Doi: https://doi.org/10.3329/ewmcj.v13i1.77327





*Literature Review*

# A LITERATURE REVIEW ON CHILDHOOD PNEUMONIA IN BANGLADESH: REDUCING MORTALITY AND ADVANCING SDG GOALS

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**Article history:**
Received: 28 October 2024
Accepted: 28 November 2024

**Abstract:**

***Background:*** *Pneumonia is the leading cause of under-5 mortality among children worldwide. It is a burden concern, particularly in developing and underdeveloped countries. Despite being a developing country, Bangladesh has shown significant progress in achieving the target goal of the SDG by preventing childhood pneumonia and other causes of under-5 mortality rates. This study aimed to determine the risk factors and strategies that explain the lowering rate of under-five childhood pneumonia in Bangladesh by conducting a comprehensive evaluation and review of the existing epidemiology studies in this field.*

***Method:*** *Our study was conducted using a rigorous methodology. We searched, collected, and evaluated articles that reported the incidence, mortality rate risk factors, and strategies for reducing the rate of under-5 pneumonia in Bangladesh. The search was conducted following the PRISMA guideline, ensuring the thoroughness and reliability of our research.*

***Results:*** *We identified seventeen articles from Bangladesh that met our inclusion criteria. After reviewing the articles, we found that the overall incidence of pneumonia might range from 310 to 511 episodes per 1000 child-years. The mortality rate due to childhood pneumonia is 4 to 6.20 per 1000 live births which varies from paper to paper. The incidence and mortality rate declining significantly every year.*

***Conclusions****: Our research goal is to understand the incidence, mortality rate, and pneumonia risk factors in Bangladesh's children under five years old. Reviewing the most recent knowledge would raise awareness of the pneumonia burden in Bangladesh, highlight knowledge gaps for further investigation, and guide policymakers regarding the prevention of pneumonia. There is an annual decline in the prevalence of pneumonia in children, which is noteworthy in Bangladesh. Additionally, we attempted to rule out all strategies that would lessen Bangladesh's childhood pneumonia incidence and under-5 mortality rates.*

***EWMCJ Vol. 13, No. 1, January 2025: 54-64***

**Keywords:** Childhood pneumonia, Under-5 mortality, Incidence, Risk factors, Bangladesh, SDG

## Introduction:

Across the world, 4.9 million children under 5 die every year[1]. Among them, 725,000 under-5 children die from childhood pneumonia, which is the most significant infectious disease among children in the world[2]. Amid the under-5 mortality rate is 37.12 per 1000 live births, the percentage of pneumonia incidence occurring in the under-5 age group is 14%[27].

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According to the Global Action Plan for Pneumonia and Diarrhoea (GAPPD), the target value of the pneumonia mortality rate under five is 3 per 1000 live births. On the other hand, the rate is 4 per 1000 in Bangladesh[3]. However, the country has witnessed a considerable decline in pneumonia-related deaths in recent years, which has been attributed to a multitude of factors, including improvements in socioeconomic conditions, increased access to preventive interventions, and enhanced quality of healthcare services from 2000 to 2015 the incidence of childhood pneumonia decreased by 30%. The mortality declined by 15% globally[4]. Childhood mortality each year per 1000 live around the world is 37.12 in South Asia, 35.87, and 28.78 in Bangladesh. The percentage of childhood pneumonia in under-5 mortality in the world is 14.24%, in South Asia 11%, and in Bangladesh 10.12%[28]. Therefore, Bangladesh has achieved more success than South Asia and the world in reducing the incidence of childhood pneumonia and under-5 mortality rates.

It was due to implementing the strategies and actions taken by Bangladesh to implement the SDG 2030 Goal. For instance, Bangladesh govt. Introduced HIB on January 15, 2009[5] and PCV -10 vaccination in its EPI schedule in March 2015[6].

The pneumonia vaccination coverage in 1-year-old children is more than 97% in Bangladesh[7]. On the other hand, increasing parental education, consciousness about the safe household environment and safe sanitation, use of pure drinking water, increasing awareness for exclusive breastfeeding for neonates, prevention of malnutrition because of decreasing poverty, etc., are the main reasons behind reducing childhood pneumonia and under-five childhood mortality rate.

