



Original Research Article

Clinical Profile of Severe Pneumonia and Associated Risk Factors in Children Aged 2-59 Months in a Tertiary care Hospital in New Delhi: A Cross sectional Study

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Abstract

Introduction: *In India, hospital admission is recommended when a child is being diagnosed as a case of severe pneumonia according to revised WHO 2013 pneumonia definitions. Hospital care should allow for prompt identification of signs of clinical deterioration and timely intervention and at the same time we can explore associated risk factors if any. Identification of risk factors is also very important for enhancing insight into the aetiology and prevention of pneumonia.*

Objective: *To assess clinical profile of severe pneumonia in children treated in tertiary care hospital in New Delhi by implementation of the revised WHO pneumonia guidelines and associated risk factors in children aged 2 to 59 months*

Materials and Methods: *This was an observational cross-sectional study where 150 patients were enrolled who were diagnosed cases of severe pneumonia in the age group of 2-59 months (fitting into revised WHO classification). Equal number of sex and age index matched healthy children attending immunization clinic were taken as controls.*

Results: *Fast breathing was present among 146 (97.3%) cases and chest indrawing was observed in 133(88.7%) cases. The association of various socio-demographic and birth-related risk factors (low education level of mother, working status of mother, preterm birth and LBW babies,) history related risk factors (smoking history in parents, history of contact with TB patients, history of partially immunized or unimmunized for age, history of top feeding and malnutrition), environmental factors (overcrowding and poor ventilation in living area) increased the risk of severe pneumonia in children subsequently.*

Conclusion: *Tachypnoea and chest indrawing were the two most commonly observed signs in identifying severe pneumonia. Multiple modifiable risk factors for severe pneumonia have been identified in this study to which health care workers should be aware of to reduce mortality to severe pneumonia.*

Keywords: *LBW, Preterm, malnutrition, severe pneumonia.*

Introduction

Pneumonia in under 5 years children is a leading cause of mortality in India and other developing countries¹. The World Health Organization (WHO) has estimated an incidence of 0.37 episodes per child per year for severe pneumonia and India accounts for 36% of the total WHO South East Asia regional burden^{2,3}. Approximately 10 to 20% of these episodes tend to be severe⁴. Identifying clinical profile and risk factors for severe childhood pneumonia that are amenable to intervention is of public health importance.

The “Pneumonia” cases have been defined by WHO as fast breathing or tachypnoea (in children 2–12 months of age, breathing rate ≥ 50 cycles per minute; in children 12–59 months of age, breathing rate ≥ 40 cycles per minute) and/or chest indrawing and “Severe pneumonia” as a child aged 2–59 months with cough and/or difficulty in breathing along with any of the danger signs: inability to drink, persistent vomiting, convulsions, lethargy, unconsciousness, stridor in a calm child, severe malnutrition⁵. In many developing countries like India that uses WHO case management guidelines, hospital admission is recommended when a child is being diagnosed as a case of severe pneumonia according to revised WHO 2013 definitions⁵. Severe pneumonia cases are admitted accordingly and treatment initiated at the earliest. Hospital care should allow for prompt identification of signs of clinical deterioration and timely intervention with appropriate investigations, treatment, and supportive care including oxygen, fluids, and feeds. With this approach, overall outcome is improved and at the same time we can explore associated risk factors if any.

It is important to understand the risk factors of pneumonia at the global, regional, and national levels. Identification of risk factors is also very important for enhancing insight into the aetiology of pneumonia, prevention, and adequate and timely diagnosis. There is a wide variation in the risk factors for pneumonia in the published studies. Most of the studies for risk factors of pneumonia were hospital-based and represented only a small proportion of pneumonia cases^{6,7,8,9,10}. The epidemiological

information regarding risk factors and management is scanty. A large gap exists in this knowledge about these factors, which needs to be fulfilled by systematic studies. However, more knowledge on the risk factors affecting the severity of pneumonia is required to reduce deaths from childhood pneumonia, but only a few studies from India have reported the risk factors for severe pneumonia^{6,7,9,10-13}. More clinical studies from India are needed as the country alone contributes to 32% of the annual global burden of paediatric pneumonia⁸. The identified risk factors for childhood pneumonia are undernutrition, incomplete immunization, use of solid fuels in the household, over-crowding, lack of exclusive breastfeeding, low degree of maternal education, and limited access to secondary care. These risk factors are characteristics of low socioeconomic status and are inter related. However, due to the linear relation of these risk factors, it is difficult to estimate their individual risk.

