Save the Children

# CHILDHOOD PNEUMONIA AND ITS ASSOCIATED FACTORS IN INDIA

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# FOREWORD

In nearly three decades, under-five mortality in India declined from 126 (1990) to 32 (2020) per 1000 children. Despite this remarkable progress, child mortality is a key concern for a country like India as it, along with Nigeria, contributes to one-third of the global child mortality. Adding to the plight, most of the deaths occurring among children under five are due to preventable infectious diseases. Pneumonia, often referred to as the "silent killer" is one of the leading causes of death among children across the globe. In 2013, GAPPD set a global goal for reducing pneumonia deaths using a framework of protection, prevention, and treatment. Despite Global Alliance for Vaccination and Immunization (GAVI)'s mandate to vaccinate the world's most vulnerable children, half of them did not receive all of the pneumonia-fighting vaccines as of 2019.

With 11% of the global contribution of pneumonia deaths in 2019, India has the second highest burden of childhood pneumonia deaths worldwide. Higher fatality is observed among infants. Rural residents are more vulnerable to the infection of Pneumonia. Besides, impoverished and malnourished children are at a higher risk amongst all. Relentless efforts of the Indian government and organizations such as the World Health Organisation, UNICEF, Save the Children, CHAI and Every Breath Counts have certainly helped in the decline in Pneumonia in recent years. However, with just three years left to achieve the IAPPD target to reduce pneumonia deaths to lesser than 3 children per 1000 live births and the sudden outbreak of COVID-19 severely impacting the healthcare facilities and vaccination provisions, the accomplishment of the IAPPD target by 2025 and the SDG targets by 2030 may be far-fetched without any dedicated policy formulations.

Thus, this study named "Situational Data Analysis of Pneumonia and Its Associated Risk Factors in India" highlights the burden of Pneumonia using the two latest rounds of the National Family Health Survey (NFHS-4 and NFHS-5). Further, the estimates of India's burden in the global context and the population at risk in the nearby future are also analyzed. The study also identifies malnourishment among children, poverty and illiteracy of parents, and the non-availability of clean cooking fuel and hand-washing facilities as potential risk factors among children under five. Vaccinations, exclusive breastfeeding and complementary feeding practices as well as the use of clean fuel are identified as possible interventions for preventing Pneumonia among children. The study is a timely effort to add invaluable insights and draw the attention of the Indian government and policy formulators to implement strong initiatives to bring down the burden of Pneumonia in India.

# ACKNOWLEDGEMENTS

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We acknowledge the contribution of Dr. K. S. James, Director at the International Institute for Population Sciences (IIPS) for providing the logistics support to the team so that the project could be carried out smoothly.

We are optimistic that this report will add great value in understanding the implications of Pneumonia in the current scenario and motivate the policy formulators to come up with effective policies to combat the most significant infectious cause of under-five mortality. We hope that the report instills interest in the international and national organizations addressing this issue to join hands with the government of India to achieve SDG target 3.2. i.e., to end preventable deaths of newborns and children under five at the earliest.

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# ABBREVIATIONS

| | |
|---|---|
| ARI | Acute Respiratory Infections |
| GAPPD | Global Action Plan for Pneumonia and Diarrhea |
| GAVI | Global Alliance for Vaccines and Immunisations |
| HMIS | Health Management Information System |
| IAPPD | [India] Integrated Action Plan for Pneumonia and Diarrhoea |
| ICDS | Integrated Child Development Services |
| IIPS | International Institute for Population Sciences |
| MCE | Maternal and Child Epidemiology |
| MCP | Mother and Child Protection Card |
| MoHFW | Ministry of Health and Family Welfare |
| NFHS | National Family Health Survey |
| OBC | Other Backward Classes |
| OLS | Ordinary Least Squares |
| PCV | Pneumococcal Conjugate Vaccine |
| RGI | Registrar General of India |
| SAANS | Social Awareness and Action to Neutralise Pneumonia Successfully |
| SC | Scheduled Caste |
| SDGs | Sustainable Development Goals |
| ST | Scheduled Tribe |
| UIP | Universal Immunization Programme |
| UNICEF | United Nations International Children's Fund |
| WHO | World Health Organization |

# EXECUTIVE SUMMARY

## Background

In nearly three decades, under-five mortality in India declined from 126 (1990) to 32 (2020) per 1000 children. India is a major contributor to global childhood pneumonia deaths. Sustained efforts by the Government of India including the universalisation of Pneumococcal Vaccine, roll out of SAANS campaign for operationalization of Pneumonia Control Guidelines and support provided by World Health Organisation, UNICEF, Save the Children, CHAI and Every Breath Counts have certainly helped in the decline in Pneumonia in recent years. Reducing childhood mortality from 37 per 1000 live births in 2017 to 23 per 1000 live births by 2025 is one of the goals of India's National Health Policy, 2017. To achieve this goal, childhood pneumonia attributable mortality needs to be reduced to lesser than 3 per 1000 live births which is also in consonance with India's Integrated Action Plan for Pneumonia and Diarrhoea (IAPPD) target. With this context in mind, the current study was undertaken using the unit-level data of the National Family Health Surveys (NFHS).

Introducing the Pneumococcal Conjugate Vaccine (PCV) into the Universal Immunization Programme in 2021 is also a step in the right direction. However, there is a need for more comprehensive evidence around "hot spots" of the problem, identification of vulnerable populations and risk factors. In this context, this study's primary objective is to analyze the unit-level data of NFHS-5 for Pneumonia prevalence in children and its association with key risk factors as per the GAPPD framework that emphasizes 'Prevent', 'Protect' and 'Treat' interventions. Further, to make an appropriate comparison from NFHS-4, wherever necessary, an analytical model has been used to estimate the current burden and forecast national level estimates till 2030. In the second stage, this report presents the evidence to be used for designing informed advocacy to neutralize Pneumonia.

## Data and methods

The study used the two latest rounds of the National Family Health Survey (NFHS, 2015-16 and 2019-21). In the absence of separate information on Pneumonia in NFHS, Acute Respiratory Infections (ARI) have been taken as the nearest proxy measure for Pneumonia for its estimates which is also in accordance with UNICEF and WHO methodology for estimating Pneumonia burden across the countries in the world.

For a thorough understanding of the scenario of Pneumonia, its trends and patterns are depicted at the national and sub-national levels and across the key socio-economic characteristics and seasons. In order to estimate India's contribution to the global burden and time intensity of infections, absolute incidence numbers have been used. The linear approach of the mathematical model of projection has been used to estimate the prevalence of Pneumonia up to 2030. Additionally, the regression-based decomposition model has been used to estimate the relative contribution of the various risk factors of Pneumonia and the relative contribution of Pneumonia to neo-natal, infant and under-five deaths.

## Key Findings and Policy Highlights

The average prevalence of Pneumonia in India was 2.7% in 2015-16, which marginally increased to 2.8% in 2019-21.

Just three states, Uttar Pradesh (24.6%), Bihar (16.6%), and Maharashtra (9.3%), together account for more than 50% of the total burden of children suffering from Pneumonia.

With a child getting infected with Pneumonia every second, India contributes nearly 26% of the total Pneumonia cases worldwide for the period of 2019-21.

The district-level pattern shows that 42 out of 69 of the "hot spot districts" of Pneumonia (prevalence above 5.5%) are in North India. Compared to 2015-16, the study observes the emergence of new "hot spots" in Andhra Pradesh, Karnataka, Madhya Pradesh and Maharashtra in 2019-21.

Although at the national level, Pneumonia is more prevalent in rural areas compared to urban, this pattern significantly varies across the states with glaring heterogeneity in terms of the absolute rural-urban gaps.

The prevalence of Pneumonia is highly skewed to younger ages, more among males compared to females. Though the variation in Pneumonia is not much prominent across religious group, the prevalence is comparatively higher among scheduled castes and the poorest against other social and economic groups.

Seasonal variations for Pneumonia exhibit that the prevalence is highest in winter and lowest in summer. Among children suffering from Pneumonia, about 56% of them had sought treatment or advice from healthcare providers while only 39% took the treatment or advice on the same day or next day (within two days).

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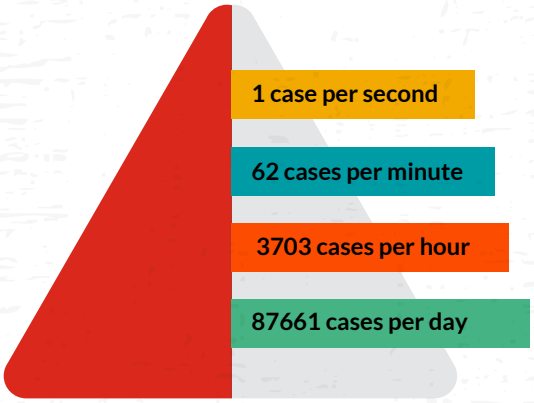
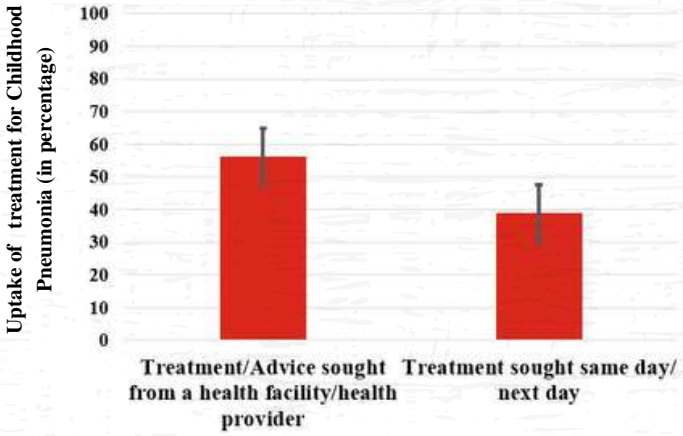
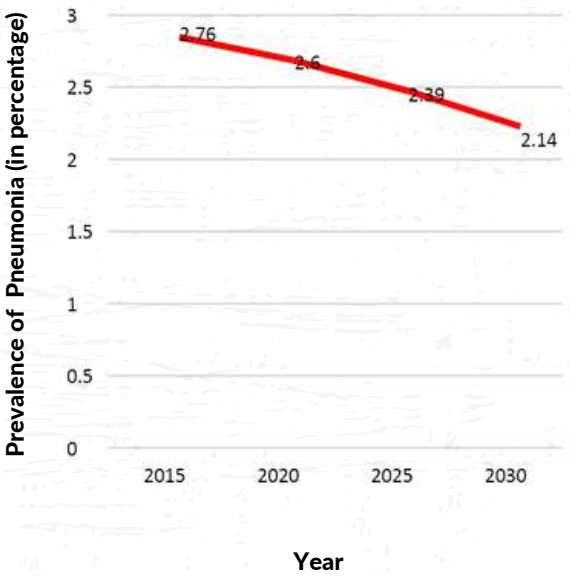
**Time-intensity estimates of Pneumonia cases in India as of 2019-21**



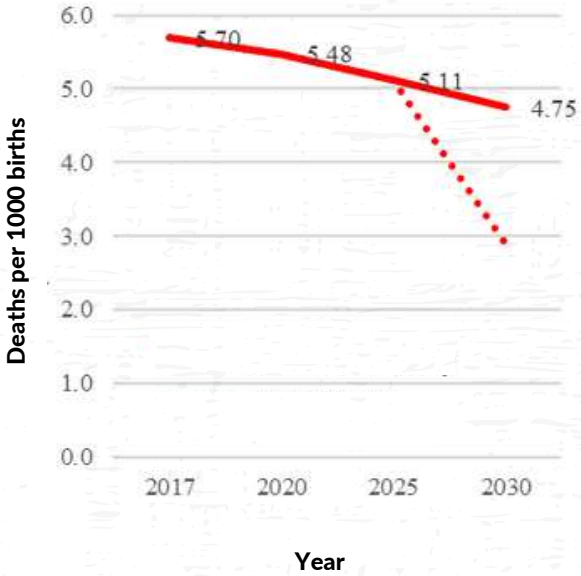

**Uptake of treatment for Childhood Pneumonia in 2019-21**




**Projected trends of Pneumonia 2015 to 2030**




**Estimated Pneumonia attributable Under-five Mortality Rate, 2017 to 2030**




Prevalence of Pneumonia

GAPPD Target

Pneumonia related under- five mortality

Child malnutrition attributes to 35% of the relative contribution and is the leading risk factor of Pneumonia. Apart from it, poor economic status (7.5%), and lack of education among father and mother (9%) also contribute significantly to the occurrence of Pneumonia. Handwashing with soap and water, clean fuel, mother having an MCP card, and exclusive breastfeeding, however, contributes negatively to Pneumonia prevalence.

