under-five Children, Urban-Rural, North 24 Parganas**

I. INTRODUCTION

The two primary causes of death for children under-five worldwide, especially in low and middle-income nations, continue to be pneumonia and diarrhea. All of these avoidable diseases contribute significantly to child fatalities and remain significant public health issues. According to Walker et al. (2013), these conditions result in millions of child fatalities each year, with the highest burden observed in resource-constrained settings such as rural India.

Pneumonia, primarily a respiratory infection, is caused by a range of bacterial, viral, or fungal pathogens. It surpasses AIDS, measles and malaria combined in terms of mortality among children (Roy, P., & Mahato, M. 2024). In India alone, pneumonia accounts for approximately 15% to 30% of under-five deaths (Pradhan et al. 2016). Community Acquired Pneumonia (CAP) infections acquired outside healthcare facilities is a common and life-threatening condition in this age group (Farrar et al. 2019). Key risk factors include under-nutrition, lack of immunization, low socioeconomic status, maternal illiteracy, delayed initiation of complementary feeding and non-exclusive breastfeeding (Nirmolia et al. 2018). Early diagnosis is crucial, as pneumonia is often treatable with low-cost antibiotics. Symptoms such as rapid breathing, chest in drawing and inability to feed should prompt immediate medical attention (Minz, A., & Mahobiya, C. 2017).

In contrast, **diarrhoea** is a gastrointestinal infection that leads to the frequent passage of loose or watery stools. It is commonly caused by viral, bacterial, or parasitic infections, often transmitted through contaminated food or water (Biswas, A., & Mandal, A. K. 2016). Diarrhoea remains a significant health burden in rural India, affecting millions of under-five children. It can result in rapid fluid and nutrient loss, leading to dehydration and malnutrition (Barbhuiya et al. 2018). Unsafe water, improper sanitation, poor hygiene practices and lack of awareness regarding oral rehydration therapy (ORS) are major contributors (Mosisa et al. 2021). Groundwater pollution, often due to anthropogenic activities, further exacerbates the issue in many parts of India, including West Bengal. The Integrated Disease Surveillance Programme (IDSP) reported multiple diarrhoeal outbreaks in North 24 Parganas between 2010 and 2014, although many lacked laboratory confirmation (Debnath, F., & Ponnaiah, M. (2018). Pneumonia and diarrhoea differ fundamentally in their modes of transmission and risk profiles. While pneumonia is influenced by factors related to respiratory hygiene, immunization and overall health status including exposure to indoor air pollutants diarrhoea is primarily associated with water quality, food safety, hygiene and sanitation. Consequently, effective public health interventions must address the unique determinants of each illness.

This study aims to analyse and compare the pervasiveness and determinants of pneumonia and diarrhoea under five-year children in rural-urban settings of North**24 Parganas district**, West Bengal, using primary data. Specific variables, such as vaccination status, exclusive breastfeeding (EBF), maternal education, family size, socioeconomic status, child nutrition and healthcare-seeking behaviours, are explored in relation to each disease. For diarrhoea, additional emphasis is placed on factors like complementary feeding, safe drinking water, sanitation, hygiene practices and ORS knowledge.

II. OBJECTIVES

1. To find out how common diarrhea and pneumonia are in children under-five in selected rural and urban areas.
2. To determine the socio-demographic and environmental variables linked to diarrhea and pneumonia in the study population.
3. To evaluate the relationship between the incidence of diarrhea in children under-five and ORS knowledge, water sources, hygiene and supplemental feeding.
4. To analyze empirical relationships between independent variables and the prevalence of diarrhea and pneumonia in rural and urban areas using a bivariate approach.
5. To examine and compare the risk factors (e.g., vaccination status, breastfeeding practices, maternal education, hygiene practices, exposure to smoke and treatment delays) associated with pneumonia in rural versus urban settings.

III. METHODOLOGY

3.1 Study Population and Sampling

Children under-five years of age were the target population. Two separate but comparable samples were drawn. For the analysis of pneumonia, a total of 515 children were included in the study, with 257 children from rural areas and 258 from urban areas. Similarly, for the analysis of diarrhoea, 505 children participated, comprising 248 from rural regions and 257 from urban regions. This balanced distribution allowed for a comparative examination of the prevalence and determinants of both illnesses across rural-urban settings. The difference in sample size arises due to variations in data completeness and recall accuracy during field data collection. In some cases, caregivers were able to provide information about pneumonia symptoms but could not reliably recall recent episodes of diarrhoea, or vice versa. Additionally, missing or inconsistent responses related to diarrhoea-specific variables such as hygiene practices, water source, or ORS knowledge led to the exclusion of a small number of records from that specific analysis. This approach ensured that only complete and accurate data were included for each condition, thereby maintaining the validity and reliability of the results.A stratified random sampling method was adopted to ensure proportional representation from both rural and urban settings. Households with at least one child under-five were selected randomly from the selected villages and urban wards.

3.2 Data Analysis

Primary data were collected using a structured, pre-tested questionnaire, included sections on socio-demographic characteristics, child health, hygiene practices and treatment-seeking behaviour. The presence of pneumonia and diarrhoea was based on maternal recall of symptoms using WHO Integrated Management of Childhood Illness (IMCI) criteria. Binary logistic regression is used to analyses the relationship between a binary dependent variable and multiple independent variables (Asmare, A. A., & Agmas, Y. A. 2022). The binary dependent variable, which can take on one of two possible outcomes like yes/no, true/false, or 1/0, is categorical in nature. The Crude Odds Ratio (COR) with 95% Confidence Intervals (CI) was calculated to estimate the strength of associations.