**Methods:**

**Search strategy:** The search strategy followed the Preferred Reporting Items Systematic Reviews and Meta-Analyses (PRISMA) checklist and adhered to PRISMA guidelines[28]. We searched our desired literature from PubMed. The search terms on PubMed included “Childhood pneumonia” OR “Under-5 respiratory illness” OR “Under-5 mortality” OR “Under-5 pneumonia” AND “incidence” OR “risk factors” OR “epidemiology AND “Bangladesh” NOT “adult pneumonia” NOT “qualitative article” NOT “clinical trials.” We set the article publication year from 1990 to 2024 in the search filters. We also searched different journals on Google Scholar, BMC, Springer, Elsevier, JSTOR, Semantic Scholar, and Bangladesh Journal Online (BanglaJOL). Additionally, we searched data on the WHO database, plenty of national e-paper versions, and national government international websites for desired data.

**Inclusion and exclusion criteria:** We included the article based on the following criteria:

1) Primary research.
2) Quantitative/analytical data.
3) Defined geographical population. (Under-5 children)
4) Defined geographical area.
5) Defined diagnostic criteria for childhood pneumonia (According to IMCI, clinical features and other diagnostic criteria include chest X-ray, sputum for culture, and blood c/s for confirmation).
6) Incidence data.
7) Risk factors
8) Mortality rate and,

We excluded articles based on-

1) Descriptive data.
2) Those published as theses or dissertations.
3) Clinical trials

**Quality assessment:** Authors 1 & 2 independently screened the title to determine what should be included and excluded. They assessed the gathered material to determine if the title matched our desired literature. The author 3, 4 & 5 again evaluated the article more thoroughly. Finally, Author 3 reviewed and rechecked the entire article. All the authors thoroughly investigate each article to determine whether the following points are appropriate: (i) research objectives and aims; (ii) study design(descriptive/analytical study, if analytical, then case-control/ cross-sectional/ cohort study, etc.); (iii) study population; (iv) study region; (v) risk factors (vi) data collection method; (vii) diagnostic criteria viii) quantitative outcome; and (ix) statistical analysis (e.g., the odds ratio, p values, confidence intervals,

etc.), x) results in xi) discussion and conclusion. We excluded any submissions that failed to match the objectives of our journal. STROBE (Strengthening the Reporting of Observation Studies in Epidemiology) guidelines have been followed to maintain the report's quality.

**The selection of the articles:** We extracted six articles After the final evaluation. We categorized the data and tabulated it by 1) Author, 2) Year of study, 3) Country, 4) Setting: Hospital/Hon-hospital, 5) Diagnosis Dx, 6) Case Detection Method, 7) Population (Age), 8) Number of Cases (Age), 9) Incidence. If the article contained several analyses, only data that met the inclusion criteria were taken. The selection process of the articles displayed in the following flowchart.


**Flow chart:** *PRISMA criteria for sorting out the desired article*

**Results**:

**1. Risk factors of childhood pneumonia:**

**Table-I**

*Summaries of childhood pneumonia risk factors in Bangladesh*

| No. | Citation serial number in reference list | Study Aim | Study/Year | Study area | Risk factor |
|---|---|---|---|---|---|
| 1 | [14] | Household air quality risk factors associated with childhood pneumonia | 2014 | Urban Dhaka, Bangladesh | Crowding, a tin roof in the living space, low socioeconomic status, and the male sex of the child |
| 2. | [15] | Factors associated with community-acquired severe pneumonia among under-five children | 2022 | Dhaka, Bangladesh | Male sex, longer duration of illness, fever, received prior medical care, and severe stunting. |
| 3 | [16] | Epidemiology and risk factors for pneumonia severity and mortality in Bangladeshi children <5 years of age | 2016 | Entire Bangladesh | Low weight for age and access to safe drinking water |
| 4 | [17] | Multihospital surveillance of pneumonia burden among children aged <5 years hospitalized for pneumonia in Bangladesh. | 2009 | Entire Bangladesh | Infancy, very severe pneumonia, blood culture positive for bacteria, severe malnutrition, and delayed admission |
| 5 | [18] | Incidence of Respiratory Virus-Associated Pneumonia in Urban Poor Young Children | 2009–2011 | Dhaka, Bangladesh | Respiratory viral pathogen. |
| 6 | [19] | Pneumonia mortality and healthcare utilization in young children in rural Bangladesh: a prospective verbal autopsy study | 2018 | Entire Bangladesh | Delay in seeking appropriate care and access to multiple sources for treatment |
| 7 | [20] | pediatric pneumonia in rural Bangladesh: a case -control study | 2015 | Rural Bangladesh | Low to moderate arsenic exposure |
| 8 | [21] | Epidemiology and etiology of childhood pneumonia. | 2008 | Entire Bangladesh | Lack of exclusive breastfeeding, undernutrition, indoor air pollution, low birth weight, crowding, and lack of measles immunization |