COVID-19-led disruptions caused under-reporting for Pneumonia. In 2019-21, Pneumonia caused 18% of the total under-five deaths, 12% of infant deaths and 7% of neo-natal deaths in the country respectively.

In 2021, with 3.3 million estimated numbers of Pneumonia cases in India, it is projected to decline to 2.2 million by 2030. The projected Pneumonia prevalence suggests that it could decline to 2.4% by 2025 and 2.14% by 2030.

The study also estimates Pneumonia attributable under-five mortality rate to be around 5.48 deaths per 1000 live births. With the current annual decline of 1.3% in Pneumonia attributable under-five mortality rate, the country needs to pace up and attain 5% of the annual rate of decline in order to achieve the GAPPD target of less than 3 deaths per 1000 live births.

The annual inflation adjusted estimated cost of inaction due to Pneumonia burden for the country is 1631.5 crores rupees.

## Conclusion

The Pneumococcal Conjugate Vaccine Programme was launched by the Ministry of Health and Family Welfare (MoHFW) in a phased manner in May, 2017 in selected districts of a few states. While it is launched nationally on October 29th, 2021 with an expectation of reducing childhood deaths by nearly 60%. Though vaccination is the most effective measure to combat Pneumonia, the nation needs to work rigorously on the potential risk factors in order to attain the target set by GAPPD as well as IAPPD. Special attention must be provided to reduce malnutrition, the major risk factor for acute respiratory infections. Provision of Vitamin A supplementation for missing children, strengthening of the facility and community-based care of childhood Pneumonia should be enhanced. The emphasis should also be on the accessibility of clean fuel, better feeding practices and handwashing with soap and water. In order to neutralize acute respiratory infections, in particular Pneumonia, poverty needs to be eradicated at a faster pace and parental education needs to be alleviated.

# INTRODUCTION

World Health Organization defines Pneumonia as a 'form of acute respiratory infection that affects the lungs' (World Health Organization, 2021). The lungs contain small sacs named 'alveoli', that fill with air when a healthy person breathes. However, the alveoli get filled with pus and fluid for individuals with Pneumonia, limiting oxygen intake and making breathing painful. Pneumonia, thus, is often referred to as a lower respiratory infection (World Health Organization, 2021).

Naturally, the pneumonia mortality rate of children in rural areas is 1.6 times higher than their urban counterparts due to limited healthcare services at the community and facility levels. In terms of gender, more girls die due to Pneumonia than boys (Wahl, Knoll, Shet et al., 2020). However, previous studies lack in terms of comprehensive national level investigation of pneumonia prevalence by states, districts and across other socioeconomic characteristics and seasons.

Most pneumonia deaths are preventable, and evidence-based interventions are known. Prevent, Protect and Treat (PPT) framework under Global Action Plan for Pneumonia and Diarrhoea (GAPPD) defines critical interventions. In most cases, the disease goes unnoticed due to a lack of awareness and unnecessary delay in initiating medication. To a great extent, lack of comprehensive evidence leads to poor policy design to neutralize Pneumonia.

Tackling Pneumonia in children under five is one of the three centenary commitments of Save the Children and is in resonance with its global campaign 'Every Last Child'. "Save the Children" has been a pioneer in working with the national and state governments to address childhood pneumonia, influence national policies, and develop training resources and Social Awareness and Actions to Neutralize Pneumonia Successfully (SAANS) Campaign guidelines. Save the Children, India has also conducted a situational analysis to study childhood pneumonia in two districts each of five high-burden states of India namely, Uttar Pradesh, Madhya Pradesh, Rajasthan, Bihar, and Jharkhand in 2019 (Save the Children, 2019).

Despite a few recent attempts to understand the trends, patterns, and risk factors of Pneumonia by others, the lack of comprehensive national-level evidence greatly hinders the designing cost-effective strategies to eliminate the burden of this disease

Most of the previous studies are either small cross-sectional case studies or hospital-based studies (Gothankar, Doke and Dhumale et al., 2018; Chakraborty, Mukherjee, Bhattacherjee, et al., 2020; Save the Children, 2019). Therefore, the proposed study is to comprehend the current knowledge on the prevalence of childhood pneumonia and its risk factors using the unit-level data of the National Family Health Survey-5 (NFHS-5) which could help public health professionals comprehend the relationship of key risk factors for the predisposed pneumonia burden in the country, highlighting the 'hot-spot' districts, states and other population sub-groups.

The study's primary objective is to analyze the unit-level data of NFHS-5 for Pneumonia prevalence in children and its association with key risk factors as per the GAPPD framework that emphasizes Prevent, Protect and Treat interventions. Further, to make an appropriate comparison from NFHS-4, wherever necessary or relevant, we use an analytical model to estimate the current burden and forecast national and state level estimates till 2025. In the second stage, this report presents the evidence to be used for designing informed advocacy to achieve neutralized Pneumonia.

# DATA, METHODOLOGY AND LIMITATIONS

## Data Source

The study mainly uses the latest rounds of the National Family Health Survey (IIPS and ICF, 2017; IIPS and MoHFW, 2021). NFHS is a nationally representative sample survey conducted by the International Institute for Population Sciences (IIPS), Mumbai under aegis of the Ministry of Health Family Welfare, Government of India. The survey covers information ranging from household and an individual's socio-economic, demographic and health characteristics including children under-five years. Maternal and child health and their health care are the primary focus of the survey.

From the wide range of information available at an individual level, our study uses information on demographic characteristics such as age and sex and socio-economic characteristics such as religion, caste and wealth quintile of the children under five suffering with acute respiratory infections in the past two weeks. Further, the potential risk factors have been identified using the information collected on their parental education, feeding practices such as exclusive breastfeeding and pre-lacteal feeding and their nutritional status (child malnourishment and anaemia), vitamin A supplementation in the last six months and utilization of Integrated Child Development Services (ICDS) at an individual level. Also, from the data collected at the household level, the study used information on hand-washing practices and fuels used for cooking to assess their role in increasing the risk of childhood pneumonia.

Besides the two latest rounds of NFHS, this study uses data from Health Management Information System of India (HMIS) for the years, 2019-20 and also age-wise projected population totals for the years 2016 and 2020 from the National Population Commission of Registrar General of India (RGI), Government of India. Also, information on risks of Pneumonia incidence reported in previous studies has been used in the epidemiological modelling for estimating Pneumonia burden and its time intensity in the case of India (Rudan et al. 2004).

## Methodological Notes

Using NFHS data, the study captures Pneumonia as ARI symptoms with short, rapid breathing which was chest-related and/or difficult breathing which was chest-related in the 2 weeks preceding the survey (IIPS and MoHFW, 2017, 2021). The definition is consistent with the UNICEF and WHO estimates of Pneumonia derived from several developing countries using demographic and health surveys (World Health Organization, 2021; UNICEF, 2022).

The study used multiple analytical methods for presenting the data on Pneumonia and its risk factors, as well as its burden and future projections. In the first stage, the study estimates Pneumonia at the national, state and district level. A GIS mapping tool is used to show the geographic distribution of Pneumonia prevalence across states and districts. The study also presents Pneumonia by key socio-economic and demographic characteristics. In the second stage, the relative contribution of key risk factors of Pneumonia is estimated using a regression-based decomposition model. Further, in the third stage, the Pneumonia burden is estimated and projected using epidemiological and linear mathematical projection approach. Lastly, the study estimates cost of inaction on Pneumonia for India.

### *Estimation of the relative contribution of risk factors to variance in Pneumonia prevalence across the states: regression-based inequality decomposition model*

In this method, first, a Pneumonia-generating function is set as

$$ln\left(Pneumonia_i\right) = \alpha + \sum_{i=1}^{k} \beta_i x_i + \varepsilon \qquad (1)$$

where Pneumonia $_i$ is Pneumonia prevalence for $i$=1, ...., k; $x_i$ is a vector of explanatory variable; $\beta_i$ are the corresponding regression coefficients estimated by OLS regression; and ε is the residual term, assumed to be unrelated to other variables.

$$ln\left(Pneumonia_i\right) = \alpha + \sum_{i=1}^{k} Z_i + \varepsilon \qquad (2)$$

where each $Z_i$ for $i$=1, ...., k. is a `composite' variable, equal to the product of an estimated regression coefficient and an explanatory variable. To calculate inequality decomposition, the value of $\alpha$ is not relevant as it is constant for every observation. Thus, one may consider the following equation

$$\widehat{ln(Pneumonia_i)} = \alpha + \sum_{i=1}^{k} Z_i \quad (3)$$

where dependent variable is Pneumonia $_i$ hat or predicted Pneumonia variable. Note, there is no residual term and we can neglect the constant term α.

Following Fields and Yoo (2000), Fields (2003), and Shorrocks (1982), the contribution of each composite variable to Pneumonia inequality can then be assessed as following

$$\sigma^2(s) = \sum_{i=1}^{k} \beta_i cov(s, x_i) + \sigma^2(\varepsilon) \quad (4)$$

where, $\sigma^2$ (Pneumonia $_i$ ) is the variance of Pneumonia $_i$ , cov (s, $x_i$ ) represents the covariance of Pneumonia $_i$ with each variable ($x_i$) and this term can be considered as the relative contribution of factor components to Pneumonia inequality, which sums to 100 percent.

### *Absolute number of Pneumonia cases:*

To estimate the absolute number of Pneumonia cases, the study used Pneumonia prevalence from NFHS-4 (2015-16) and NFHS-5 (2019-21) and projected under-five population for the corresponding years from United Nations Population Prospects (2022). The following mathematical expression shows the procedure of calculation:

Number of Pneumonia cases = Prevalence rate*Under - five population

### *Incidence estimation (Episodes per child-year):*

The estimated number of episodes of Pneumonia cases in India has been carried out using the developing countries average incidence of episodes (0.28) per child-year (Rudan et al., 2004). The projected under-five population was collected from United Nations Population Prospects (2022).

Incidence estimation Episodes per child-year = 0.28 * Under-five population

### *Projection of Pneumonia prevalence and its attributable childhood mortality:*

The study used linear growth function from mathematical projection approaches to estimate the Pneumonia prevalence up to 2030.

$$Pneumonia_{2030} = Pneumonia_{2020} + \mathrm{dn}$$

where $Pneumonia_{2030}$ is the project values, $n$ is the time interval and d is the annual rate of decline.

### *Cost of Inaction estimation procedure:*

The cost of inaction by definition is a direct and indirect financial cost caused due to non-acting on a problem. In this case, it is the cost of non-avoidance of Pneumonia infections and related mortality. The direct cause will be expenses in the treatment of the disease. Patra, Arokiasamy and Goli (2015) have reported the average cost of treatment of Pneumonia infection to be around Rs. 486 rupees after adjusting for today's inflation rate. Similarly, it also involves indirect costs. For instance, assuming that a majority of the couples who lost under-five children due to Pneumonia will tend to replace them by going for another child, and this leads to additional maternal and child health expenses for the country. After adjusting for today's inflation, the average maternity cost estimates by Goli et al. (2016) is Rs. 18720. Also, another important indirect cost is the wage of the caregiver of a sick child. After adjusting today's inflation, the average wage loss reported for India is 397 rupees per day (Labour Bureau, Government of India, 2019-20), while average no. of days of care required for each Pneumonia infection is 5 days. Thus, the cost of inaction on Pneumonia comprises direct and indirect cost.

Cost of Inaction =(Per capita treatment*No. of Pneumonia cases)+
(Per capita maternity cost * no. of Pneumonia deaths) +
(Wage loss* [no. of Pneumonia cases* no. days of caregiving required for a Pneumonia infection])

## Limitations

In the absence of direct information on Pneumonia, this study considered ARI symptoms with short, rapid breathing which were chest-related and/or difficult breathing which was chest-related as the nearest proxy to Pneumonia. Also, for estimating incidence of Pneumonia (episodes per child-year), we used Rudan et al (2004) incidence rates for developing countries: 0.28 episodes per child-year. The value of developing countries may not accurately represent the Indian context.