The outcome being predicted in this analysis is binary, indicating whether or not a patient has a disease (1 = presence, 0 = absence). For diarrhoea, the outcome is defined as the presence or absence of three or more loose stools within a 24-hour period during the past two weeks. To predict these outcomes, various predictors or features are considered. Some predictors are common to both diseases, including gender, age, vaccination status, exclusive breastfeeding (EBF), mother's education level, wealth index and family size. In addition, each disease has its own set of specific predictors. For pneumonia, the disease-specific predictors include the child's weight, exposure to smoking, presence of symptoms, history of pneumonia and any delay in seeking treatment. For diarrhoea, the specific predictors include the type of complementary food consumed, source of drinking water, hygiene practices and knowledge of oral rehydration solution (ORS).

The model estimates the probability p that the dependent variable equals 1. The formula is:

$$\text{Log}\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta_n X_n$$

Where,

p is the probability

In the model β_0 is the constant term.

$\beta_1, \beta_2, \ldots\ldots \beta_n$ are the coefficients of the predictor variables $X_1, X_2, \ldots\ldots X_n$

Log $\left(\frac{p}{1-p}\right)$ is the odds ratio, representing the odds of the event occurring relative to the odds of not occurring.

To convert the logit to a probability, the sigmoid function or logistic function is used.

The logistic function is defined as:

$$\text{Sigmoid}(z) = \frac{1}{1+e^{-z}}$$

Where,

z is the Sum of the predictor variables with associated coefficients, given by:

$$z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta_n X_n$$

Here,

β_0 is the intercept.

$\beta_1, \beta_2, \ldots\ldots \beta_n$ are the coefficients of the predictor variables $X_1, X_2, \ldots\ldots X_n$

3.2.1 Predicting Probabilities

Once the logistic regression model has been fit, it can be employed to forecast the likelihood p of the event happening for given values of the predictor variables values $X_1, X_2, \dots \dots X_n$. This probability p is calculated by applying the logistic function to the linear combination z.

$$p = \text{Sigmoid}(z) = \frac{1}{1+e^{-z}}$$

This predicted probability p can then be used to make binary classifications by setting a threshold. For example, when p is equal to or exceeds 0.5, the result is categorized as 1; if p falls below 0.5, the result is categorized as 0.

3.2.2 Log Odds

The **odds ratio (OR)** is a useful tool for comparing the likelihood of an event occurring in two different groups. It helps determine whether the occurrence of an event is more likely in one group relative to another and the magnitude of this likelihood. The value of the odds ratio provides insight into the strength and direction of this association.

The odds of an event refer to the ratio of the probability that the event will occur to the probability that it will not occur. Mathematically, the odds are calculated as follows.

$$Odds = \frac{P(event)}{1 - P(event)}$$

Where,

$P(event)$ is the probability of the occurrence of event.

$1 - P(event)$ is the probability of the event non-occurrence.

IV. RESULT

4.1 Comparative Analysis of Childhood Pneumonia in Selected Rural-Urban areas of North 24 Parganas District

Pneumonia in children is a serious public health issue, particularly in areas with few resources. The prevalence of pneumonia in children under-five in a few chosen rural and urban locations is examined in this study. The study assesses the prevalence of pneumonia as well as other environmental and healthcare-related factors in both settings using chi-square statistical testing.

Table1 presents the findings, including percentage distribution, chi-square values and corresponding p-values for each variable in rural and urban populations. The results indicated a statistically significant association between underweight children and pneumonia under-five years in both urban and rural areas. The Pearson's chi-square values were $\chi^2 = 62.09$, for rural areas and $\chi^2 = 35.26$, for urban areas. Significant associations were also found with breastfeeding (rural: $\chi^2 = 57.8$, ; urban: $\chi^2 = 38.06$), smoking status (rural: $\chi^2 = 37.5$; urban: $\chi^2 = 29.5$) and vaccination history (rural: $\chi^2 = 9.11$; urban: $\chi^2 = 15.5$), There is also a significant association between symptoms(cold, cough, breathing) and childhood pneumonia under-five years. The Pearson's chi-square values were $\chi^2 = 41.6$ for rural areas and $\chi^2 = 32.94$ for urban areas. Significant associations were also found with family size (rural: $\chi^2 = 18.29$, urban: $\chi^2 = 26.71$), family pneumonia history (rural: $\chi^2 = 58.1$; urban: $\chi^2 = 42.6$) and delayed treatment (rural: $\chi^2 = 70.15$; urban: $\chi^2 = 23.92$), as shown in Table 1. This led to the rejection of the null hypothesis, indicating that there is a statistically significant correlation between determinants and childhood pneumonia.

The associations between child age, wealth index and mother's education were not significant. The Pearson's chi-square values were (rural: $\chi^2 = 3.91$, $p = 0.141$; urban: $\chi^2 = 2.35$, $p = 0.308$), (rural: $\chi^2 = 0.166$, $p = 0.683$; urban: $\chi^2 = 4.20$, $p = 0.122$), (rural: $\chi^2 = 0.66$, $p = 0.417$; urban: $\chi^2 = 2.27$, $p = 0.132$), as shown in Table 1. Consequently, the null hypothesis was accepted, concluding that there is a no significant relationship between childhood pneumonia and determinants.

Table 1: Descriptive and Bivariate Analysis of Childhood Pneumonia and Determinants

Variables	No. of Observation	Rural (%) N=515	RURAL		Urban (%) N=515	URBAN	
			Chi-Square	p-value		Chi-Square	p-value
Gender	Male	226(43.8)	0.007	0.93	245(47.5)	0.102	0.749
	Female	289(56.1)			270(52.4)		
Child Age(months)	1-15 months	76(14.7)	3.911	0.141	68(13.2)	2.35	0.308
	16-40 months	163(31.6)			182(35.3)		
	41-59 months	276(53.5)			265(51.4)		
Child Weight	Underweight	146(28.3)	62.09	0.000	132(25.6)	35.26	0.000
	Normal	369(71.6)			383(74.3)		
Smoking Status	Yes	171(33.2)	37.5	0.000	135(26.2)	29.52	0.000
	No	344(66.8)			380(73.7)		