We identified the following risk factors after studying textbooks, journal articles, and other sources -

1) Viral and bacterial infection: primarily by influenza, parainfluenza, streptococcus pneumonia
2) Age: more than one year. The incidence rate is the same in boys and girls with low parental education, low birth weight history
3) Previous history of treatment intervention like asthma, steroid treatment, TB treatment, cotrimoxazole therapy, antibiotic therapy
4) Nutritional deficiency: Malnutrition, wasting and stunting
5) Living in a polluted area like a slum
6) Incomplete vaccination year ago
7) Drinking water from a non-purified water source
8) Vitamin deficiency
9) Crowding family
10) Past comorbidity:
    i. Malaria parasitemia
    ii. HIV AIDS
    iii. Previous pneumonia hospitalization
    iv. History of wheezing or asthma
    v. Measles
    vi. Thalassemia
    vii. Sickle cell disease
    viii. Anemia
    ix. Diarrhea

**2. Incidence of Childhood Pneumonia:**

**Table-II**

*Summarize studies showing the incidence age group of childhood pneumonia*

| Country (reference no) | Study year | Duration | Setting | Study Method | Diagnosis | Case Detection Method | Population (Age) | Number Of Cases (Age) | Incidence |
|---|---|---|---|---|---|---|---|---|---|
| [9] | 2012-2014 | Two years | H & NH | Case-control study | Physician DX | Notification by physician, radiology, and laboratory dept. | 100,878 (<5 years) | Case- 525, Control-772 (<5 years) | N/R |
| Bangladesh [10] | 2004-2008 | Four years | NH | NR | Physician DX | Notification by physician, radiology, and laboratory dept. | 17644 (median age 22.6 months) | 6335 children had 12,499 clinic visits. Among them, 6345 had pneumonia episodes | 36 episodes/100 child-years |
| Bangladesh [11] | 2004-2006 | Two years | NH | Cross-sectional study | Physician DX | Notification by physician and blood culture | 6,167(<5 years) | NR | 0.51 episodes/child-year |
| Bangladesh [12] | 2004-2007 | Three years | NH | Cross-sectional study | Physician DX | Notification by physician and by culture sensitivity | 12,062(<5 years) | NR | 511 episodes per 1000 child years |
| Bangladesh [13] | 2004-2007 | Three years | H & NH | Cross-sectional study | Physician DX | Notification by physician and by culture sensitivity | 12,000(overall under 5) | 9411(overall under 5) | 310 episodes per 1000 child years |

NH: Non-Hospitalized, H: Hospitalized

The table shows the overall incidence rate of childhood pneumonia in Bangladesh. The highest episode rate shown is 511 per 1000 child-years. All the articles were analytical studies conducted from 2004 to 2014. The population range for those studies was from 6,117 to 100,878. The age group was children under five years old.

Childhood mortality each year per 1000 live around the world is 37.12 in South Asia, 35.87, and 28.78 in Bangladesh. The percentage of childhood pneumonia in under-5 mortality in the world is 14.24%, in South Asia 11%, and in Bangladesh 10.12%[28].