# KEY RESULTS & FINDINGS

## National and Sub-national Trends and Patterns of Pneumonia

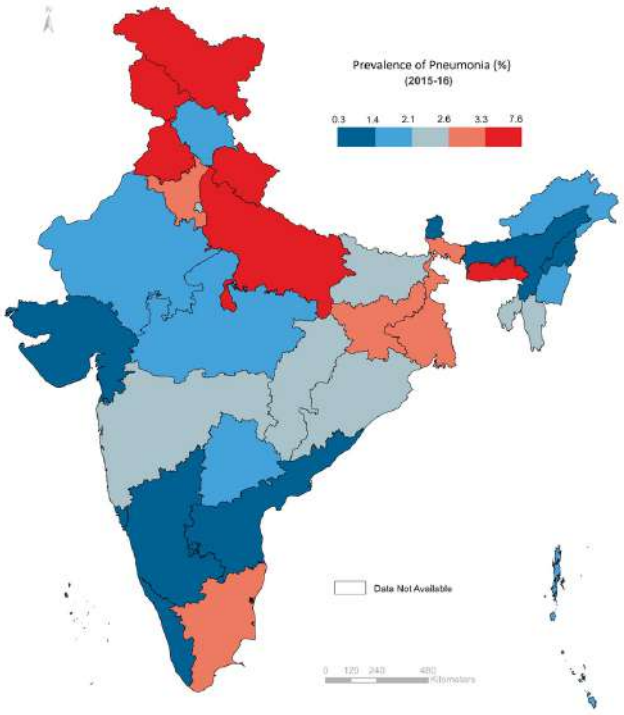
***Prevalence of Childhood Pneumonia:***

At the national level, the prevalence of Pneumonia remains constant during the period 2015 to 2020. ***The average prevalence of Pneumonia in India was 2.7% in 2015-16, which marginally increased to 2.8% in 2019-2***1. The lack of progress in the efforts to neutralize the Pneumonia possibly be due to: (1) Disruptions in healthcare and vaccinations due to the emergence of COVID-19; (2) Smaller time intervals between the two latest rounds of NFHS. Compared to the 10-year interval between NFHS-3 (2005-06) and NFHS-4 (2015-16), there were only three years interval between NFHS-4 (2015-16) and NFHS-5 (2019-21).

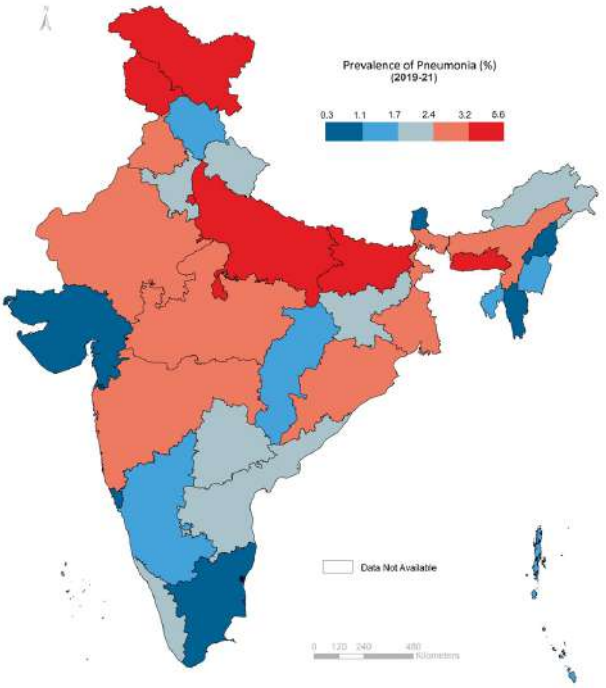
***Prevalence of Pneumonia by states:***

The trends and patterns in Pneumonia prevalence across the states exhibits a heterogeneous pattern (Figure 1). For instance, in the year 2015-16, Pneumonia prevalence ranged from as high as 7.6% in Ladakh to as low as 0.3% in Sikkim. The top five states with a prevalence of Pneumonia above 4.5% in the same year were Ladakh, Meghalaya, Jammu and Kashmir, Uttar Pradesh, and Uttarakhand. However, in the year 2019-21, the regional pattern of the Pneumonia prevalence in the states changed significantly. Delhi (5.6%), the national capital territory of India, becomes the state with the highest prevalence of Pneumonia by replacing Ladakh, while Chandigarh (0.3%) with the lowest Pneumonia prevalence replaces Sikkim.

Figure 1: State-wise prevalence of Pneumonia amongst children below 5 years in India




a) 2015-16



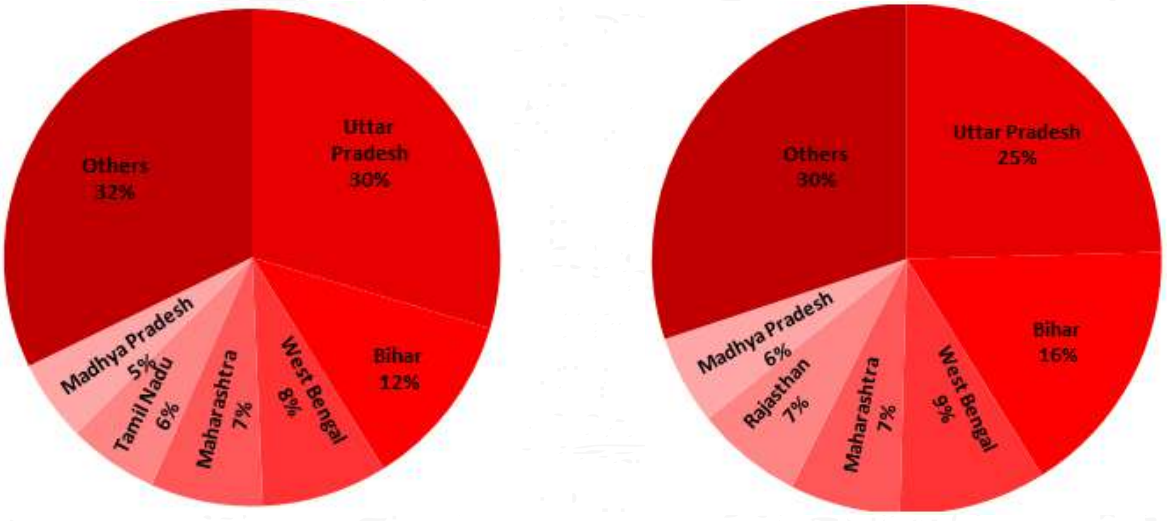

b) 2019-21

There is also a change in the list of the top five states with the highest prevalence of Pneumonia. The current top five lists comprise Delhi (5.6%), Ladakh (5.3%), Puducherry (4.9%), Meghalaya (4.8%), and Jammu and Kashmir (3.8%). Besides these states, Pneumonia is also highly prevalent in populous states such as Bihar (3.5%), Uttar Pradesh (3.5%), and Maharashtra (3.2%). The study observes a significant change in the Pneumonia prevalence in some of the better-performing states as well (e.g. Andhra Pradesh and Kerala).

In 2019, five states have a prevalence higher than 3.5%, three-fifths have a prevalence ranging between 1.5% and 3.5%, and the rest lies below 2.5%. ***Henceforth just three states, Uttar Pradesh (24.6%), Bihar (16.6%), and Maharashtra (9.3%) have the highest burden in absolute numbers—accounting for above 50% of the total proportionate share of children suffering from Pneumonia.*** Along with West Bengal (7.0%), Rajasthan (6.8%), and Madhya Pradesh (5.6%), the proportion share reaches 70%. In simple terms, just six out of thirty-six states have seven out of ten children suffering from Pneumonia (Figure 2).

Despite having the maximum decrement in terms of percentage contribution of children suffering from Pneumonia, Uttar Pradesh still contributes to one-quarter of them. Contrastingly in 2019-21, Tamil Nadu, with the second highest decrement, shifted down by three folds in terms of its position in the proportionate share of children with Pneumonia. The sudden rise and fall in the prevalence of Pneumonia in Delhi and Tamil Nadu may plausibly be due to the disruptions in terms of vaccinations or reporting errors caused by COVID-19. As COVID-19 and Pneumonia have similar symptoms, this may have also confused the reporting of the disease.

Figure 2. Top six states with the highest share of children with Pneumonia in India.



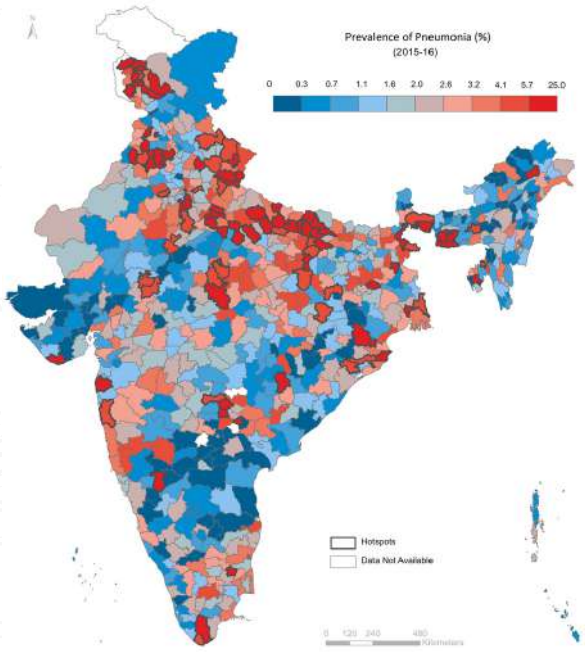

a) 2015-16 b) 2019-21

***Prevalence of Pneumonia by districts:***

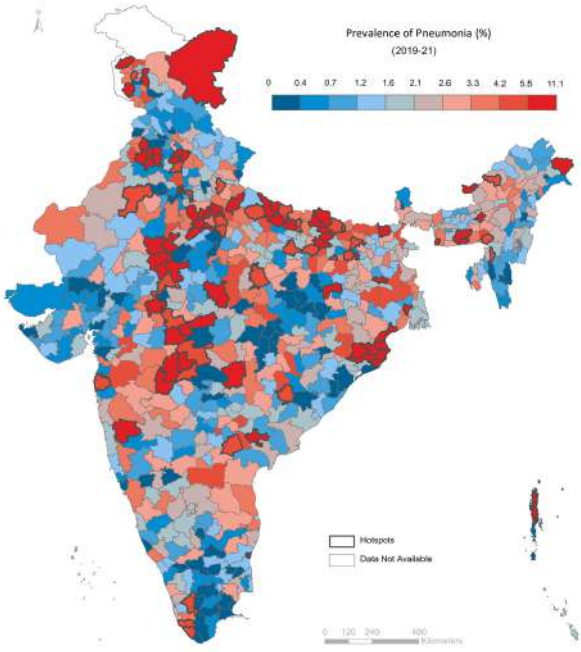
The district is a crucial policy execution unit in the administrative set-up of India. The study maps Pneumonia prevalence at the district level not only to understand intra-state heterogeneity but also to identify the "hotspots" of the Pneumonia problem in India. A majority of the districts with a higher prevalence of Pneumonia is in North India. During 2015-16 and 2019-21, the North-Indian pattern has not changed much apart from a marginal increase in the prevalence in some districts. Himachal Pradesh and Ladakh, however, violate the aforesaid statement by exhibiting a tremendous transformation at the district level. In the case of Ladakh, the prevalence of Pneumonia increased almost by three folds in 2019-21 compared to what it was in 2015-16.

Conversely, in Himachal Pradesh, it is reduced to below 1.6% in most districts which were above 3.2% in 2015-16. Compared to 2015-16, several districts of South India and Northeast India has a higher prevalence of Pneumonia among children under-five in 2019-21. For instance, the prevalence in most districts of Karnataka and Andhra Pradesh was above 2.6% in 2019-21 compared to below 0.7 % in 2015-16. Also, the study observes an emergence of new "hotspots" in the states of Odisha, Maharashtra, Madhya Pradesh, and Andaman and Nicobar Islands in 2019-21 (Figure 3).