The cascade of care for paediatric pneumonia diagnosis and treatment specially in low- and middle socio-economic group in developing country like India encompasses key steps that begin with healthcare worker’s recognition of illness and severity stratification by implementing revised WHO pneumonia guidelines.

In this study, we assessed clinical profile of severe pneumonia in children treated in tertiary care hospital in New Delhi by implementation of the revised WHO pneumonia guidelines and associated risk factors in children aged 2 to 59 months.

Objectives

Our study objective was to assess the clinical profile and associated risk factors of severe pneumonia aged 2-59 months.

Methods

This was an observational cross-sectional study carried out at paediatrics department of a tertiary Hospital of New Delhi where 150 patients were enrolled which were diagnosed cases of severe pneumonia in the age group of 2-59 months (fitting into revised WHO classification). Equal number of

sex and age index matched healthy children attending immunization clinic taken as controls. Practically, these controls are from source population. The mother or caregiver accompanying the child fulfilling the inclusion criteria were interviewed to fill a predefined case record proforma. Children with anatomical defects (like cleft lip and cleft palate), chronic systematic illness (like tuberculosis, bronchial asthma) and having Immune compromised states like human immune deficiency virus infection (HIV) were excluded from the study. Patients whose parents not willing to give consent were also excluded. A total of 170 children of age group of 2 to 59 months presenting to the Deen Dayal Upadhyay Hospital were considered for enrolment in the study. The flowchart demonstrates the flow of participants in this study. Twenty children were excluded from study in initial stages due to presence of exclusion criteria.

At the time of admission a detailed history, thorough clinical examination of respiratory system including sign and symptoms of pneumonia, danger signs of pneumonia according to WHO (not able to drink or breastfeed, persistent vomiting, convulsion, lethargy, severe acute malnutrition or stridor in calm child) were recorded.

Various risk factors were also noted. These are socio-demographics of the child and parents (age, sex, mother's education, mother's occupation, socio-economic class), family history (history of smoking at home, contact with TB patient), and birth history (preterm, birth weight), Feeding history (h/o exclusive breastfeeding), immunization status of the child (unimmunized, complete immunization, incomplete immunization), environmental factors related information (overcrowding, poor ventilation in living area) and malnutrition were noted. Anthropometric measurements like weight, height, weight for height and mid arm circumference were recorded in each case. Severe acute malnutrition in severe pneumonia cases was diagnosed according to WHO criteria for severe acute malnutrition¹⁴. The weight-for-age criteria were taken to assess nutritional status by the diagnosis of different grades of malnutrition, as per the nutrition subcommittee of

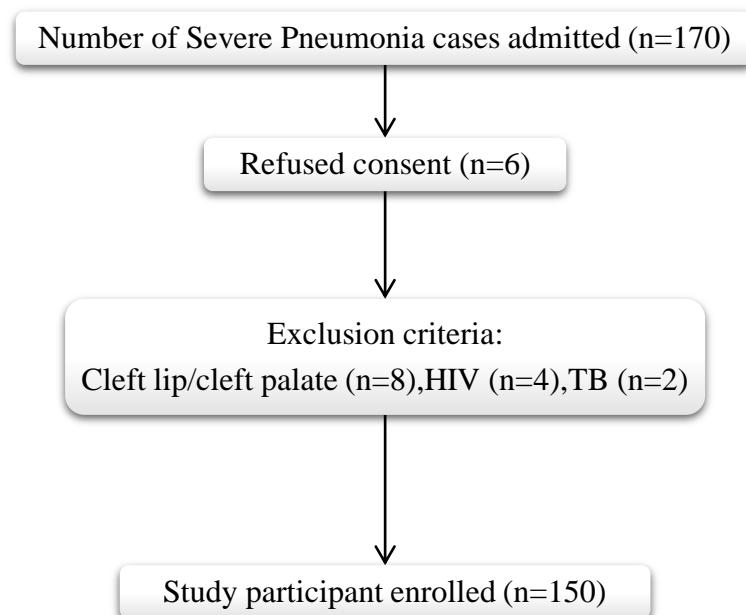
Indian Academy of Paediatrics in the year 1972¹⁵. Socioeconomic class was identified using Modified Kuppuswamy Scale¹⁶.