Vaccination	Yes No	243(47.1) 272(52.8)	9.11	0.003	282(54.7) 233(45.2)	15.5	0.000
Exclusive Breastfeeding	Yes No	305(59.2) 210(40.7)	57.8	0.000	302(58.6) 213(41.3)	38.06	0.000
Symptoms (Cold, Cough, Breathing)	Yes No	283(54.9) 232(45.0)	41.6	0.000	252(48.9) 263(51.0)	32.94	0.000
Wealth Index	Upper Middle Lower	 271(52.6) 244(47.3)	0.166	0.683	245(47.5) 234(45.4) 36(6.9)	4.2	0.122
Family Size	Less than five More than five	240(46.6) 275(53.4)	18.29	0.000	324(62.9) 191(37.6)	26.71	0.000
Pneumonia History	Yes No	120(23.3) 395(76.7)	58.1	0.000	104(20.1) 411(79.8)	42.63	0.000
Mothers Education	Below Secondary Above Secondary	331(64.2) 184(35.7)	0.66	0.417	85(16.5) 430(83.5	2.271	0.132
Delayed Treatment	Yes No	205(39.8) 310(60.1)	70.15	0.000	189(36.7) 326(63.3)	23.92	0.000

4.2 Risk Variants for Childhood Pneumonia in North 24 Parganas' Urban and Rural Areas: A Bivariate Statistical Analysis

The findings of a bivariate study that looked at the relationship between several demographic, environmental and health-related factors and the prevalence of childhood pneumonia in urban and rural areas are shown in Tables 2 and Table 3.This study utilized dummy variables to specify categorical variables, where the coefficients represented the influence of the independent variable on the outcome. The coefficients indicated the variation in the probability of falling into the outcome category relative to the reference level. Odds ratios (ORs) were used to relate the relative odds of occurrence and to explain the significance level of explanatory variables with a 95% confidence interval (CI).

The pervasiveness of pneumonia was 7.7% in urban areas and 10.4% in rural areas. Pneumonia was found to be more common in children aged 41-59 months, with a prevalence of 9.4% in urban regions and 12.6% in rural areas. The odds of having pneumonia in children in urban areas were 6.46 times higher [OR: 6.46 (95% CI: 3.25, 12.82); p-value < 0.000] among children who were underweight compared to those with normal weight. In rural areas, the odds were 9.5 times higher [OR: 9.5 (95% CI: 5.01, 18.2); p-value < 0.000] among children who were underweight compared to those with normal weight, indicating a significant association between underweight children and Pneumonia under five year. In urban areas, children of mothers with education below secondary level had higher odds of Pneumonia [OR: 0.56 (95% CI: 0.26, 1.199); p-value >0.136]. In rural areas, mothers with education below the secondary level also had a higher likelihood of their children experiencing stunting [OR: 1.26 (95% CI: 0.71, 2.25); p-value > 0.417].Socio-economic status also played a role. In urban areas, children from lower socio-economic classes had higher odds of Pneumonia [OR: 4.0 (95% CI: 0.52, 30.5); p-value > 0.181] compared to those from upper classes. The middle class had lower odds [OR: 2.28 (95% CI: 0.29, 17.82); p-value > 0.431]. In rural areas, children from the lower class had significantly higher odds of Pneumonia [OR: 1.12 (95% CI: 0.63, 1.97); p-value >0.68] compared to urban children.

Table 2: Empirical Association of Childhood Pneumonia and Determinants in Urban Areas

Variables	Characteristics	Pneumonia		Total	Coef.	Crude Odd Ratio (95%CI)	p-value
		Absence	Presence				
Gender	Male	225(91.8)	20(8.1)	245		ref.	
	Female	250(92.5)	20(7.4)	270	-0.1	0.9(0.47,1.71)	0.749
	Total	475(92.2)	40(7.7)	515			
Child Age (months)	1-15 months	63(92.6)	5(7.3)	68		ref.	
	16-40 months	172(94.5)	10(5.4)	182	0.27	0.73(0.24,2.22)	0.583
	41-59 months	240(90.5)	25(9.4)	265		1.31(0.48,3.56)	0.594
	Total	475(92.2)	40(7.7)	515			
Child Weight	Underweight	369(96.3)	14(3.6)	383		ref.	
	Normal	106(80.3)	26(19.7)	132	1.86	6.46(3.25,12.82)	0.000
	Total	475(92.2)	40(7.7)	515			
	Yes	365(96.0)	15(3.9)	380		ref.	

Smoking Status	No Total	110(81.4) 475(92.2)	25(18.5) 40(7.7)	135 515	1.71	5.53(2.81,10.85)	0.000
Vaccination	Yes No Total	203(87.1) 272(96.4) 475(92.2)	30(12.8) 10(3.5) 40(7.7)	233 282 515	-1.39	ref. 0.24(0.11,0.52)	0.000
Exclusive Breast-Feeding	Yes No Total	297(98.3) 178(83.5) 475(92.2)	5(1.6) 35(16.4) 40(7.7)	302 213 515	-2.45	ref. 0.08(0.03,0.22)	0.000
Symptoms (Cold, Cough, Breathing)	Yes No Total	215(85.3) 260(98.8) 475(92.2)	37(14.6) 3(1.14) 40(7.7)	263 252 515	2.7	ref. 14.9(4.53,49.0)	0.000
Wealth Index	Upper Middle Lower Total	230(93.8) 210(89.7) 35(97.2) 475(92.2)	15(6.1) 24(10.2) 1(2.7) 40(7.7)	245 234 36 515	-0.155	ref. 4.0(0.52,30.5) 2.28(0.29,17.82)	0.181 0.431
Family Size	Less than five More than five Total	314(96.9) 161(84.2) 475(92.2)	10(3.0) 30(15.7) 40(7.7)	324 191 515	-1.76	ref. 0.17(0.08,0.35)	0.000
Pneumonia History	Yes No Total	80 (76.9) 395(96.1) 475(92.2)	24 (23.0) 16(3.8) 40(7.7)	104 411 515	2	ref. 7.4(3.76,14.5)	0.000
Mothers Education	Below Secondary Above Secondary Total	75(88.2) 400(93.0) 475(92.2)	10(6.9) 30(11.7) 40(7.7)	85 430 515	-0.57	ref. 0.56(0.26,1.19)	0.136
Delayed Treatment	Yes No Total	160(84.6) 315(96.6) 475(92.2)	29(15.3) 11(3.3) 40(7.7)	189 326 515	1.64	ref. 5.19(2.52,10.65)	0.000