Figure 3. District-wise prevalence of Pneumonia amongst the children below 5 years in India




a) 2015-16




b) 2019-21

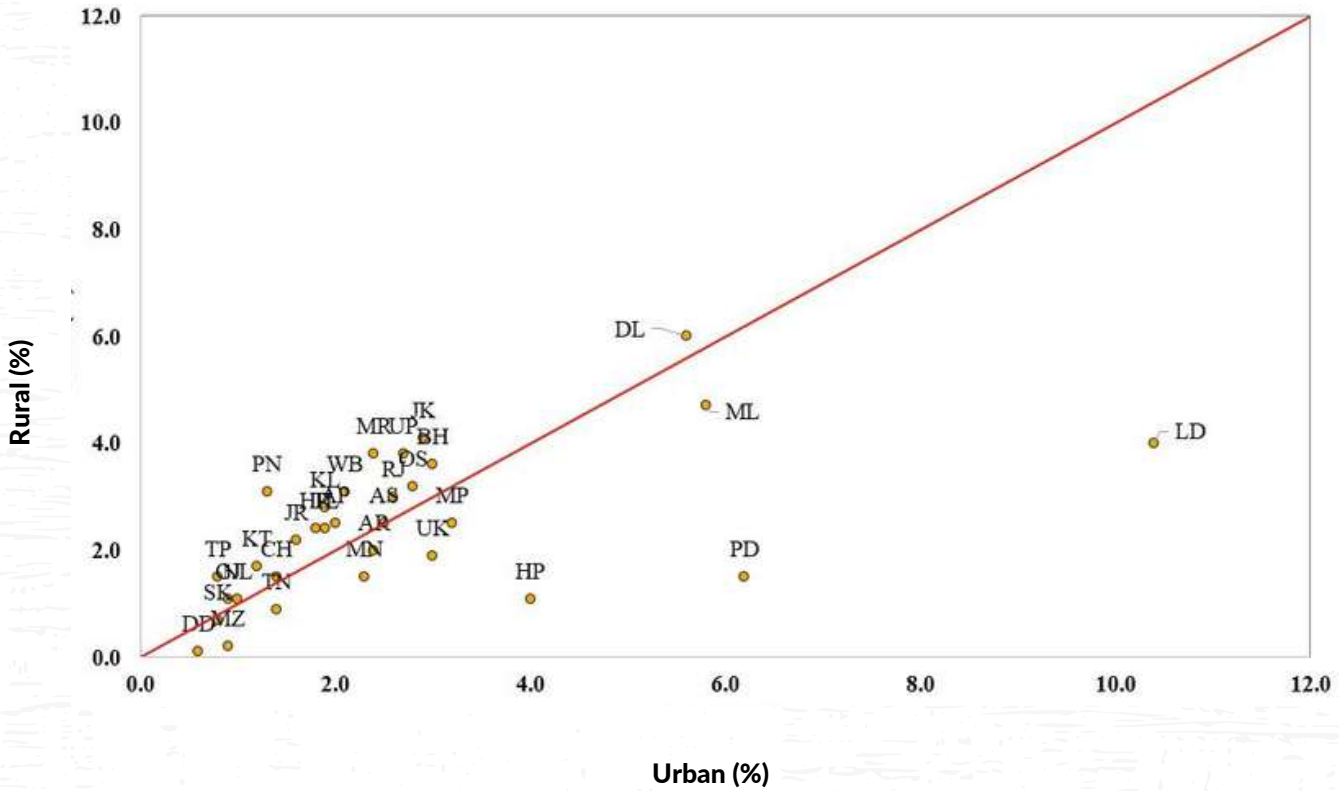
## Rural-Urban Trends and Patterns in Pneumonia

Considering the variation in risk factors such as the levels of development, access to healthcare facilities, treatment-seeking behaviour, sanitation practices, and family structure, prevalence varies in urban and rural areas (Chakraborty et al., 2020). As shown in Figure 4, the prevalence is higher in rural areas than in urban areas. In 2019-21, the prevalence of Pneumonia in urban areas is 2.3%, while it stands at 3.0% in rural areas.

Rural-Urban differences in Pneumonia prevalence significantly vary across the states. As shown in Figure 4(b), rural-urban differentials in the prevalence of Pneumonia among children under five across the states and union territories have been measured under two aspects: first, the rural-urban skewness in the prevalence of Pneumonia across the states; second, the distance (rural-urban gap) from the line of (rural-urban) equity for all the states or union territories.

Figure 4. Prevalence of Pneumonia by the place of residence

(a)

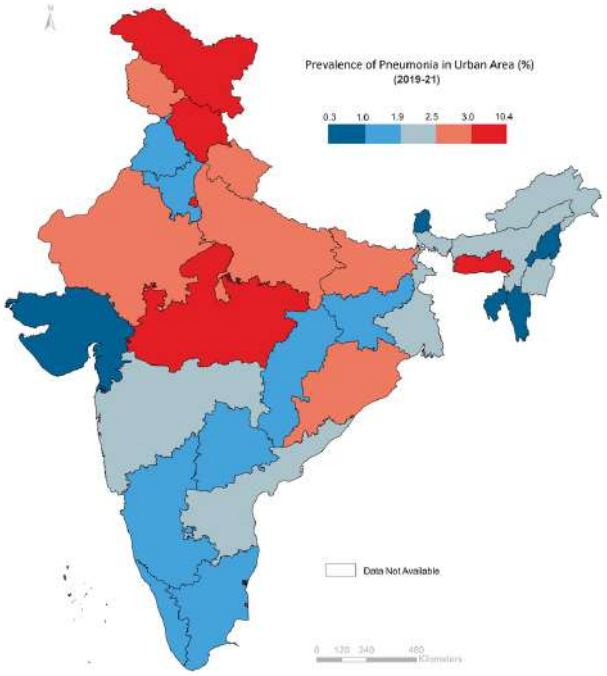


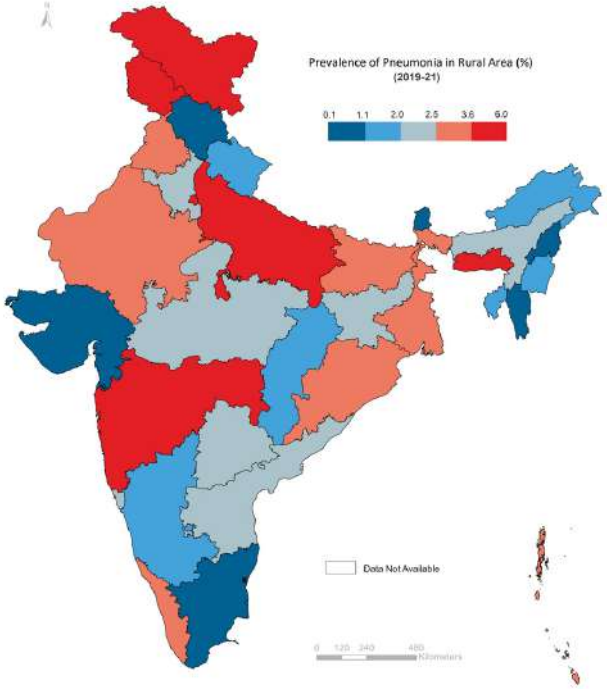
In 2019-21, Jammu and Kashmir, Ladakh, Delhi, Uttar Pradesh, Karnataka, and Meghalaya are the six states with a prevalence above 3.6% in rural areas. Whereas, Ladakh, Meghalaya, Delhi, Madhya Pradesh, and Punjab are the states with a prevalence higher than 3% in urban areas. The rural-urban gap is not uniform across the states. It is much more significant in states such as Himachal Pradesh, Puducherry, and Ladakh, where urban areas show a higher prevalence of Pneumonia.

Punjab, Maharashtra, Jammu and Kashmir, Uttar Pradesh, and Kerala also show a substantial rural-urban gap in Pneumonia prevalence, but with a greater prevalence in rural areas.

Overall, one-third of the states have a higher prevalence in urban areas while for other states, the prevalence is higher in rural areas in 2019-21.

(b)



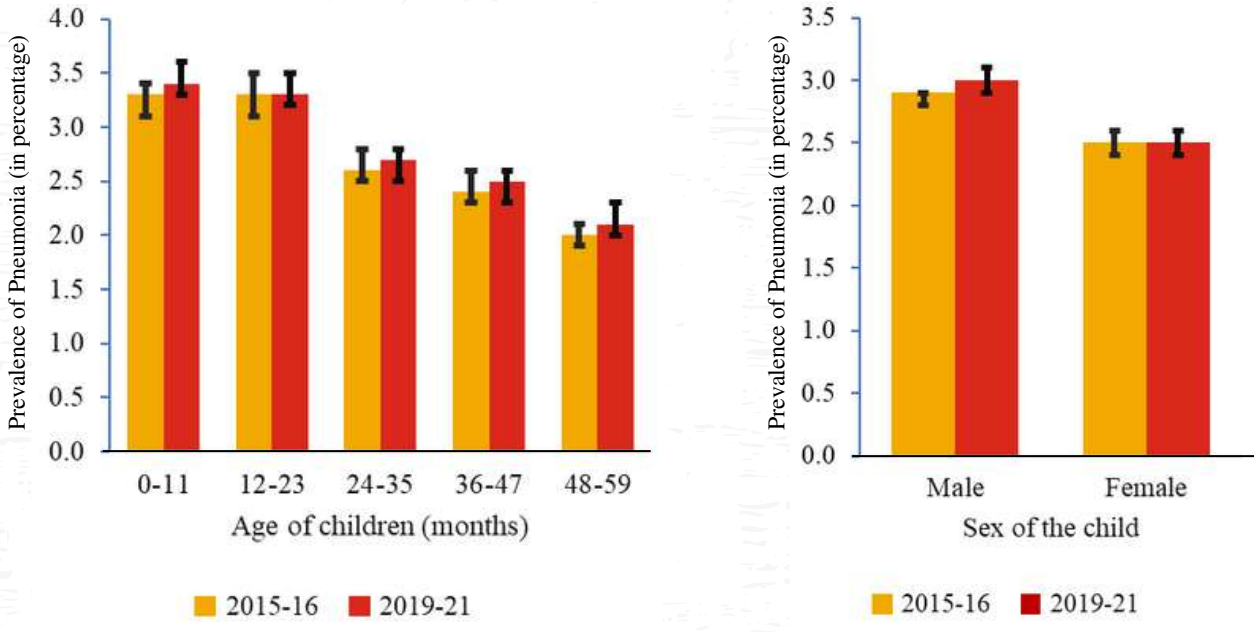
## Socio-economic Trends and Patterns of Pneumonia

In this section, the study presents socio-demographic trends and patterns in Childhood Pneumonia prevalence. Social variations in health and healthcare are key barriers to India's laggardness in meeting the targets set in Sustainable Development Goal-3. The study exhibits Pneumonia prevalence by five key socio-demographic characteristics: age, sex, caste, religion, and wealth quintile.

Pneumonia prevalence by age suggests a significant variation on the age scale. It is generally the highest among infants below one year and subsequently declines as one moves upward on the age scale. Even though the change in Pneumonia prevalence during 2015-16 to 2019-21 is insignificant, it has shown a marginal increase in all age groups except for children aged 12-23 months. A high prevalence of Pneumonia among infants under two years is plausibly due to their weaker immunity and greater susceptibility to risk factors.

Sex differentials in Pneumonia show a higher prevalence among males than females for both periods. Among males, the study observes a slight increase in Pneumonia in 2019-21 (3.0%) compared to 2015-16 (2.9%). However, it has remained constant for females at 2.5% for both the periods, 2015-16 and 2019-21.

Figure 5: Prevalence of Pneumonia amongst the children below 5 years in the year 2015-16 and 2019-21 in India by their age and sex

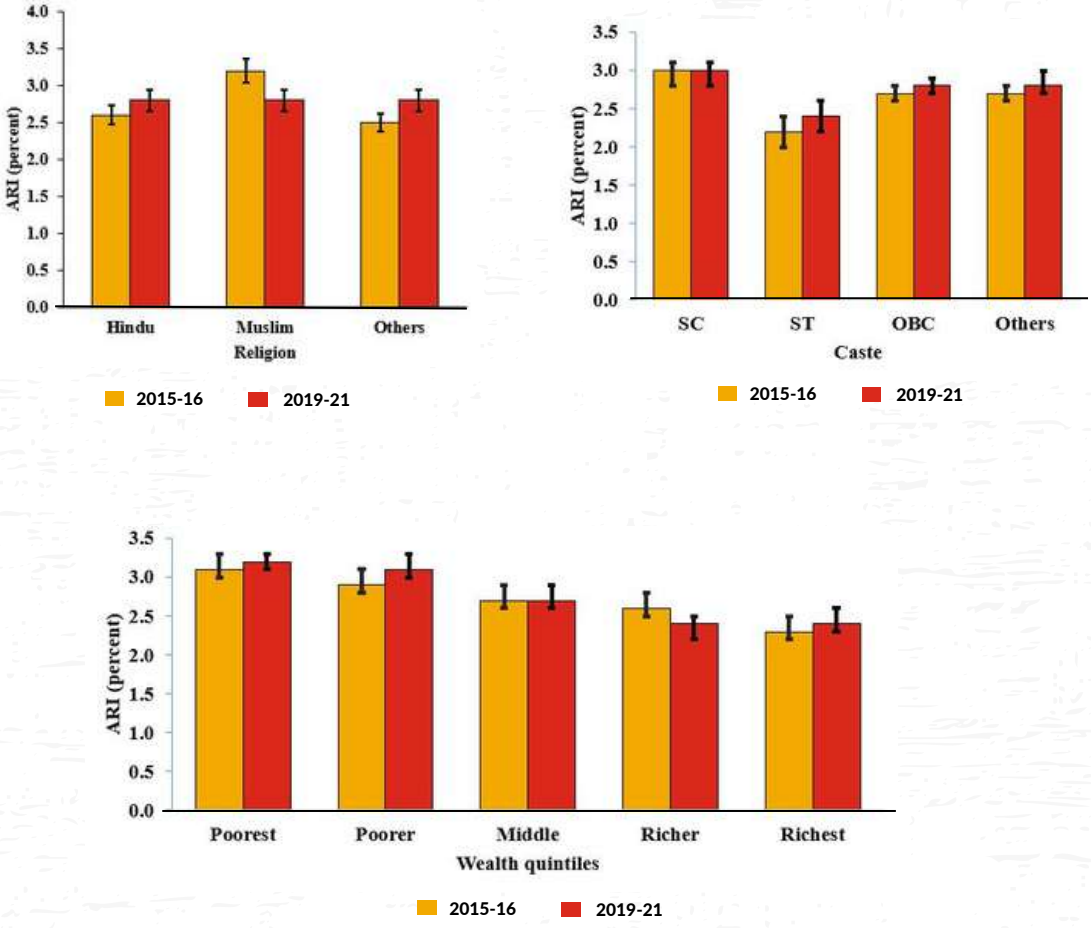



(a) Age

(b) Sex

Given the social order of the population in India, the study presents Pneumonia prevalence among socio-religious groups. Religion-wise variations in Pneumonia prevalence, as shown in Figure 6, demonstrate that Muslims have the highest prevalence of Pneumonia among all religious groups in 2015-16. However, in 2019-21, Pneumonia prevalence is exactly the same across all religious groups in India.