Statistical Analysis

Following data collection, data was entered into Microsoft excel worksheet (Microsoft, USA). Data analysis was done using IBM Statistical Package for Social Sciences. Categorical data was described in terms of frequencies and percentages. The association between independent variables (risk factors) and the outcome variable of severe pneumonia was evaluated in 2-by-2 tables using the Pearson chi-square test. The results of the 2-by-2 tables with each independent risk factor were reported as unadjusted odd ratios. The final reported model was developed by stepwise multivariate logistic regression models with backward elimination of the independent variables having p values more than 0.1 were used. The final model reported the adjusted odd ratios (AORs) and their 95% confidence intervals (CIs). P-value less than 0.05 was considered statistically significant.

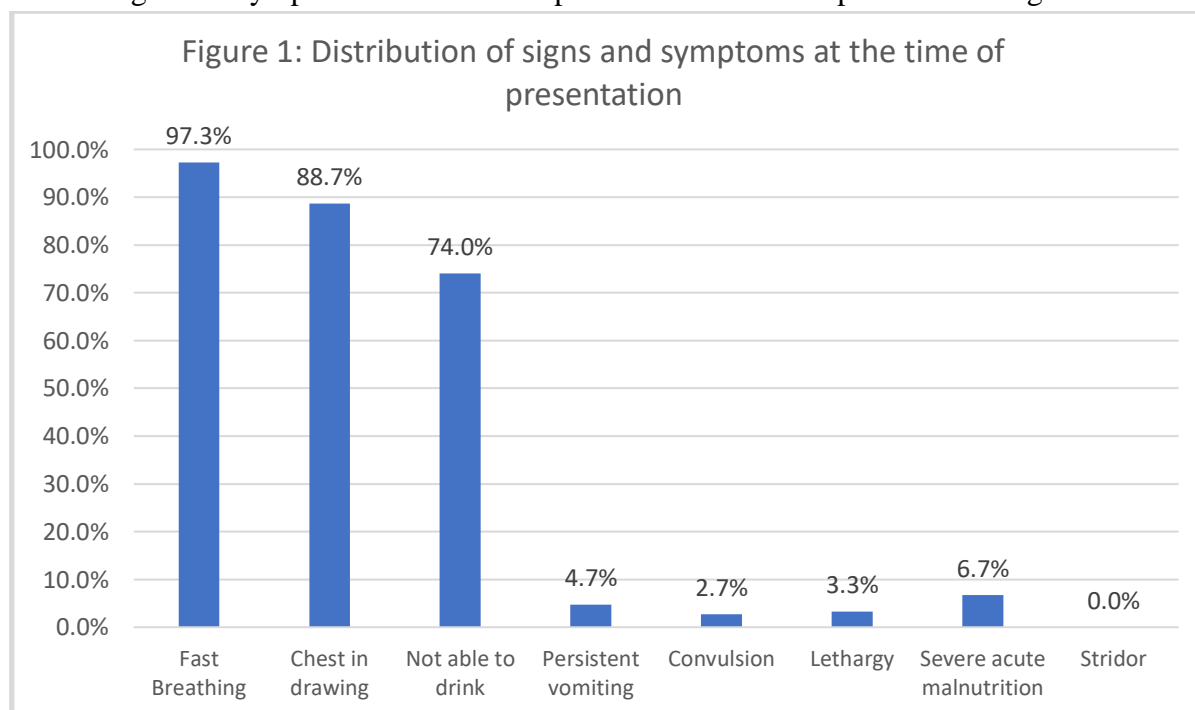
Results and Analysis

Fig 1: Flow of participants in the study



Results

Distribution of signs and symptoms at the time of presentation has been presented in Figure 1.