**3.Childhood mortality rate due to pneumonia in Bangladesh:**

This study included prior studies of childhood pneumonia risk factors in Bangladesh among children-

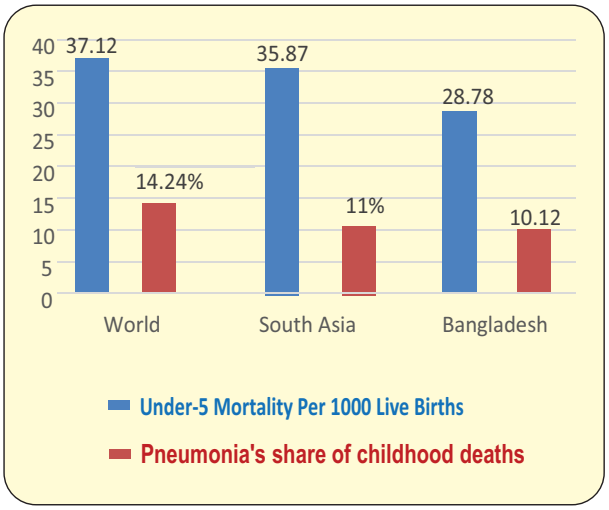


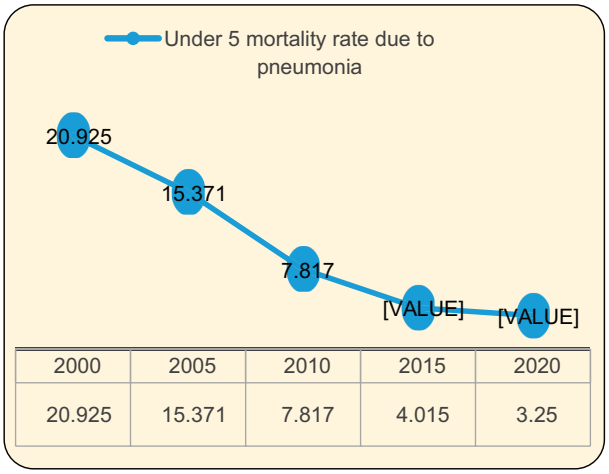

**Figure 1:** *Childhood mortality rate and pneumonia's share of childhood deaths*

**Table-III**

*Summaries of childhood mortality rate in Bangladesh due to pneumonia*

| No. | Citation serial number in reference list | Study aim | Year of publish | Study area | Total number of under 5 deaths in mentioned year | Mortality rate per 1000 live births |
|---|---|---|---|---|---|---|
| 1 | [22] | Pneumonia Death Analysis in Bangladesh | 2018 | Entire Bangladesh | 12,000 children under the age of five. (13% among the children's) | 4 per 1000 live births |
| 2. | [19] | Pneumonia mortality and healthcare utilization in young children in rural Bangladesh | 2018 | Rural areas in Bangladesh, among 4 weeks to 59 months children. | Pneumonia caused 26.4% of deaths. | 6.20 per 1000 live births |
| 3 | [23] | Pneumonia: the forgotten killer of children in Bangladesh | 2016 | Entire Bangladesh | 16,000 children under the age of five | 5.33 per 1000 live births |
| 4 | [3] | Spotlight on leading threats to child survival under the age of five - focusing on Pneumonia and Diarrhoea. | 2022 | Entire Bangladesh | N/A | 4 per 1000 live births |

The table shows the overall mortality rate of childhood pneumonia. One of these studies shows that four children die per 1000 lives under five years old age. Two studies found that every year, 12000 and 16000 children die due to childhood pneumonia. After doing the formulation according to the formula, the mortality rate was calculated and the result is 4 and 5.33. A study says pneumonia accounts for 26.4% of all child deaths. Mortality rate 6.20 is calculated.




| 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|
| 20.925 | 15.371 | 7.817 | 4.015 | 3.25 |

**Figure 2:** *Childhood mortality rate due to childhood pneumonia per 1000*

According to "UN Inter-agency Group for Child Mortality Estimation", According to the "United Nations Inter-Agency Group for Child Mortality Estimation", the share of pneumonia, which causes childhood death, is declining significantly. In the year 2000, the rate of childhood mortality due to pneumonia was 20.93 per 1000 live births. However, by 2020, the rate had drastically decreased to just 3.25, following a significant decline[27].