Maternal care significantly impacted childhood Pneumonia. The odds of Pneumonia were higher for children who had symptoms like cold cough and breathing problems [OR: 14.9 (95% CI: 4.53, 49.04)] in urban areas and [OR: 25.8 (95% CI: 6.23, 107.5); p-value < 0.000] in rural areas. Children with family Pneumonia history had higher odds of Pneumonia: 7.40 times higher [OR: 7.40 (95% CI: 3.76, 14.57)] in urban areas and 8.14 times higher [OR: 8.14 (95% CI: 4.44, 14.93)] in rural areas, indicating a significant association with family Pneumonia history. Exclusive breastfeeding for at least 6 months was associated with a lower risk of Pneumonia. The odds were [OR: 0.08 (95% CI: 0.03, 0.22); p-value < 0.000] in urban areas and [OR: 0.06 (95% CI: 0.02, 0.16); p-value < 0.000] in rural areas. Family smoking status had higher odds of childhood Pneumonia: 5.53 times higher [OR: 5.53 (95% CI: 2.81, 10.28)] in urban areas and 5.85 times higher [OR: 5.85 (95% CI: 3.15, 10.86)] in rural areas, indicating a significant association with smoking status. Delayed treatment and ignorance had a higher risk of Pneumonia. The odds were [OR: 5.19 (95% CI: 2.52, 10.65); p-value < 0.001] in urban areas and [OR: 24.6 (95% CI: 8.75, 69.5)] in rural areas. Family size also played a role in childhood pneumonia. The odds were 0.17 times [OR: 0.17 (95% CI: 0.08, 0.35)] in urban areas and 0.26 times [OR: 0.26 (95% CI: 0.0.14, 0.50)] in rural areas, indicating a significant association with family size.

Table 3: Empirical Association of Childhood Pneumonia and Determinants in Rural Region

Variables	Characteristics	Pneumonia		Total	Coef.	Crude Odd Ratio (95%CI)	p-value
		Absence	Presence				
Gender	Male Female Total	202(89.3) 259(89.6) 461(89.5)	24(10.6) 30(10.3) 54(10.4)	226 289 515	-0.02	ref. 0.97(0.55,1.71)	0.93
Child Age (months)	1-15 months 16-40 months 41-59 months Total	72(94.7) 148(90.8) 241(87.3) 461(89.5)	4(5.2) 15(9.2) 35(12.6) 54(10.4)	76 163 276 515	0.43	ref. 1.82(0.58,5.69) 2.61(0.89,7.60)	0.301 0.078
Child Weight	Underweight Normal Total	106(72.6) 355(96.2) 461(89.5)	40(27.4) 14(3.7) 54(10.4)	146 369 515	2.25	ref. 9.56(5.01,18.2)	0.000

Smoking Status	Yes No Total	133(77.7) 328(95.3) 461(89.5)	38(22.2) 16(4.6) 54(10.4)	171 344 515	1.76	ref. 5.85(3.15,10.86)	0.000
Vaccination	Yes No Total	228(93.8) 233(85.6) 461(89.5)	15(6.1) 39(14.3) 54(10.4)	243 272 515	-0.93	ref. 0.39(0.21,0.73)	0.003
Exclusive Breast-Feeding	Yes No Total	299(98.0) 162(77.1) 461(89.5)	6(1.9) 48(22.8) 54(10.4)	305 210 515	-2.69	ref. 0.06(0.02,0.16)	0.000
Symptoms (Cold, Cough, Breathing)	Yes No Total	231(81.6) 230(99.1) 461(89.5)	52(18.3) 2(0.86) 54(10.4)	283 232 515	3.25	ref. 25.8(6.23,107.5)	0.000
Wealth Index	Middle Lower Total	244(90.0) 217(88.9) 461(89.5)	27(9.9) 27(11.0) 54(10.4)	271 244 515	0.11	ref. 1.12(0.63,1.97)	0.68
Family Size	Less than five More than five Total	261(94.9) 200(83.3) 461(89.5)	14(5.09) 40(16.6) 54(10.4)	275 240 515	-1.31	ref. 0.26(0.14,0.50)	0.000
Pneumonia History	Yes No Total	85(70.8) 376(95.1) 461(89.5)	35(29.1) 19(4.8) 54(10.4)	120 395 515	2.09	ref. 8.14(4.44,14.93)	0.000
Mothers Education	Below Secondary Above Secondary Total	299(90.3) 162(88.0) 461(89.5)	32(9.6) 22(11.9) 54(10.4)	331 184 515	0.23	ref. 1.26(0.17,2.25)	0.417
Delayed Treatment	Yes No Total	155(75.6) 306(98.7) 461(89.5)	50(24.3) 4(1.29) 54(10.4)	205 310 515	3.2	ref. 24.6(8.75,69.5)	0.000