The association of socio-demographic and birth-related risk factors with severe pneumonia is depicted in Table 1. The table depicts that illiterate and non-working mother, premature birth (before 37 weeks of gestational age) and low birth weight of newborn increased the risk of severe pneumonia subsequently. Based on mother's education there were 78 (52%) illiterate cases and 51 (34%) illiterate

controls, 23 (19.3%) primary educated cases and 23 (15.3%) controls, 36 (24%) secondary educated cases and 13 (8.7%) controls and 7 (4.7%) cases with education above secondary as opposed to 63 (42%) controls with the statistically significant difference between the groups ($p < 0.001$). Based on mother's occupation, 142 (94.7%) cases and 129 (86%) controls had home makers mothers with the odd of

risk of severe pneumonia as 1.899 (CI=1.042-3.463). Based on Kuppaswamy socio-economic scale there were 1 (0.7%) case and 5 (3.3%) controls in upper middle class, 29 (19.3%) cases and 30 (20%) controls in lower middle class, 61 (40.7%) cases and 74 (49.3%) controls in upper lower class and 59 (39.3%) cases and 41 (27.3%) controls in lower class with no statistically significant difference ($p=0.067$) and hence not shown in the table.

Based on gestational age, there were 57 (38%) cases of severe pneumonia and 16 (10.7%) controls born

pre-term and the odds of severe pneumonia were 2.693 (CI= 1.724-4.208). The difference between the groups was statistically highly significant ($p<0.001$). Based on birth weight there were 25 (16.7%) cases of severe pneumonia and 4 (2.7%) controls who had low birth weight with odds of 1.869 (CI= 1.539-2.2) whereas 125 (83.3%) cases and 146 (97.3%) controls were born with birth weight more than 2.5 Kg with the odds of 0.256 (CI=0.102-0.640) and the difference between the groups was statistically highly significant ($p<0.001$).

Table 1: Associations of socio-demographic and birth-related factors

| Variable | | Severe pneumonia n | Control n | OR | P Value |
|---------------------|-----------------|-----------------------|--------------|-------|----------|
| Mother's education | Illiterate | 78 | 51 | a | <0.001** |
| | Primary | 23 | 23 | a | |
| | Secondary | 36 | 13 | a | |
| | Above secondary | 7 | 63 | a | |
| Mother's Occupation | Not working | 142 | 129 | 1.899 | 0.011 |
| | Working | 8 | 21 | 0.657 | |
| Gestational age | Full term | 93 | 134 | 0.525 | <0.001** |
| | Pre term | 57 | 16 | 2.693 | |
| Birth weight | <2.5 kg | 25 | 4 | 1.869 | <0.001** |
| | >2.5 kg | 125 | 146 | 0.256 | |

a- cannot be computed, *Statistically significant, **Statistically highly significant

Table 2 depicts results of association between history-related factors in cases and controls. Factors such as history of smoking in parents, history of contact with TB patients, immunization, history of top feeding and malnutrition increases the risk of severe pneumonia. There was 1 (0.7%) case with history of congenital heart disease while rest all 149 (99.3%) cases and 150 (100%) controls did not have the history with statistically no significant difference between the groups ($p = 0.317$). Hence it was not shown in the table. History of smoking in parents was present in 122 (81.3%) cases and 25 (16.7%) controls with the odds of 4.804 (CI=2.225-6.919) while it was absent in 28 (18.7%) cases and 125 (83.3%) controls

with the odds of 0.221 (CI=0.157-0.311) and the difference between the groups was statistically highly significant ($p<0.001$). History of contact with TB patients was present in 26 (17.3%) cases and 13 (8.7%) controls with odd of 1.575 (CI=0.995-2.491) while it was absent in 124 (82.7%) cases and 137 (91.3%) controls with statistically significant difference between the groups ($p=0.026$). There were 66 (44%) cases and 110 (73.3%) controls with complete immunization, 76 (50.7%) cases and 39 (26%) controls with incomplete immunization and 8 (5.3%) cases and 1 (0.7%) control without immunization and the difference between the groups was statistically highly significant ($p<0.001$). There