Figure 6: Prevalence of Pneumonia amongst children below 5 years in the year 2015-16 and 2019-21 in India by their socio-economic characteristics



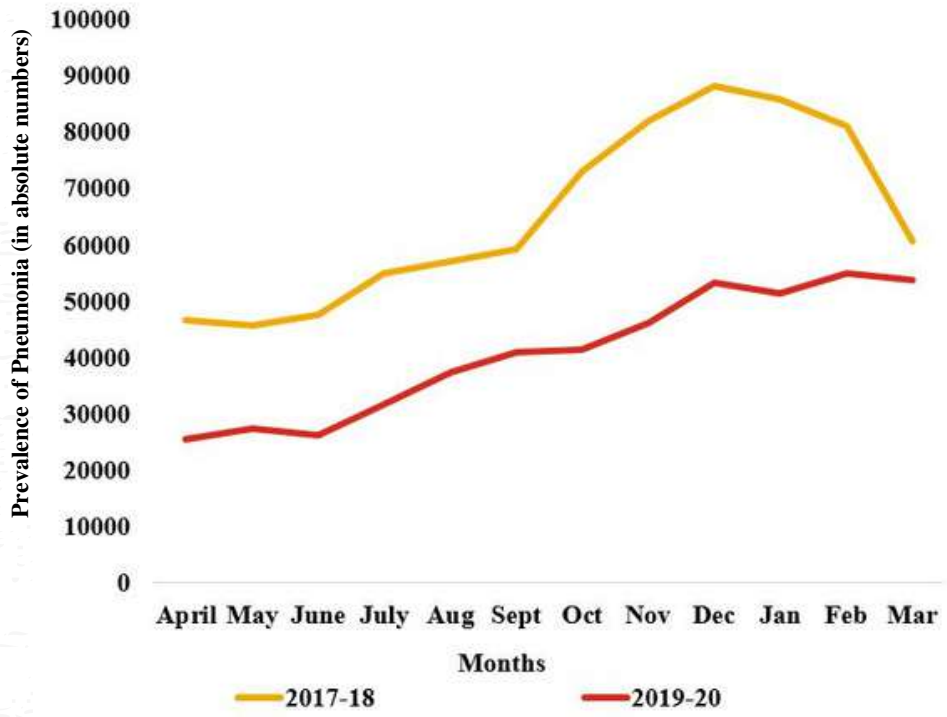

Among social groups, Scheduled Castes (SCs) have the highest prevalence, and Scheduled Tribes (STs) have the lowest prevalence of Pneumonia in 2015-16 and 2019-21.

Wealth status is the key predictor of child health status and the same can be noticed in Figure 6. The prevalence of Pneumonia declines steeply with the improved wealth status of the household. For 2019-21, the prevalence of Pneumonia ranges from 3.1% among the poorest to 2.2% among the richest. It is also noted that the prevalence among the poor wealth quintile substantially increased during 2015-16 and 2019-21.

## Seasonal Variations in Pneumonia

As shown in Figure 7, seasonal variations in Pneumonia indicate that Pneumonia is more prevalent during winter than in summer. Further, with the onset of monsoons, pneumonia cases start advancing steeply. After reaching its peak in the mid-winter, Pneumonia starts declining gradually with fading of winter and reaches its lowest during early summer. Compared to 2017-18, the increase in pneumonia cases is steeper from September to December, which continued during January and February but thereafter experienced a sharp fall for the year 2019-20.

Figure 7: Seasonal Variations in the prevalence of Pneumonia in India




Source: HMIS (2017-18) and HMIS (2019-20)

Note: Pneumonia cases reported in the HMIS are facility-based registration, thus they are on lower side compared to community-based reporting observed in surveys like NFHS.

## Key Risk Factors of Pneumonia

Identifying key risk factors and their contribution to Pneumonia prevalence among under-five children is critical for successfully neutralizing Pneumonia including Pneumonia cases. 13 risk factors considered for the model together explain 71% of the variation in Pneumonia prevalence across the states in India. Risk factor-specific relative contribution suggests that ***child malnutrition with nearly 35% contribution is the leading risk factor for Pneumonia***, followed by Vitamin A supplementation in the last 6 months (10%), pre-lacteal feeding (8%), and public healthcare access (5%). Although public health care is a protective factor, but its initiation is also an indicator of sickness and vulnerable condition of the children (Table 1). More research is required to understand the association between Vitamin A supplementation and prevalence of pneumonia. However, a preliminary examination of its socioeconomic distribution suggests that it is more among vulnerable groups, thus leading to its positive contribution to childhood mortality.

Additionally, poor economic status (7.5%), mother and father's no education together (8.96%) also contributes significantly to the occurrence of Pneumonia (Table 1).

Handwashing with soap and water, clean fuel, availability of mother's MCP card, and exclusive breastfeeding contribute negatively to Pneumonia prevalence; this implies that improvement in these variables will lead to a reduction in the Pneumonia prevalence.

Table 1. Relative contribution of the risk factors of Pneumonia among under-five children in India.

| Risk factors | Relative percentage Contribution |
|---|---|
| Mothers not educated | 7.54 |
| Father's not educated | 1.42 |
| Poor | 7.58 |
| Exclusive breastfeeding | -0.45 |
| Pre-lacteal feeding | 8.21 |
| Public healthcare access | 4.49 |
| Mother's MCP card availability | -1.5 |
| Utilisation of ICDS Services | 0.78 |
| Clean fuel | -0.99 |
| Vitamin A supplementation in last 6 months | 10.28 |
| Child malnourishment | 36.47 |
| Child anaemia | 0.03 |
| Handwashing | -2.53 |
| Unexplained component | 28.65 |
| **Total** | **100.00** |

## COVID-19 and Pneumonia

The repercussions of COVID-19 are well known, and the sudden lockdown obstructed things midway. To understand the impact of COVID -19 on childhood pneumonia, a comparative study has been done at the national level for thirteen states where the survey was conducted during pre-COVID and post-COVID periods. The results in figure 8 suggest that the prevalence of Pneumonia in the pre-COVID era (3.3%) is approximately twice that of the post-COVID era (1.6%). However, the sudden dip in Pneumonia prevalence in 2019-21 might be ambiguous as COVID-19 disrupted the Indian healthcare system greatly. Many hospitals failed to provide essential healthcare services for diseases other than COVID. Also, the stigma attached to allopathic medication among the Indians refrained them from seeking health treatment from primary health centres. Instead, they preferred seeking treatment at home. This might have resulted in non-reporting or further misreporting of cases as 'COVID' out of their symptomatic similarities. Additionally, an increase in treatment-seeking behaviour, better sanitation practices, and less exposure to outside pollution might be other plausible causes for the decline in the cases (Figure 8).

Figure 8. Prevalence of Pneumonia in pre-COVID-19 and post-COVID-19 era

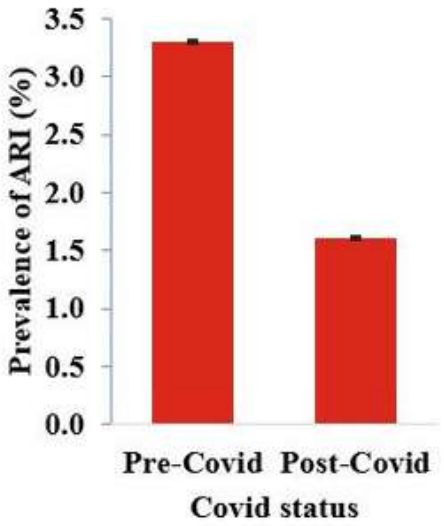
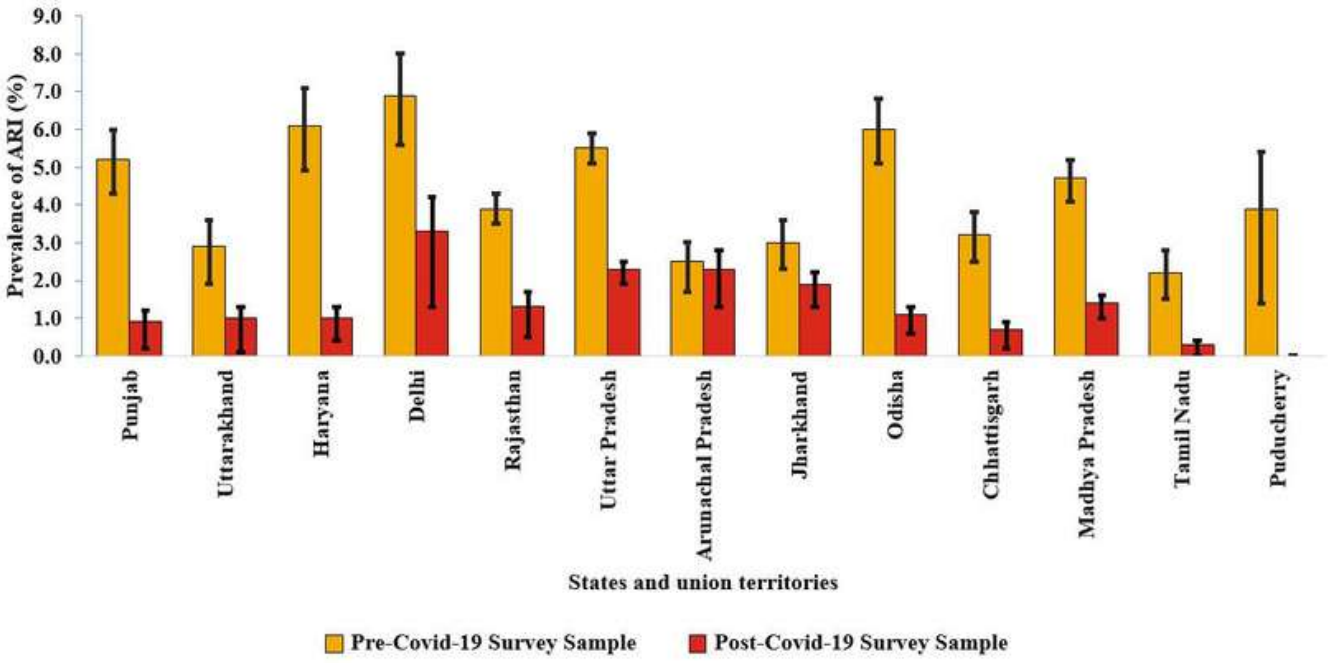



Figure 9 depicts the regional variation in the prevalence of Pneumonia in pre- and post-COVID times. The highest prevalence of Pneumonia pre-COVID is noticed in the north Indian states, with Delhi leading at 6.9%, followed by Haryana at 6.1%. Uttar Pradesh and Punjab also have a prevalence above 5% (5.5% and 5.2% respectively). This could be because of the burning of agricultural crops by farmers in the nearby fields generating ambient particulate-matter (PM2.5) pollution, severely affecting the north Indian states, especially Delhi, Haryana, and Punjab (Chakrabarti et al., 2020). Some of it could also be attributed to the indoor air pollution generated by the burning of solid fuels, in states such as Uttar Pradesh.

Odisha is the only outlier in the top 5 states with a prevalence of 6% pre-COVID which could be associated with the tropical weather in the state that make children vulnerable to infections. Smoking habits of the parents could be a factor too. The state, however, registers a fall in the prevalence (1.1%) post-COVID which could be the result of the proactive campaigns by the government such as Social Awareness and Action to Neutralise Pneumonia Successfully (SAANS) to alleviate the predominance of childhood pneumonia, which included not only the treatment drives but also counselling regarding the prevention and control of the childhood pneumonia (Government of Odisha, 2020). Similarly, for Puducherry, which almost registers negligible prevalence post-COVID, the launch of pneumococcal conjugate vaccine (PCV) under the National Immunization Programme to reduce cases of Pneumonia among under-5 children could be a major factor for the positive performance.