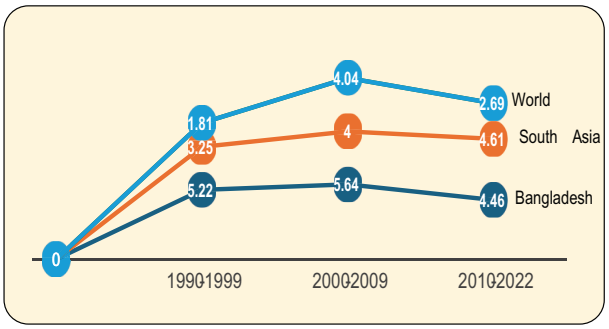



**Figure 3:** *Under-five mortality rate declining percentage per decade*

According to the "United Nations Inter-Agency Group for Child Mortality Estimation", the declining percentage per decade in Bangladesh is higher than South Asia or World[27].

**Action taken by Bangladesh to eliminate childhood pneumonia:**

To reduce pneumonia morbidity and mortality and improve child survival rate, the Bangladesh Govt. has implemented some strategies to control under five pneumonia in collaboration with various National and international organizations. This study is broadly divided into four main sections describing below-

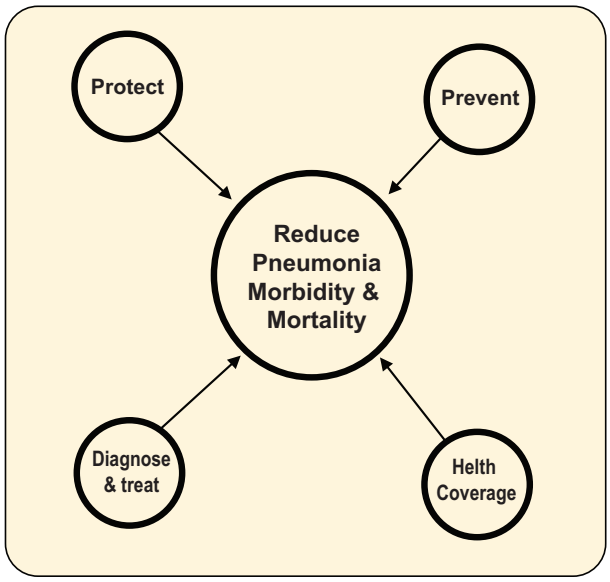



**Figure 4:** *Action taken by Bangladesh to reduce pneumonia morbidity and mortality*

**Protect the child's health:**

1. By eliminating nutritional deficiency: According to SDG 2.2, by 2030, we must end all forms of malnutrition, including achieving targets on wasting in children under 5 to less than 5% and stunting less than 16%, which is 10% and 28%[3]. Bangladesh's progress in stunting rate, dropping from 42% in 2013 to 28% in 2019, signifies the importance of our continued efforts[24].
2. Breastfeeding: According to the World Health Assembly resolution, the target for exclusive breastfeeding should be 50% by 2025. In Bangladesh, the rate was about 62% in 2019, a figure that we must maintain and improve upon, as it is a crucial aspect of child health[24].

**Prevention of the incidence:**

1. Vaccination: In Bangladesh, 90% National and at least 80% district-level or equivalent

administrative unit coverage for vaccination by 2022 as per the Global Vaccine Action Plan, where 98% pentavalent vaccine and 97% pneumococcal vaccine coverage was done among 1-year-olds in 2018[25].

2. Urgent action is needed to improve water safety, sanitation, and hygiene maintenance. Currently, 64% of people use basic sanitation facilities, and only 43% have access to safely managed drinking water. Furthermore, only 75% of people have basic hand-washing facilities at home[24].
3. Elimination of air pollution: Bangladesh is still lagging. According to air quality guidelines, ten micrograms per cubic meter of air should be the mean annual exposure to Fine Particulate Matter. But we have 90 micrograms per cubic meter of air[24].

By early diagnosis and treatment of pneumonia:

1. Role of healthcare professionals and workers: Before direct intervention in the disease, healthcare personnel must be needed. According to WHO's recommendation, 44.5 healthcare persons per 10,000 are required. However, we have only 13[8]. It is not much more alarming because this country produces many skilled Healthcare personnel, including doctors, nurses, and paramedics. The primary healthcare providers and the parents must have knowledge about pneumonia, dangers sign of pneumonia and ability to early diagnosis. So that they can quickly take the children to the hospital. The diagnostic criteria of childhood pneumonia-

**IMCI classification for pneumonia**

**Table-IV**

*Classification of childhood pneumonia according to IMCI*

| | |
|---|---|
| Signs | |
| | Any danger signs or chest in-drawing in calm child |
| | Fast Breathing |
| | No signs of very severe disease or pneumonia |
| Classify As | |
| | Severe pneumonia or very severe pneumonia |
| | Pneumonia |
| | No pneumonia |

**Danger signs**: Had convulsions during the present illness, convulsion now, lethargic or unconsciousness, not able to drink and breastfeed, vomits everything.