4.3 Comparative Analysis of Prevalence of Diarrhoea in Selected Rural-Urban Areas of North 24 Parganas District

The results indicated a statistically significant association between Childhood Diarrhoea and Complementary Food under-five years in both urban and rural areas. The Pearson's chi-square values were $\chi^2 = 66.38$, $p = 0.000$ for rural areas and $\chi^2 = 64.72$, $p = 0.000$ for urban areas. Significant associations were also found with Breastfeeding (rural: $\chi^2 = 59.28$, while in urban: $\chi^2 = 30.95$), Drinking Water (rural: $\chi^2 = 37.5$, $p = 0.000$; urban: $\chi^2 = 29.5$, $p = 0.000$) and Vaccination history (rural: $\chi^2 = 19.85$; urban: $\chi^2 = 56.13$). There is also a significant association between knowledge of ORS and childhood Diarrhoea under-five years. The Pearson's chi-square values were $\chi^2 = 23.12$, $p = 0.000$ for rural areas and $\chi^2 = 12.9$, $p = 0.000$ for urban areas. Significant associations were also found with Hygiene practices (rural: $\chi^2 = 42.05$, $p = 0.000$; urban: $\chi^2 = 33.7$, $p = 0.000$), family size (rural: $\chi^2 = 24.4$, $p = 0.000$; urban: $\chi^2 = 66.05$, $p = 0.000$). The associations between child age, wealth index and mother's education were not significant. The Pearson's chi-square values were (rural: $\chi^2 = 2.42$, $p = 0.298$; urban: $\chi^2 = 3.77$, $p = 0.151$), (rural: $\chi^2 = 0.863$, $p = 0.353$; urban: $\chi^2 = 3.608$, $p = 0.057$), (rural: $\chi^2 = 0.193$, $p = 0.660$; urban: $\chi^2 = 3.77$, $p = 0.010$), as shown in Table 4. Consequently, the rejection of the null hypothesis indicated that there is a statistically significant correlation between determinants and childhood Diarrhoea.

Table 4: Descriptive and Bivariate Analysis of Diarrhoeal Disease and Determinants

Variables	No. of Observation	Rural (%)	RURAL		Urban (%)	URBAN	
		N=505	Chi-Square	p-value	N=505	Chi-Square	p-value
Gender	Male Female	261(51.6) 244(48.3)	5.09	0.024	260(51.4) 245(48.5)	0.083	0.772
Child Age (months)	1-15 months 16-40 months 41-59 months	46(9.1) 199(39.4) 260(51.4)	2.42	0.298	47(9.3) 158(31.2) 300(59.4)	3.77	0.151
Mothers Education	Below Secondary Above Secondary	400(79.2) 105(20.7)	0.193	0.660	80(15.8) 425(84.1)	6.55	0.010
Exclusive Breast-Feeding	Yes No	285(56.4) 220(43.5)	59.28	0.000	235(46.5) 270(53.4)	30.95	0.000
Vaccination	Yes	295(58.4)	35.67	0.000	360(71.2)	53.01	0.000

	No	210(41.5)			145(28.7)		
Hygiene Practice	Yes No	235(46.5) 270(53.4)	42.05	0.000	305(60.4) 200(39.6)	33.76	0.000
Complementary Food Milk Products	Yes No	170(33.6) 335(66.3)	66.38	0.000	155(30.6) 350(69.3)	64.72	0.000
Drinking water	improved water unimproved	234(46.3) 271(53.6)	19.85	0.000	390(77.2) 115(22.7)	56.13	0.000
ORS Knowledge	Yes No	180(35.6) 325(64.3)	23.12	0.000	211(41.7) 294(58.2)	12.9	0.000
Asset Index	Upper Middle Lower	n. a 335(66.3) 170(33.6)	0.863	0.353	193(38.2) 312(61.7) n. a	3.608	0.057
Family Size	Less than five More than five	230(45.5) 275(54.4)	24.42	0.000	342(67.7) 163(32.2)	66.05	0.000

Note: n.a. means Not Available

4.4 Bivariate Statistical Analysis of Risk Factors of Diarrhoeal Prevalence in Urban and Rural Regions of North 24 Parganas

The occurrence of Diarrhoea under-five year children living in rural-urban areas are compared in Table 5 and Table 6. The prevalence of Diarrhoea was 15.8% in urban and 20.5% in rural areas. Diarrhoea was found to be more common in children aged 41-59 months, with a prevalence of 18.3% in urban regions and 22.6% in rural areas.

The odds of having Diarrhoea in children in urban zones were 7.15 times higher [OR: 7.15(95% CI: 4.23, 12.06)] among children who had complementary food or cow milk compared to those who were not. In rural areas, the odds were 6.19 times higher [OR: 6.19 (95% CI: 3.88, 9.89)] among children who had complementary food or cow milk compared to those who were not, indicating a significant association between prevalence of Diarrhoea and complementary food.

In urban areas, children of mothers with education below secondary level had higher odds of Diarrhoea [OR: 3.21 (95% CI: 1.25, 8.22)]. In rural areas, mothers with education below the secondary level also had a higher likelihood of their children experiencing Diarrhoea [OR: 0.88 (95% CI: 0.514, 1.52); p-value >0.66].Socio-economic status also played a role. In urban areas, children from lower socio-economic classes had higher odds of Diarrhoea [OR: 1.65 (95% CI: 0.98, 2.78); p-value > 0.059] compared to those from upper classes. In rural areas, children from the lower class had significantly higher odds of Diarrhoea [OR: 1.23 (95% CI: 0.78, 1.93); p-value > 0.353] compared to urban children. After adjusting for socio-demographic and household factors, it was found that children who were vaccinated had a lower risk of having Diarrhoea. The odds were [OR: 0.17 (95% CI: 0.104, 0.286)] in urban areas and the same in rural areas [OR: 0.26 (95% CI: 0.164, 0.411)].