were 112 (74.7%) cases and 136 (90.7%) controls who were exclusively breastfed with odds of 0.618 (CI=0.499-0.766) as opposed to 38 (25.3%) cases and 14 (9.3%) controls who were non-exclusively breastfeed with odds of 2.037 (CI=1.284-3.232) with statistically highly significant difference between the groups ($p<0.001$). Based on grade of malnutrition,

there were 20 (13.3%) cases and 118 (78.7%) controls with normal nutrition. Grade 1 was seen in 63 (42%) cases and 19 (12.7%) controls, Grade 2 was seen in 59 (39.3%) cases and 10 (6.7%) controls whereas Grade 3 was seen in 8 (5.3%) cases and 3 (2%) controls. Grade 4 was not seen in either cases or controls.

Table 2: Association of history-related factor:

| Variable | | Severe pneumonia | Controls | OR | P value |
|-------------------------------------|------------------|------------------|----------|-------|----------|
| History of smoking in parents | Present | 122 | 25 | 4.804 | <0.001** |
| | Absent | 28 | 125 | 0.221 | |
| History of contact with TB patients | Present | 26 | 13 | 1.575 | 0.026* |
| | Absent | 124 | 137 | 0.713 | |
| Immunization | Complete | 66 | 110 | a | <0.001** |
| | Incomplete | 76 | 39 | a | |
| | Unimmunized | 8 | 1 | a | |
| Feeding | Exclusive Breast | 112 | 136 | 0.618 | <0.001** |
| | Top feeding | 38 | 14 | 2.037 | |
| Grade of malnutrition | Normal nutrition | 20 | 118 | a | <0.001** |
| | Grade 1 | 63 | 19 | a | |
| | Grade 2 | 59 | 10 | a | |
| | Grade 3 | 8 | 3 | a | |
| | Grade 4 | 0 | 0 | a | |

OR—odds ratio, a- cannot be computed, *Statistically significant, **Statistically highly significant

Table 3 shows result of association of environmental factors. Factors such as overcrowding and poor ventilation in living area increased the risk of severe pneumonia in children. Overcrowding was present in 111 (74%) cases with odds of 1.784 (CI=1.426-2.232) whereas poor ventilation in living area was present in 134 (89.3%) cases odds of 2.782 (CI=2.217-3.491) and the difference between the groups was statistically

highly significant ($p<0.001$). Based on type of family 115 (76.7%) cases and 119 (79.3%) controls had nuclear family with odds of 0.927 (CI=0.713-1.204) whereas 35 (23.3%) cases and 31 (20.7%) controls had joint family with odds of 1.083 (0.814-1.441) and the difference between the groups was not statistically significant ($p=0.557$), hence not included in the table.

Table 3: Association of environmental factors

| Variable | | Severe pneumonia | Control | Odds ratio | P value |
|------------------|---------|------------------|---------|------------|----------|
| Over crowding | present | 111 | 68 | 1.784 | <0.001** |
| | Absent | 39 | 82 | 0.520 | |
| Poor Ventilation | Present | 134 | 59 | 2.784 | <0.001** |
| | Absent | 16 | 91 | 0.215 | |

**Statistically highly significant

Table 4 depicts **Multivariate analyses of socio-demographic, past treatment-related, environmental, and sign and symptom-related risk factors of severe pneumonia in cases and controls.** The risk factors identified in the final model included: age in months (continuous variable, AOR= 0.989, CI= 0.973-1.006, p=0.198); gender (male versus female, AOR= 0.890, CI= 0.510-1.551, p=0.680); term of pregnancy (full versus premature,

AOR= 4.566, CI= 2.338-8.919, p<0.001), vaccination status (complete versus incomplete, AOR= 3.382, CI= 2.007-5.699, p<0.001), type of home (pukka versus kuccha, AOR= 0.793, CI= 0.265-2.372, p=0.678); overcrowding (present versus absent, AOR= 3.280, CI= 1.880-5.721, p<0.001); poor ventilation in living area (present versus absent, AOR= 1.456, CI= 0.293-7.243, p=0.646).