Overall, the prevalence of Pneumonia could be seen falling in all the regions. If the fall is indeed not due to under-reporting or misreporting as highlighted in the explanation for figure 1, this could be accredited to the early effects of India's national immunization coverage against pneumococcal Pneumonia which stood at 15% in 2019. India also has been successful in surpassing the global targets of exclusive breastfeeding (58% exclusive breastfeeding rate) which helps build immunity in a child against infections.

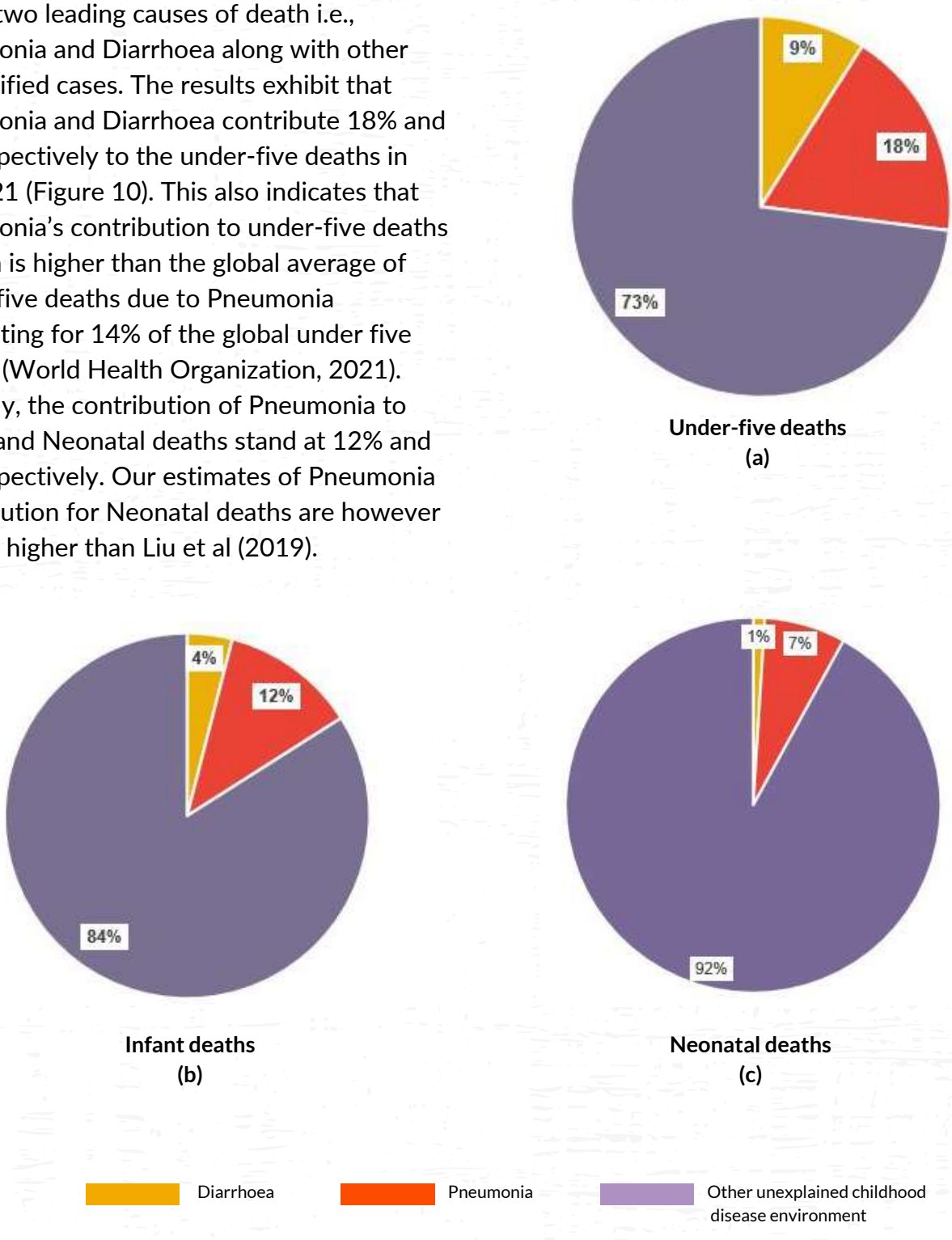
Figure 9. Regional Variation in the Prevalence of Pneumonia during the pre-COVID-19 and post-COVID-19 era



## Pneumonia attributable under-five deaths

Using decomposition analyses, the study estimates the relative proportional contribution of the two leading causes of death i.e., Pneumonia and Diarrhoea along with other unspecified cases. The results exhibit that Pneumonia and Diarrhoea contribute 18% and 9% respectively to the under-five deaths in 2019-21 (Figure 10). This also indicates that Pneumonia's contribution to under-five deaths in India is higher than the global average of under-five deaths due to Pneumonia accounting for 14% of the global under five deaths (World Health Organization, 2021). Similarly, the contribution of Pneumonia to Infant and Neonatal deaths stand at 12% and 7% respectively. Our estimates of Pneumonia contribution for Neonatal deaths are however slightly higher than Liu et al (2019).

Figure 10: Pneumonia attributable under-five, infant and neo-natal deaths in India



## Projection of Pneumonia Cases

The study used a mathematical model for estimating and projecting the absolute number of Pneumonia cases in India. The estimated number of Pneumonia cases in India is 3.3 million, which is projected to decline to 2.2 million by 2030. Similarly, the projected Pneumonia prevalence suggests that at the current rate of annual decline, it can reach to 2.39% by 2025 and 2.14% by 2030 (Table 2).

The study estimates Pneumonia attributable under-five mortality rate to be around 5.48 deaths per 1000 live births in 2020 which is projected to reduce to 4.75 per 1000 live births by 2030. Thus, in order to achieve the GAPPD target of less than 3 deaths per 1000 live births, the country needs to pace up at a 5% annual rate of decline with the current annual decline of 1.32% in Pneumonia attributable under-five mortality rate (Table 2).

Table 2: Projected population of Pneumonia cases and the prevalence rate, 2015-2030

| Year | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| **Total number of Pneumonia cases in India** | 3,291,701 | 2,976,917 | 2,600,000 | 2,200,000 |
| **Total population of children under 5 years of age.** | 118,910,000 | 114,273,000 | 108,710,000 | 102,483,000 |
| **Rate of prevalence** | 2.76 | 2.60 | 2.39 | 2.14 |

## India's Contribution to Global Burden of Pneumonia

Global targets of reducing under-five mortality rate and also neutralizing Pneumonia highly depend on the countries that contribute in bulk to the global burden of Pneumonia. Previous studies have shown that India contributes to the second largest number of Pneumonia cases to the world, next only to Nigeria. Thus, in this study, we have estimated the proportional contribution of India as 26% to the global burden of Pneumonia for the latest period, 2019-21 (Table 3).

Table 3: Global burden estimation of pneumonia cases in India, 2019-21

| Specification | Absolute number of cases | Source |
|---|---|---|
| Population of under five children in the world | 822 million | UN World Population Prospects (2022) |
| Number of pneumonia cases in the world | 11.5 million | Total Pneumonia cases has been estimated at the rate of 1400 cases per 100,000 children (World Health Organization, 2021) |
| Number of episodes of pneumonia cases in the world | 138 million | Directly adopted from McAllister et al. (2019), The Lancet paper |
| Under-five population of India, 2021 | 107.8 million | UN World Population Prospects (2022) |
| No. of pneumonia cases in India | 2.9 million | Estimated based on NFHS prevalence rates of 2019-21 and Under-five population of India, 2021. |
| Number of episodes of pneumonia cases in India | 30 million | Derived by applying the developing country standard value of 0.28 episodes of Pneumonia per child-year. |
| India's contribution to global pneumonia burden | 26% | (Number of pneumonia cases in the world/ No. of pneumonia cases in India) *100 |

## Spotlight on Pneumococcal Conjugate Vaccine (PCV)

Worldwide, 57% of pneumonia deaths in children occur in countries where PCV coverage is below 60%, with children in lower-income countries bearing the greatest burden. It is, therefore, critical for the countries to increase the access and coverage of PCV in order to save millions of lives.

It had been introduced in the Universal Immunization Programme in a phased manner from May 2017 onwards in selected districts of Bihar, Himachal Pradesh and Uttar Pradesh. However, on October 29, 2021 Ministry of Health and Family Welfare (MoHFW), Government of India launched Nationwide Pneumococcal Conjugate Vaccine programme with an expectation of reduction in childhood mortality by nearly 60%.

# CONCLUSION AND RECOMMENDATIONS

Childhood pneumonia is one of the gravest infections among under-five children, specifically in India which has the second highest burden of childhood pneumonia deaths in the world. During period of 2019-21, India contributed 26% of the total Pneumonia cases in the world, whereas, in 2019 alone, the disease caused 77,000 under-five deaths in the country. Acknowledging the urgent need to control the damage and save children from this preventable disease, the Ministry of Health and Family Welfare (MoHFW) of the Government of India launched the Nationwide Pneumococcal Conjugate Vaccine (PCV) programme in 2021. The aim has been to curtail child mortality caused by Pneumonia by at least 60% i.e., less than 3 deaths due to childhood pneumonia per 1000 live births.

The need is to address the associated risk factors, particularly related to nutrition, Vitamin A supplements, breastfeeding, good healthcare, clean fuel, and awareness about cleanliness. Besides, eradication of poverty and ensuring parental education are some other distal risk factors that can neutralize the incidences of Pneumonia. While there is an understanding regarding the intricacies of the trends, risk factors, and interventions required to tackle the infections, the paucity of extensive national-level evidence impedes the designing of effective policies to eliminate Pneumonia.

This study was conducted to fill this gap by analyzing unit-level data of NFHS (2019-21) to understand the prevalence of Pneumonia in children and its relationship to key risk factors. It also carried out data comparisons of estimates with the previous round of NFHS (2015-16), as deemed necessary, using analytical models to estimate the current national level Pneumonia burden as well as forecast it till 2030. The study ultimately puts forth policy recommendations to be utilized to neutralize Pneumonia.

## Hot Spots

Overall, the national average prevalence of Pneumonia changed slightly, from 2.7% in 2015-16 to 2.8% in 2019-21, however, the state-level trends showed significant changes, mostly due to the disruption caused by the pandemic. In 2015-16, the top five states with the highest prevalence of Pneumonia were Ladakh, Meghalaya, Jammu and Kashmir, Uttar Pradesh, and Uttarakhand (all above 4.5%), whereas in the year 2019-21, the top five were Delhi (5.6%), Ladakh (5.3%), Puducherry (4.9 %), Meghalaya (4.8%), and Jammu and Kashmir (3.8%). The state with the lowest prevalence changed from Sikkim to Chandigarh in the two aforementioned periods.

The district-level analysis highlights North India as a ‘hotspot’. The trend does not change significantly during the two periods, apart from a marginal increase in the prevalence in some districts.

The study also observes a higher prevalence of Pneumonia among children under-five in several districts of South India and Northeast India in 2019-21 compared to 2015-16. Besides, it notes the emergence of new 'hotspots' in Andhra Pradesh, Karnataka, Madhya Pradesh, and Maharashtra in 2019-21.

## Key Concerns

The study outlines 13 key risk factors and highlights their association with pneumonia prevalence among under-five children to help formulate effective policy suggestions. Among the risk factors, child malnutrition is a leading factor with a contribution of 35% of the prevalence. Poor economic status (7.5%) and lack of parental education (8.96%) together contribute significantly to the prevalence as well. Contrastingly, handwashing with soap and water, clean fuel, mothers having an MCP card, and exclusive breastfeeding contribute negatively to the Pneumonia prevalence.

The study also estimates the impact of COVID-19 on the prevalence of Pneumonia. The results suggest that the prevalence of Pneumonia in the pre-COVID era (3.3%) was almost twice that of in the post-COVID era (1.6%). However, there is no clear evidence to reason for the sudden dip and the causes could be ambiguous such as COVID-19 disrupting the Indian healthcare system leading to a lack of treatment for diseases other than COVID-19, or awareness among people to seek treatment in hospitals, misidentifying Pneumonia as COVID due to similar symptoms thus leading to under-reporting of the cases.

In 2020, Pneumonia attributable under-five mortality rate is evaluated to be around 5.48 deaths per 1000 live births. However, with the current annual decline of 1.3%, India needs to attain a 5% annual rate of decline in order to achieve the GAPPD target. If policies are designed and introduced timely and effectively, the estimated number of Pneumonia cases in India is projected to decline from 3.3 million currently to 2.2 million by 2030 as well as the projected Pneumonia prevalence is expected to decline to 2.39% by 2025 and 2.14% by 2030.