Hygiene practices significantly impacted diarrhoeal diseases. The odds of Diarrhoea were higher for children who does not follow hygiene practices and sanitation [OR: 0.23 (95% CI: 0.14, 0.39)] in urban areas and [OR: 0.19 (95% CI: 0.11, 0.32)] in rural areas. Knowledge of ORS had lower risk odds of Diarrhoea: 1.65 times lower [OR: 2.41 (95% CI: 1.47, 3.92)] in urban areas and 2.88 times lower [OR: 2.88 (95% CI: 1.85, 4.48)] in rural areas, indicating a significant association with Knowledge of ORS. Exclusive breastfeeding for at least 6 months was associated with a lower risk of Diarrhoea. The odds were [OR: 0.23 (95% CI: 0.13, 0.40)] in urban areas and [OR: 0.16 (95% CI: 0.09, 0.26)] in rural areas. Improved drinking water had lower odds of Diarrhoea: 0.16 times lower [OR: 0.16 (95% CI: 0.09, 0.27)] in urban areas and 0.34 times higher [OR: 0.34 (95% CI: 0.21, 0.56)] in rural areas, indicating a significant association with Drinking water. Family size also played a role in Diarrhoeal Disease. The odds were 0.30 times [OR: 0.30 (95% CI: 0.18, 0.49)] in urban areas and 0.26 times [OR: 0.26 (95% CI: 0.0.14, 0.50)] in rural areas, indicating a significant association with family size.

Table 5: Empirical Association between Diarrhoeal Prevalence and Determinants in Rural Region

Variables	Characteristics	Diarrhoea		Total	Coef.	Crude Odd Ratio (95%CI)	p-value
		Absence	Presence				
Gender	Male Female Total	197(75.4) 204(83.6) 401(79.4)	64(24.5) 40(16.3) 104(20.5)	261 244 505	-0.5	ref. 0.6(0.38,0.93)	0.025
Child Age (months)	1-15 months 16-40 months 41-59 months Total	40(86.9) 160(80.4) 201(77.3) 401(79.4)	6(13.0) 39(19.6) 59(22.6) 104(20.5)	46 199 260 505	0.26	ref. 1.62(0.64,4.10) 1.95(0.79,4.84)	 0.304 0.146
Mothers Education	Below Secondary Above Secondary Total	85(80.9) 316(79) 401(79.4)	20(19.0) 84(21) 104(20.5)	105 400 505	-0.12	ref. 0.88(0.51,1.52)	0.66
Exclusive Breast-	Yes No	261(91.5) 140(63.6)	24(8.4) 80(36.3)	401 104	-1.82	ref. 0.16(0.09,0.26)	0.000

Feeding	Total	401(79.4)	104(20.5)	505			
Vaccination	Yes No Total	261(88.4) 140(66.6) 401(79.4)	34(11.5) 70(33.3) 104(20.5)	295 210 505	-1.34	ref. 0.26(0.16,0.41)	0.000
Hygiene practice	Yes No Total	216(91.9) 185(68.5) 401(79.4)	19(8.0) 85(31.4) 104(20.5)	235 270 505	-1.65	ref. 0.19(0.11,0.32)	0.000
Complementary Food Milk Products	Yes No Total	100(58.8) 301(89.8) 401(79.8)	70(41.1) 34(10.1) 104(20.5)	170 335 505	1.82	ref. 6.19(3.88,9.89)	0.000
Drinking Water	improved water unimproved Total	206(88.0) 195(71.9) 401(79.8)	28(11.9) 76(28.0) 104(20.5)	234 271 505	-1.05	ref. 0.34(0.21,0.56)	0.000
ORS Knowledge	Yes No Total	122(67.7) 279(85.8) 401(79.8)	58(32.2) 46(14.1) 104(20.5)	180 325 505	1.05	ref. 2.88(1.85,4.48)	0.000
Asset Index	Middle Lower Total	270(80.6) 131(77.0) 401(79.8)	65(19.4) 39(22.9) 104(20.5)	335 170 505	0.21	ref. 1.23(0.78,1.93)	0.353
Family Size	Less than five More than five Total	205(89.1) 196(71.2) 401(79.8)	25(10.8) 79(28.7) 104(20.5)	230 275 505	-1.19	ref. 0.302(0.18,0.49)	0.000+

Table 6: Empirical Association between Diarrhoeal Prevalence and Determinants in Urban Region

Variables	Characteristics	Diarrhoea		Total	Coef.	Crude Odd Ratio (95%CI)	p-value
		Absence	Presence				
Gender	Male Female Total	220(84.6) 205(83.6) 425(84.1)	40(18.3) 40(16.3) 80(15.8)	260 245 505	0.07	ref. 1.07(0.66,1.73)	0.772
Child Age (months)	1-15 months 16-40 months 41-59 months Total	40(85.1) 140(88.6) 245(81.6) 425(84.1)	7(14.8) 18(11.3) 55(18.3) 80(15.8)	47 158 300 505	0.289	ref. 0.73(0.28,1.88) 1.28(0.54,0.39)	0.521 0.568
Mothers Education	Below Secondary Above Secondary Total	350(82.3) 75(93.7) 425(84.1)	75(17.6) 5(6.2) 80(15.8)	425 80 505	1.16	ref. 3.21(1.25,8.22)	0.015
Exclusive Breast-Feeding	Yes No Total	250(92.5) 175(74.4) 425(84.1)	20(7.4) 60(25.5) 80(15.8)	270 235 505	-1.45	ref. 0.23(0.13,0.40)	0.000
Vaccination	Yes No Total	330(91.6) 95(8.3) 425(84.1)	30(8.3) 50(34.4) 80(15.8)	360 145 505	-1.75	ref. 0.17(0.10,0.28)	0.000
Hygiene Practice	Yes No Total	280(91.8) 145(72.5) 425(84.1)	25(8.2) 55(27.5) 80(15.8)	305 200 505	-1.44	ref. 0.23(0.14,0.39)	0.000
Complementary Food Milk Products	Yes No Total	100(64.5) 325(92.8) 425(84.1)	55(35.4) 25(7.14) 80(15.8)	155 350 505	1.96	ref. 7.15(4.23,12.06)	0.000
Drinking Water	improved water unimproved Total	354(90.7) 71(61.7) 425(84.1)	36(9.2) 44(38.2) 80(15.8)	390 115 505	-1.8	ref. 0.16(0.09,0.27)	0.000
	Yes	163(77.2)	48(22.7)	211		ref.	