Table 4: Multivariate analyses of risk factors of severe pneumonia in cases and controls

| Independent Variables | AOR | 95% CI | p value |
|---|-------|-------------|---------|
| Term of pregnancy (full versus premature) | 4.566 | 2.338-8.919 | <0.001 |
| Vaccination (complete versus incomplete) | 3.382 | 2.007-5.699 | <0.001 |
| Overcrowding (present versus absent) | 3.280 | 1.880-5.721 | <0.001 |
| Poor ventilation in living area (present versus absent) | 1.456 | 0.293-7.243 | 0.646 |

Discussion

The WHO protocol puts forward two signs as the “entry criteria” or basis for examining a child below five years of age for possible pneumonia. The present study included children aged two-59 months of age with WHO-defined symptoms and danger signs to define pneumonia and severe pneumonia. We have done a hospital based descriptive observational study for clinical profile of severe pneumonia and risk factors associated with severe pneumonia in children aged two-59 months. Our primary objective was to study the clinical profile of severe pneumonia in children aged two-59 months. In this study 150 cases of severe pneumonia were recruited as per inclusion criteria and assessed for clinical profile. Fast breathing was present among maximum no of cases followed by chest in drawing and unable to drink. Other clinical profiles that were present in less number were persistent vomiting, convulsion and lethargy. Severe acute malnutrition was also observed in few cases. None of the cases showed stridor.

Kasundriya.SK et al.¹⁰, Sriram G et al.¹¹, Murali Rao G et al.¹², have observed that tachypnoea and chest retractions were highly specific signs in detecting pneumonia.

Our secondary objective was to identify risk factors associated with severe pneumonia in children aged two-59 months. Among the socio-demographic risk factor, mother’s higher education status had a statistically significant difference between the groups as a covariate. According to Kasundriya.SK et al.¹⁰ and Murali Rao G et al.¹² study, low educational levels of mothers are independent risk factors for severe pneumonia. Our study does not show any association of socio-economic status with severe pneumonia as our cases and controls are from the same socio-geographical area. Severe pneumonia affects children irrespective of socioeconomic status in our study. According to Murali Rao G et al.¹² study, a statistically significant association was found between social class and severe pneumonia, whereas Jyotiranjjan Champatiray et al.¹³ study, socio economic status does not find to be associated with severe pneumonia. History of smoking in parents and household contact with Tuberculosis patients as a covariate had a highly significant association with severe pneumonia cases in our study. Murali Rao G et al.¹² study finds out significant association of smoking in parents and severe pneumonia. Kasundriya SK et al.¹⁰ study does not find out any significant difference between parental

smoking and severe pneumonia whereas finds out significant association between household contact with tuberculosis and severe pneumonia. Children with a low birth weight and those born preterm appeared to have more risk of severe pneumonia. Our results are comparable with study done by Kasundriya SK et al¹⁰ and by Murali Rao G et al.¹² Our study showed that complete immunization status decreased the risk of severe pneumonia with highly significant p value <0.001. Our results are comparable with Kasundriya SK et al.¹⁰ and Murali Rao et al.¹² In contrast, Jyotiranjana Champatiray et al.¹³ showed that immunisation status does not affect severity of pneumonia. Receiving all doses of pentavalent vaccine were protective against severe pneumonia in a study done by Saha et al¹⁷ from Bangladesh. The children who were not exclusively breastfeed for 6 months was independent risk factor for severe pneumonia in our study. Similar result was also obtained by a study done by Kasundriya SK et al.¹⁰ In Jyotiranjana Champatiray et al. study,¹³ feeding practice does not affect severity of pneumonia. In Sriram G et al.¹¹ study, 78.7% cases of severe pneumonia are associated with exclusively breastfeed. In the present study there was a statistically significant association between overcrowding and poor ventilation in living area and severe pneumonia. Indoor air pollution because of use of cooking gas was not found to be a significant risk factor for severe pneumonia in our study. In our study, malnutrition was highly statistically significant association with severe pneumonia. Our results are comparable with study done by Sriram G et al.¹¹ and Murali Rao G et al¹².