**Fast breathing:**

2 months up to 12 months: 50 or more breaths per minute

12 months up to 5 years: 40 or more breaths per minute

1. Bangladesh's dedication to improving child healthcare is evident in the establishment the National Newborn Health Program IMCI, which was set as the integrated management of childhood illness guidelines in 1998. The Dx and Rx protocols for children under five should adhere to the IMCI standards.
2. Oxygen supply: All tertiary health centers in Upazila (sub-district) Health Complex have emergency oxygen supply facilities for pneumonia patients.
3. Antibiotic policy: Amoxicillin 250 mg capsule and syrup 250 mg per 5 ml is part of the national drug policy, 2016. The government of Bangladesh offers free medications to all patients.

**Implementation of the national and universal health coverage for combat against pneumonia:** Bangladesh's Govt. along with many national and international public and private organizations, has implemented the strategy, accommodated the budget, and is slowly going to achieve quality primary healthcare services for all, reducing inequity and strengthening healthcare facilities. According to UNICEF in Bangladesh, essential Healthcare coverage was 52% in 2021, and 46% of children under 5 with pneumonia were taking the healthcare facilities in 2019. This percentage is improving every year. An adequate budget should be accommodated for formulating and implementing the strategies. As per WHO, Govt. should spend a minimum of 5% of its total budget on healthcare services, whereas Bangladesh spent 4.8% in 2021[26].

**Discussion:**

Although pneumonia is one of the leading causes of childhood mortality, the incidence of pneumonia in children is decreasing. Among our reviewed a total of 17 articles, there are five articles on the incidence rate, eight on risk factors, and four on mortality rate. A review of Table-II shows that the incidence of

childhood pneumonia is between 310 and 511 episodes per 1000 child years. One paper indicates that the rate is 0.51 per 1000 live years[11].

According to the "United Nations Inter-Agency Group for Child Mortality Estimation", the share of pneumonia, which causes childhood death, is declining significantly. In the year 2000, the rate of childhood mortality due to pneumonia was 20.93 per 1000 live births. However, by 2020, the rate had drastically decreased to just 3.25, following a significant decline[27].

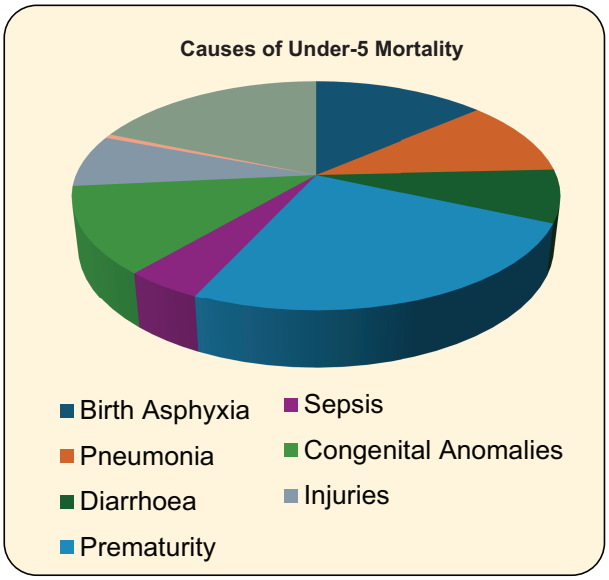



**Figure 5:** *Causes of under 5 mortality*

In Table I, we have sorted out the risk factors for childhood pneumonia. The leading causes of childhood pneumonia include inadequate vaccination, immunization age, nutritional deficiency, unhygienic household environment, unsafe drinking water, poor sanitation, low parental education, and insufficient breastfeeding, among others. However, the strategies implemented by the Bangladeshi government aid in eliminating the risk factors associated with childhood pneumonia. The pneumonia vaccination campaign, reducing malnutrition through eradicating poverty, raising awareness of breastfeeding, maintaining hygiene, use of pure drinking water, proper management, and implementation of Integrated Management of Childhood Illness(IMCI) protocols which helps health workers to diagnose and treat childhood pneumonia, adequate antibiotic therapy after pneumonia infection, etc. are the leading causes for reducing childhood pneumonia morbidity and mortality rate in Bangladesh. We are heading towards nearly 100 percent pneumonia vaccination coverage. Integrating pneumonia management into primary healthcare services has further bolstered these efforts, ensuring timely treatment and better outcomes for affected children. In Table 3, the rate and incidence of death due to pneumonia has been shown. One article shows that four under-five deaths per 1000 live births per year due to pneumonia[3].