## Cost of Inaction

Along with the loss of innocent lives, Pneumonia involves economic costs as well. This study thus estimates both direct and indirect economic losses due to Pneumonia infection and deaths. Direct costs involve the expenditure on the treatment and wage loss of the caregivers while, indirect costs involve replacement costs of children who died that also involves maternal and health care costs. The annual inflation-adjusted estimated cost of inaction on Pneumonia is 1631.5 crores for 2021. It is certainly having a huge implication as India certainly can't afford to lose 1631.5 crores annually just from a single disease i.e., Pneumonia.

## Policy Recommendations

- Considering the current level of Pneumonia attributable under-five mortality rate at 5.48 deaths per 1000 live births, the country needs to progress at a pace of 5% annual rate of decline in order to achieve the IAPPD target. However, the current rate of decline is just 1.3% per annum. Alongside PCV expansion, the country needs to strengthen its health system to prevent Pneumonia attributable mortality.

- Aspirational districts provide a unique opportunity to ensure and monitor convergent actions through the deployment of higher order resources. Pneumonia related services should be integrated in the existing convergent efforts and should be implemented in all districts.

- As the prevalence is highly skewed towards the initial two years, strengthening neonatal and infant healthcare would play a critical role in the elimination of Pneumonia related deaths as well as in achieving the IAPPD target.

- Malnutrition alone contributes to 35% of Pneumonia. Vitamin A deficiency and Anaemia, together with Malnutrition, can explain nearly 40% of Pneumonia prevalence in the country. Therefore, the elimination of Malnutrition, vitamin A deficiency and Anaemia is critical for neutralizing Pneumonia in the country.

- Considering that poor economic status and parental illiteracy contribute significantly, the children from these sections need greater attention.

- The provision of clean cooking fuel, sanitation and hygienic facilities can also significantly reduce Pneumonia. Pre-lacteal feeding seems unsuitable for children, especially for their immunity. On the other hand, timely initiation and exclusive breastfeeding help to improve immunity and neutralize Pneumonia prevalence. Thus, strengthening infant and young child feeding (IYCF) programs is necessary.

- The study also suggests for a targeted intervention with PCV Vaccination drive in particular in the identified high-burden districts and states of the country for Pneumonia. The states such as Uttar Pradesh, Bihar, Maharashtra, West Bengal, Rajasthan and Madhya Pradesh contributing 70% of the country's overall Pneumonia cases need to be prioritized in this context. We also recommend for special pneumonia package for high-burden districts and states (including additional resources).

- Rural areas need greater attention not only because of the higher Pneumonia prevalence rates we found in this study but also because they lack basic healthcare facilities, especially ventilators with sufficient oxygen supply, essential medicine and doctors.

- Pneumonia cases peak in the winter seasons. Therefore, the health system must be vigilant and show preparedness for the season, especially as envisaged under SAANS Campaign Strategy in terms of capacity building, strengthening of supplies and awareness generation among communities and health staff.

- The country must enhance the facilities alongside essential maternal and health care through the public health system. Financial provision for the ICDS programme is also crucial for intervening in child malnutrition and disseminating knowledge on breastfeeding and other good practices through awareness programmes.

- Considering the risk factors of Pneumonia, we also recommend convergence and coordination with other Ministries and Departments and formalising commitments to track the progress on Pneumonia related interventions. We recommend strengthening of multi-stakeholder convergence and coordination for better implementation and regular monitoring.

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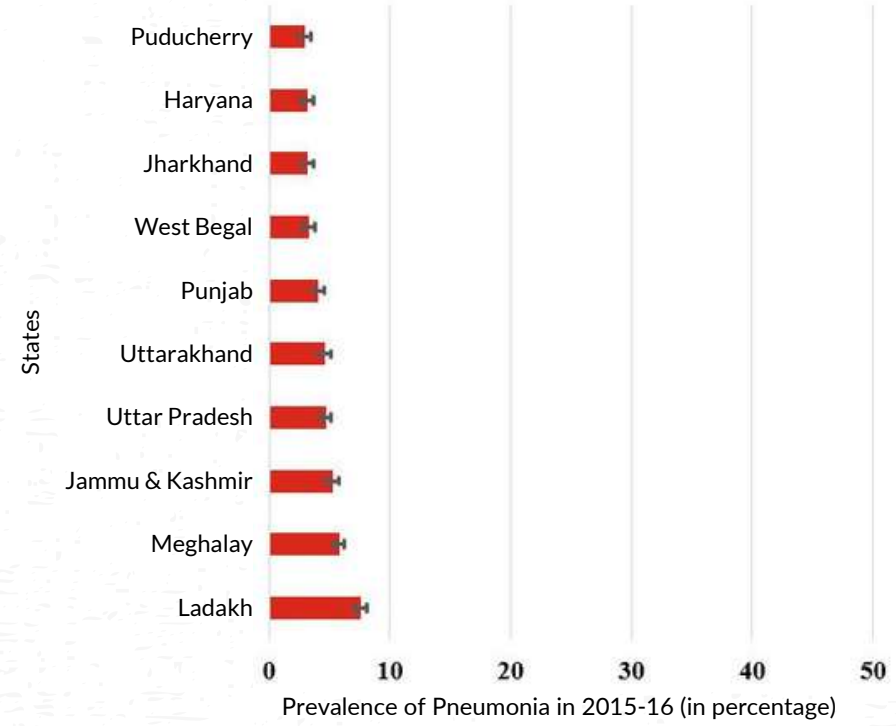
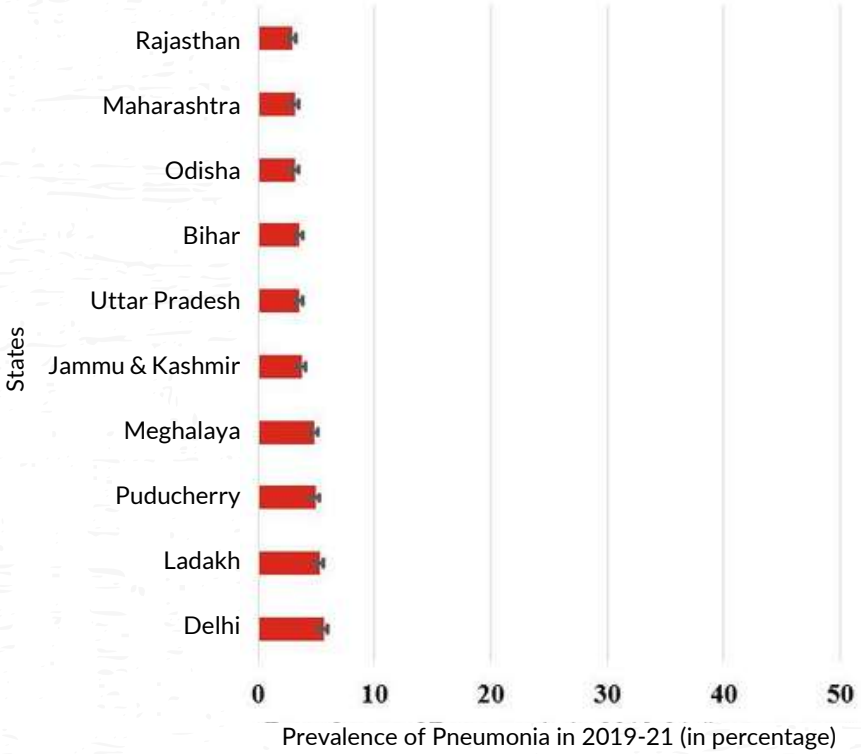
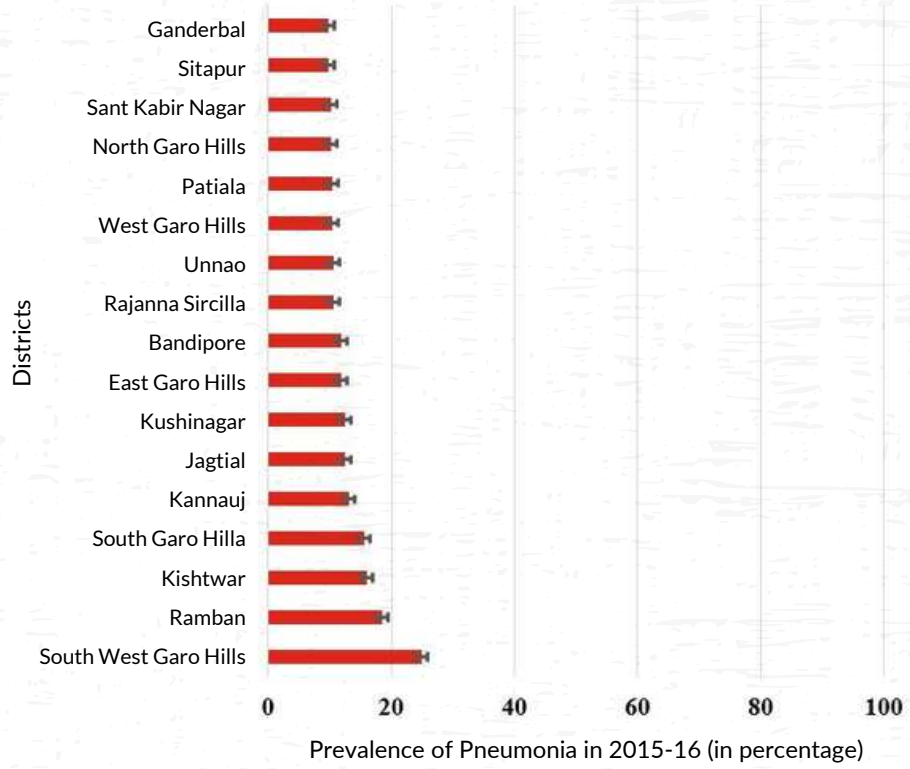
# APPENDIX

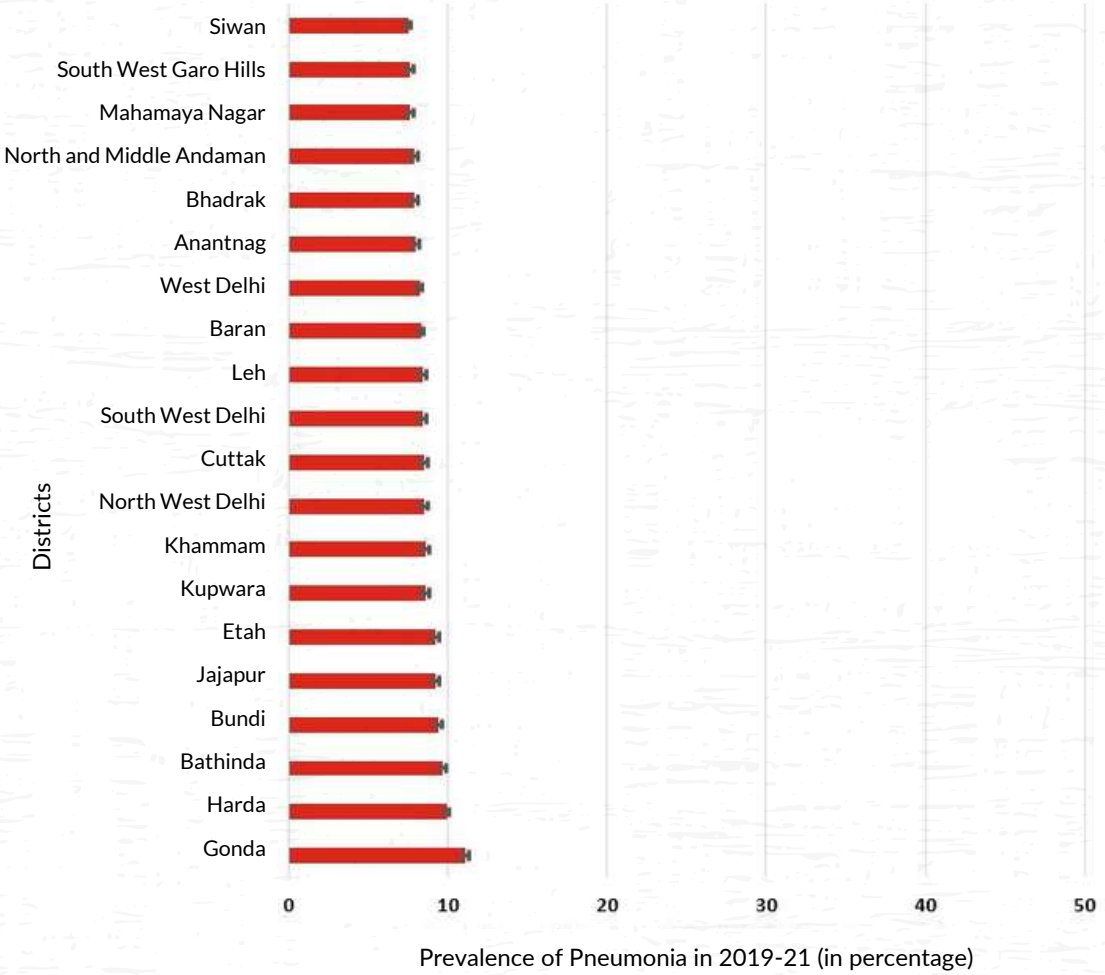
## FIGURE A1: TOP TEN STATES OF PNEUMONIA PREVALENCE IN INDIA