ORS Knowledge	No	262(89.1)	32(10.8)	294	0.88	2.41(1.47,3.92)	0.000
	Total	425(84.1)	80(15.8)	505			
Asset Index	Upper	170(88.0)	23(11.9)	193		ref.	
	Middle	255(81.7)	57(18.2)	312	0.502	1.65(0.98,2.78)	0.059
	Total	425(84.1)	80(15.8)	505			
Family Size	Less than five	319(93.2)	23(6.7)	342		ref.	
	More than five	106(65.0)	57(34.9)	163	-2.009	0.13(0.07,0.22)	0.000
	Total	425(84.1)	80(15.8)	505			

V. DISCUSSION

In both rural and urban parts of the North 24 Parganas district, West Bengal, this study shows the burden of childhood pneumonia and diarrhea among children under-five years old. It also reveals important factors linked to the incidence of these illnesses. Pneumonia was more common in rural areas (10.4%) than in urban areas (7.7%).

This finding matches the study of Shally Awasthi et al. (2019) and Mahato & Roy (2023), who also reported that rural children are more vulnerable due to poor nutritional status, delayed healthcare access and greater exposure to environmental pollutants. Among the determinants studied, low birth weight was significantly associated with pneumonia in both settings, aligning with findings from Nirmolia et al. (2018), who emphasized that under-nutrition weakens immune responses, increasing the risk of respiratory infections. Exclusive breastfeeding (EBF) was found to be strongly protective against pneumonia in this study. This matches with the study of Oddy (2001), who showed that EBF during the first six months strengthens the immune system and reduces respiratory illness. Similarly, vaccination had a significant protective effect; supporting findings by Pradhan et al. (2016) that immunization is a key intervention in preventing childhood pneumonia globally. Exposure to household smoking increased the odds of pneumonia in both rural and urban areas, which is consistent with the findings of Mahato & Roy (2023), who linked indoor air pollution to respiratory illnesses in children. The present study also found that children with a family history of pneumonia and those with symptoms such as cold, cough and breathing difficulty were at greater risk, echoing the study of Minz et al. (2017), which identified similar clinical risk factors. Children from larger families showed a higher prevalence of pneumonia, possibly due to overcrowding and increased transmission of pathogens. This finding aligns with Ghimire et al. (2022), who highlighted household crowding as a risk factor for respiratory illnesses. Delay in seeking treatment was another significant predictor, reinforcing the importance of timely healthcare-seeking behaviour. Interestingly, maternal education, child age and wealth index did not show significant associations with pneumonia, matching the results of Debnath &Ponnaiah (2018), who suggested that immediate behavioural and environmental exposures play a more direct role than socio-economic status in some contexts.

For diarrhoea, the prevalence was higher in rural (20.5%) compared to urban zones (15.8%). This finding is consistent with the study of Saha et al. (2022) and Lahiri et al. (2017), who reported higher diarrhoeal incidence in rural children due to poor sanitation, unsafe water and inadequate hygiene. This study found a strong association between diarrhoea and early or inappropriate complementary feeding, particularly the introduction of cow's milk and solid foods before six months. This matches the study of Majumder et al. (2017), which reported similar feeding practices increasing gastrointestinal infection risk. Rotavirus vaccination was found to significantly reduce the risk of diarrhoea, supporting findings from Mosisa et al. (2021) that rotavirus immunization reduces both incidence and severity of diarrhoeal diseases in young children. Similarly, exclusive breastfeeding had a protective role, consistent with the findings of Biswas & Mandal (2016), who showed that breastfeeding reduces exposure to contaminated food and water while boosting immunity through maternal antibodies. Drinking water source and hygiene practices emerged as significant predictors of diarrhoea in this study. This aligns with the study of Panda et al. (2014), which emphasized that household-level water handling and sanitation practices are critical in preventing childhood diarrhoeal illness. Additionally, knowledge of ORS was associated with reduced diarrhoeal risk, supporting the findings of Ghimire et al. (2018), who emphasized the importance of caregiver awareness in early management and prevention of complications.

Like pneumonia, diarrhoea prevalence was higher among children from larger families, which may be attributed to overcrowding and suboptimal hygiene. However, maternal education, wealth index and child age did not show strong associations with diarrhoea, consistent with the findings of Debnath & Ponnaiah (2018), suggesting that behavioural and environmental factors have more immediate impact on disease risk than background socio-economic factors in this population.

VI. CONCLUSION

Addressing childhood diarrhoea and pneumonia in North 24 Parganas District requires a comprehensive, context-specific approach that considers the significant urban-rural discrepancies in healthcare access, education, sanitation and socioeconomic conditions. Key modifiable risk factors such as under-nutrition, non-exclusive breastfeeding, lack of vaccination, exposure to tobacco smoke; poor hygiene and unsafe water and feeding practices contribute heavily to the disease burden, particularly in rural areas. These regions access clean water, further compounding the risk to children under-five. To effectively reduce incidence and mortality, it is essential to promote exclusive breastfeeding, expand vaccination coverage, improve maternal education on hygiene and disease prevention and ensure timely access to medical care. Community-based awareness initiatives, investments in clean water and sanitation and targeted policies addressing the social factors of health are critical. Interdisciplinary collaboration among healthcare providers, policymakers and community leaders will be vital in implementing sustainable and equitable health interventions. By bridging the gap between urban and rural healthcare systems and fostering active community engagement, it is possible to significantly improve child health outcomes and move toward reducing preventable deaths from diarrhoea and pneumonia in the district.

REFERENCES

Asmare, A. A., & Agmas, Y. A. (2022). Transmission Mechanism of Monetary Policy Channels and Economic Growth in Ethiopia: Cointegration and Causality Analysis Approach. Vol.12, No.1, 2022

Barbhuiya, N. I., Majumder, N., Majumder, T., & Chakraborty, J. (2018). Incidence and clinical profile of rotaviral infection among children below 5 years of age admitted with acute diarrhea in a tertiary care hospital of Tripura. *Indian Journal of Child Health*, *5*(2), 86-88.