According to the SDG goal, the under-5 childhood mortality target is 25 per 1000 live births by 2025. Under-5 childhood mortality in Bangladesh was 28.78 in 2022, which was 145.99 in 1990, 85.96 in 2000 and 49.12 in 2010. The rate is declining rapidly. We can achieve the goal by 2025 if the declining percentage remains unchanged. Bangladesh has achieved this great success in collaboration with government bodies, non-governmental organizations, and international partners by setting goals and strategies and by facilitating resource allocation, training of the healthcare workers, and the establishment of community health programs that empower families to seek timely medical help and acting according to moving towards sustainable development to eliminate childhood pneumonia, the deadliest disease of under-5.

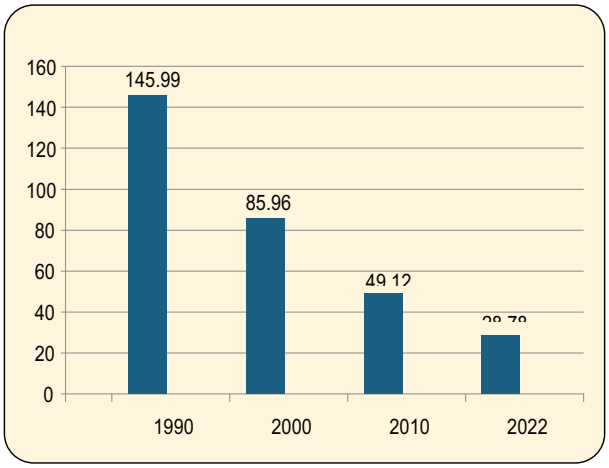



**Figure 6:** *Childhood mortality rate in Bangladesh (10 Yearly)*

Healthier children contribute to the country's society, economy, and growth. Therefore, thorough research, consistent study, and integrated healthcare help lower the load of childhood disorders and create a healthy nation.

**Conclusion:**

The incidence and mortality rate due to childhood pneumonia is decreasing because of focused

initiatives such as improved access to healthcare, vaccination programs, and increasing awareness against respiratory illness. Improving healthcare infrastructure and promoting education on hygiene and preventive measurement are also important for reducing childhood pneumonia. We can fight childhood pneumonia unitedly and give the country a healthy nation that will contribute to its development.

**Declarations**

**Acknowledgments:**
None

**Author contributions:**
Ashrafur Rahman Alif: Conceptualization, Methodology, Software, Project administration ;Hasan Mahmud Rumi: Data curation, Writing- Original draft preparation

Efta Khairul Haque Emon: Visualization, Investigation, Software, Formal analysis, Data Curation; Afnan Islam Tuba: Writing- Original draft preparation, Validation, Formal analysis; Md Ariful Haque: Writing- Reviewing

**Data Declaration:**
The data which are restricted in mentioned in table 2 were taken from third study entitled "Epidemiology of community-acquired pneumonia and implications for vaccination of children living in developing and newly industrialized countries: A systematic literature review" under DOI: https://doi.org/10.1080/21645515.2016.1174356

Declaration of Generative AI and AI-assisted technologies in the writing process:

Author's have used Quillbot and Grammarly for necessary Grammar correction.

**Competing Interests:**
The authors declare that they have no competing interests.

**Funding statement:**
Authors have not received any funds.

**Conflict of interest disclosure:**
Authors stated no conflicts of interest.

**Ethics approval statement:**
This type of article doesn't need any ethical approval.

**Patient consent statement:**
No patients were included.

**Permission to reproduce material from other sources:**
All articles are cited and references are given. This study has not taken any material that needs permission.

**Clinical trial registration:**
This is not a clinical trial.

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