# FIGURE A2: TOP 20 DISTRICTS OF PNEUMONIA PREVALENCE IN INDIA



# TABLE A.1: PREVALENCE OF PNEUMONIA IN MAJOR HOTSPOT DISTRICTS OF INDIA IN 2019-21

| Sr. No | States and Union Territories | Districts with prevalence above 5.5% | Aspirational Districts | Prevalence (%) |
|---|---|---|---|---|
| 1 | Andaman & Nicobar Islands | North & Middle Andaman | No | 7.9 |
| 2 | Arunachal Pradesh | Anjaw | No | 6.9 |
| 3 | Arunachal Pradesh | Tawang | No | 6.8 |
| 4 | Assam | Morigaon | No | 6.1 |
| 5 | Bihar | Siwan | No | 7.5 |
| 6 | Bihar | Pashchim Champaran | No | 6.8 |
| 7 | Bihar | Sheikhpura | Yes | 6.7 |
| 8 | Bihar | Gopalganj | No | 6.0 |
| 9 | Bihar | Araria | Yes | 5.8 |
| 10 | Haryana | Kurukshetra | No | 6.9 |
| 11 | Haryana | Yamunanagar | No | 6.4 |
| 12 | Haryana | Ambala | No | 5.8 |
| 13 | Jammu & Kashmir | Kupwara | Yes | 8.6 |
| 14 | Jammu & Kashmir | Anantnag | No | 8.0 |
| 15 | Jammu & Kashmir | Rajouri | No | 6.0 |
| 16 | Jharkhand | Latehar | Yes | 6.4 |
| 17 | Jharkhand | Jamtara | No | 5.6 |
| 18 | Kerala | Idukki | No | 5.5 |
| 19 | Ladakh | Leh (Ladakh) | No | 8.4 |
| 20 | Madhya Pradesh | Harda | No | 9.9 |
| 21 | Madhya Pradesh | Hoshangabad | No | 7.4 |
| 22 | Madhya Pradesh | Khandwa (East Nimar) | Yes | 7.1 |
| 23 | Madhya Pradesh | Sagar | No | 6.8 |
| 24 | Madhya Pradesh | Ujjain | No | 6.8 |
| 25 | Maharashtra | Chandrapur | No | 7.5 |
| 26 | Maharashtra | Jalna | No | 7.0 |
| 27 | Maharashtra | Akola | No | 6.6 |
| 28 | Maharashtra | Buldana | No | 6.2 |
| 29 | Maharashtra | Satara | No | 6.0 |
| 30 | Meghalaya | South West Garo Hills | No | 7.6 |
| 31 | Meghalaya | West Khasi Hills | No | 6.1 |
| 32 | Meghalaya | South West Khasi Hills | No | 5.5 |
| 33 | NCT of Delhi | North West Delhi | No | 8.5 |
| 34 | NCT of Delhi | South West Delhi | No | 8.4 |
| 35 | NCT of Delhi | West Delhi | No | 8.2 |
| 36 | NCT of Delhi | North Delhi | No | 6.3 |
| 37 | Odisha | Jajapur | No | 9.2 |
| 38 | Odisha | Cuttack | No | 8.5 |
| 39 | Odisha | Bhadrak | No | 7.9 |
| 40 | Odisha | Jagatsinghapur | No | 7.4 |
| 41 | Odisha | Kendrapara | No | 6.2 |
| 42 | Odisha | Dhenkanal | Yes | 6.0 |
| 43 | Odisha | Baleshwar | No | 5.7 |
| 44 | Puducherry | Puducherry | No | 6.3 |
| 45 | Punjab | Bathinda | No | 9.7 |
| 46 | Punjab | Sangrur | No | 7.0 |
| 47 | Punjab | Barnala | No | 6.3 |
| 48 | Punjab | Moga | Yes | 6.1 |
| 49 | Punjab | Mansa | No | 5.9 |
| 50 | Rajasthan | Bundi | No | 9.4 |
| 51 | Rajasthan | Baran | Yes | 8.3 |
| 52 | Rajasthan | Kota | No | 7.0 |
| 53 | Rajasthan | Sawai Madhopur | No | 6.6 |
| 54 | Rajasthan | Dhaulpur/Dholpur | Yes | 6.3 |
| 55 | Rajasthan | Tonk | No | 5.5 |
| 56 | Telangana | Khammam | Yes | 8.6 |
| 57 | Uttar Pradesh | Gonda | No | 11.1 |
| 58 | Uttar Pradesh | Etah | No | 9.2 |
| 59 | Uttar Pradesh | Mahamaya Nagar | No | 7.6 |
| 60 | Uttar Pradesh | Basti | No | 7.5 |
| 61 | Uttar Pradesh | Ballia | No | 7.2 |
| 62 | Uttar Pradesh | Shahjahanpur | No | 6.8 |
| 63 | Uttar Pradesh | Shrawasti | Yes | 6.8 |
| 64 | Uttar Pradesh | Bahraich | Yes | 6.7 |
| 65 | Uttar Pradesh | Mathura | No | 6.1 |
| 66 | Uttar Pradesh | Kanshiram Nagar | No | 6.1 |
| 67 | Uttar Pradesh | Kushinagar | No | 5.7 |
| 68 | Uttar Pradesh | Agra | No | 5.7 |
| 69 | West Bengal | Haora | No | 5.6 |

# TABLE A.2: PROPORTIONAL CONTRIBUTION OF STATES TO ALL INDIA PNEUMONIA PREVALENCE IN INDIA IN 2015-16 AND 2019-21

**Prevalence of Pneumonia (%) in children below five years across the states and union territories of India in 2015-16 and 2019-21.**

| States and Union Territories | 2015-16 | 2019-21 |
|---|---|---|
| Andaman And Nicobar Islands | 0.0 | 0.0 |
| Andhra Pradesh | 0.7 | 2.7 |
| Arunachal Pradesh | 0.1 | 0.1 |
| Assam | 0.9 | 2.3 |
| Bihar | 11.5 | 16.5 |
| Chandigarh | 0.1 | 0.0 |
| Chhattisgarh | 1.9 | 1.2 |
| Dadra & Nagar Haveli & Daman and Diu | 0.0 | 0.0 |
| Delhi | 1.1 | 2.6 |
| Goa | 0.1 | 0.0 |
| Gujarat | 2.3 | 1.5 |
| Haryana | 2.7 | 1.6 |
| Himachal Pradesh | 0.3 | 0.2 |
| Jammu and Kashmir | 1.6 | 1.0 |
| Jharkhand | 3.5 | 2.3 |
| Karnataka | 1.8 | 2.4 |
| Kerala | 0.5 | 1.7 |
| Ladakh | 0.1 | 0.0 |
| Lakshadweep | 0.0 | 0.0 |
| Madhya Pradesh | 5.3 | 5.7 |
| Maharashtra | 7.3 | 9.3 |
| Manipur | 0.1 | 0.1 |
| Meghalaya | 0.7 | 0.7 |
| Mizoram | 0.1 | 0.0 |
| Nagaland | 0.1 | 0.0 |
| Odisha | 2.9 | 3.5 |
| Puducherry | 0.1 | 0.1 |
| Punjab | 2.5 | 1.6 |
| Rajasthan | 4.4 | 6.8 |
| Sikkim | 0.0 | 0.0 |
| Tamil Nadu | 5.9 | 1.9 |
| Telangana | 2.1 | 1.8 |
| Tripura | 0.2 | 0.1 |
| Uttar Pradesh | 29.6 | 24.6 |
| Uttarakhand | 1.4 | 0.6 |
| West Bengal | 8.2 | 7.0 |
| India | 100.0 | 100.0 |

**Note : In 2015-16, the combined estimates were provided for Dadra and Nagar Haveli & Daman and Diu; Separate estimate for Ladakh was done by combining the districts of Ladakh UT.**

# TABLE A.3: PREVALENCE OF PNEUMONIA BY THE PLACE OF RESIDENCE

Prevalence of Pneumonia (%) in children below five years across the states of India in 2019-21 by the place of residence

| States and Union Territories | Urban | Rural | Total |
|---|---|---|---|
| Andaman and Nicobar Islands | - | 3.1 | 1.7 |
| Andhra Pradesh | 2.0 | 2.5 | 2.4 |
| Arunachal Pradesh | 2.4 | 2.0 | 2.1 |
| Assam | 2.5 | 2.5 | 2.5 |
| Bihar | 3.0 | 3.6 | 3.5 |
| Chandigarh | 0.3 | - | 0.3 |
| Chhattisgarh | 1.4 | 1.5 | 1.5 |
| Dadra and Nagar Haveli & Daman and Diu | 0.6 | 0.1 | 0.3 |
| Delhi | 5.6 | 6.0 | 5.6 |
| Goa | - | 2.4 | 0.9 |
| Gujarat | 0.9 | 1.1 | 1.0 |
| Haryana | 1.8 | 2.4 | 2.3 |
| Himachal Pradesh | 4.0 | 1.1 | 1.5 |
| Jammu and Kashmir | 2.9 | 4.1 | 3.8 |
| Jharkhand | 1.6 | 2.2 | 2.1 |
| Karnataka | 1.2 | 1.7 | 1.5 |
| Kerala | 1.9 | 2.8 | 2.4 |
| Ladakh | 10.4 | 4.0 | 5.3 |
| Lakshadweep | 1.9 | - | 1.4 |
| Madhya Pradesh | 3.2 | 2.5 | 2.6 |
| Maharashtra | 2.4 | 3.8 | 3.2 |
| Manipur | 2.3 | 1.5 | 1.7 |
| Meghalaya | 5.8 | 4.7 | 4.8 |
| Mizoram | 0.9 | 0.2 | 0.6 |
| Nagaland | 1.0 | 1.1 | 1.1 |
| Odisha | 2.8 | 3.2 | 3.2 |
| Puducherry | 6.2 | 1.5 | 4.9 |
| Punjab | 1.3 | 3.1 | 2.5 |
| Rajasthan | 2.6 | 3.0 | 2.9 |
| Sikkim | 0.8 | 0.7 | 0.7 |
| Tamil Nadu | 1.4 | 0.9 | 1.1 |
| Telangana | 1.9 | 2.4 | 2.2 |
| Tripura | 0.8 | 1.5 | 1.3 |
| Uttar Pradesh | 2.7 | 3.8 | 3.5 |
| Uttarakhand | 3.0 | 1.9 | 2.3 |
| West Bengal | 2.1 | 3.1 | 2.8 |
| India | 2.3 | 3.0 | 2.8 |

# TABLE A.4: PREVALENCE OF PNEUMONIA WITH BACKGROUND CHARACTERISTICS

**Prevalence of Pneumonia (%) in children below five years in India by their background characteristics in the year 2015-16 and 2019-21.**

| Background characteristics | 2015-16 | 2019-21 |
|---|---|---|
| Age of the children (years) | 3.3 | 3.4 |
| 1 | 3.3 | 3.3 |
| 2 | 2.6 | 2.7 |
| 3 | 2.4 | 2.5 |
| 4 | 2.0 | 2.1 |
| 5 | | |
| Sex of the child | 2.9 | 3.0 |
| Male | 2.5 | 2.5 |
| Female | | |
| Place of residence | 2.3 | 2.3 |
| Urban | 2.9 | 3.0 |
| Rural | | |
| Wealth quintile | 3.1 | 3.2 |
| Poorest | 2.9 | 3.1 |
| Poorer | 2.7 | 2.7 |
| Middle | 2.6 | 2.4 |
| Richer | 2.3 | 2.4 |
| Richest | | |
| Religion | 2.6 | 2.8 |
| Hindu | 3.2 | 2.8 |
| Muslim | 2.5 | 2.8 |
| Others | | |
| Caste | 3.0 | 3.0 |
| SC | 2.2 | 2.4 |
| ST | 2.7 | 2.8 |
| OBC | 2.7 | 2.8 |
| Others | 2.7 | 2.8 |

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