Biswas, A., & Mandal, A. K. (2016). A study on association between breastfeeding and its protective role against diarrhoea in under-five children in a rural block of West Bengal, India. *Int J Community Med Public Health*, *3*(9), 2499-503.

Brunie, A., Lenzi, R., Lahiri, A., &Izadnegahdar, R. (2017). Leveraging the private sector for child health: a qualitative examination of caregiver and provider perspectives on private sector care for childhood pneumonia in Uttar Pradesh, India. *BMC Health Services Research*, *17*(1), 159.

Debnath, F., &Ponnaiah, M. (2018). Improved timeliness for reporting of acute diarrhoeal disease under surveillance overtime: Evaluation of integrated disease surveillance programme in North 24 Parganas, West Bengal, India, 2015. *Clinical Epidemiology and Global Health*, *6*(4), 163-167.

Debnath, F., &Ponnaiah, M. (2018). Improved timeliness for reporting of acute diarrhoeal disease under surveillance overtime: Evaluation of integrated disease surveillance programme in North 24 Parganas, West Bengal, India, 2015. *Clinical Epidemiology and Global Health*, *6*(4), 163-167.

Farrar, D. S., Awasthi, S., Fadel, S. A., Kumar, R., Sinha, A., Fu, S. H., ... & Jha, P. (2019). Seasonal variation and etiologic inferences of childhood pneumonia and diarrhea mortality in India. *Elife*, *8*, e46202.

Ghimire, P. R., Agho, K. E., Renzaho, A. M., Dibley, M., & Raynes-Greenow, C. (2018). Association between health service use and diarrhoea management approach among caregivers of under-five children in Nepal. *PloS one*, *13*(3), e0191988.

Ghimire, P., Gachhadar, R., Piya, N., Shrestha, K., & Shrestha, K. (2022). Prevalence and factors associated with acute respiratory infection among under-five children in selected tertiary hospitals of Kathmandu Valley. *Plos one*, *17*(4), e0265933.

Interve, L. D. P., Bhutta, Z. A., Das, J. K., Walker, N., Rizvi, A., Campbell, H., ... & Black, R. E. (2013). Interventions to address deaths from childhood pneumonia and diarrhoea equitably: what works and at what cost? *The Lancet*, *381*(9875), 1417-1429.

Lahiri, S. K., Paul, A., Malick, S. C., Bhattacharjee, S., Mondal, S., Saha, P., & Sau, A. (2017). A study on status of water contamination of the tube wells in a rural block of North 24 parganas district of West Bengal, India. *International Journal of Community Medicine and Public Health*, *4*(3), 847.

Majumder, K. K., Mukherjee, S., Das, A., &Mazumder, D. G. (2017). Epidemiology of Diarrhoea among under-five Children in a Village in Sunderbans, South 24 Parganas, West Bengal, India. *J. Commun. Dis*, *49*(1).

Minz, A., &Mahobiya, C. (2017, January). MR image classification using adaboost for brain tumor type. In *2017 IEEE 7th international advance computing conference (IACC)* (pp. 701-705). IEEE.

Minz, A., Agarwal, M., Singh, J. V., & Singh, V. K. (2017). Care seeking for childhood pneumonia by rural and poor urban communities in Lucknow: A community-based cross-sectional study. *Journal of family medicine and primary care*, *6*(2), 211-217.

Mosisa, D., Aboma, M., Girma, T., &Shibru, A. (2021). Determinants of diarrheal diseases among under-five children in JimmaGeneti District, Oromia region, Ethiopia, 2020: a case-control study. *BMC pediatrics*, *21*(1), 532.

Nirmolia, N., Mahanta, T. G., Boruah, M., Rasaily, R., Kotoky, R. P., & Bora, R. (2018). Prevalence and risk factors of pneumonia in under five children living in slums of Dibrugarh town. *Clinical Epidemiology and Global Health*, *6*(1), 1-4.

Oddy, W. H. (2001). Breastfeeding protects against illness and infection in infants and children: a review of the evidence. *Breastfeeding Review*, *9*(2).

Panda, S., Deb, A. K., Chawla-Sarkar, M., Ramamurthy, T., Ganguly, S., Pradhan, P., ... &Dhere, R. (2014). Factors associated with diarrhoea in young children and incidence of symptomatic rotavirus infection in rural West Bengal, India. *Epidemiology & Infection*, *142*(9), 1848-1858.

Pradhan, D., Duraipandian, I., &Sethi, D. (2016). Celebrity endorsement: How celebrity–brand–user personality congruence affects brand attitude and purchase intention. *Journal of Marketing Communications*, *22*(5), 456-473.

Pradhan, S. M., Rao, A. P., Pattanshetty, S. M., &Nilima, A. R. (2016). Knowledge and perception regarding childhood pneumonia among mothers of under-five children in rural areas of Udupi Taluk, Karnataka: A cross-sectional study. *Indian Journal of Health Sciences and Biomedical Research kleu*, *9*(1), 35-39.

Roy, P., &Mahato, M. (2024). Emotional Intelligence and its Impacts on Academic Achievement of General Degree College Students. *International Journal for Multidisciplinary Research*, 1-7.

Saha, J., Mondal, S., Chouhan, P., Hussain, M., Yang, J., & Bibi, A. (2022). Occurrence of diarrheal disease among under-five children and associated sociodemographic and household environmental factors: An investigation based on National Family Health Survey-4 in rural India. *Children*, *9*(5), 658.

Shally Awasthi, S. A., Pandey, C. M., Tuhina Verma, T. V., & Neha Mishra, N. M. (2019). Incidence of Community Acquired Pneumonia in children aged 2-59 months of age in Uttar Pradesh and Bihar, India, in 2016: an indirect estimation.

Walker, C. L. F., Rudan, I., Liu, L., Nair, H., Theodoratou, E., Bhutta, Z. A., ... & Black, R. E. (2013). Global burden of childhood pneumonia and diarrhoea. *The Lancet*, *381*(9875), 1405-1416.