Primary limitation of the study was that it was a hospital-based study with limited sample size and both cases and controls were taken from same socio-geographic area. The results are generalizable to similar resource-limited settings, but hospital-to-hospital variations may be expected.

Conclusion

Tachypnoea and chest indrawing, both are the two most commonly observed signs in identifying severe pneumonia, present in more than 80% of cases.

Multiple modifiable risk factors for severe pneumonia have been identified in this study. Paediatricians and other health care workers, including the grassroot health workers, should be aware of these signs and risk factors of severe pneumonia while managing the patient with pneumonia. The management of the modifiable risk factors may reduce mortality due to severe pneumonia.

Recommendation

In our country that uses WHO case management guidelines, hospital admission is recommended when a child crosses the threshold from a non-severe to a severe pneumonia classification according to revised WHO 2013 definitions. We had observed most of admitted cases of severe pneumonia had both tachypnoea and chest indrawing. So public health intervention is required to modify the present guideline for admission of severe pneumonia cases. Otherwise, health care worker might miss the cases of severe pneumonia as pneumonia cases. Socio economic factors represent the ultimate determinants of a large proportion of the burden of severe pneumonia, but interventions against factors such as low educational levels fall outside the scope of health sector. Possible effective interventions for reducing respiratory morbidity and mortality due to environmental factors include anti-smoking campaigns, and improved housing to reduce crowding and poor ventilation in living area. Regarding nutritional factors, low birth weight, preterm pregnancy, malnutrition, lack of breast feeding and incomplete immunization constitute independent risk factors for pneumonia and interventions include efficient antenatal care, promotion of breast feeding, and appropriate MCH and family welfare services and immunization awareness campaign. It should be noted that most of above interventions have other beneficial effects in addition to their impact on respiratory infections among young children. Further work is needed to establish the cost effectiveness of possible interventions, taking into account their multiple benefits.

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References

1. Amouzou A. One Is Too Many Ending Child Death from Pneumonia and Diarrhoea; UNICEF: New York, NY, USA, 2016; Available from: https://data.unicef.org/wpcontent/uploads/2016/11/UNICEF-Pneumonia-Diarrhoea-report2016-web-version_final.pdf (accessed on 2 October,2024)
2. Mathew JL, Patwari AK, Gupta P, Shah D, Gera T, Gogia S et al. Acute respiratory infection and pneumonia in India: a systematic review of literature for advocacy and action: UNICEF-PHFI series on newborn and child health, India. *Indian Pediatrics*.2011 Mar 1;48(3):191.
3. Rudan I, O'Brien KL, Nair H, Liu L, Theodoratou E, Qazi S et al. Epidemiology and etiology of childhood pneumonia in 2010: Estimates of incidence, severe morbidity, mortality, underlying risk factors and causative pathogens for 192 countries. *Journal of Global Health*. 2013;3(1):010401.
4. Ghimire M, Bhattacharya SK, Narain JP. Pneumonia in South-East Asia region: public health perspective. *Indian Journal of Medical Research* .2012;135(4): 459–68.
5. WHO. Revised WHO Classification and Treatment of Pneumonia in Children at Health Facilities: Evidence Summaries. World Health Organization. 2014. Available online: https://apps.who.int/iris/bitstream/10665/137319/1/9789241507813_eng.pdf
6. Gothankar J, Doke P, Dhumale G, Pore P, Lalwani S, Quraishi S et al. Reported incidence and risk factors of childhood pneumonia in India: a community-based crosssectional study. *BMC public health*. 2018 Dec;18(1):1111.
7. Tiewsoh K, Lodha R, Pandey RM, Broor S, Kalaivani M, Kabra SK. Factors determining the outcome of children hospitalized with severe pneumonia. *BMC Pediatrics*. 2009 Dec 1;9(1):15.
8. Collaborators, G.B.D.L.R.I. Quantifying risks and interventions that have affected the burden of lower respiratory infections among children younger than 5 years: An analysis for the Global Burden of Disease Study 2017. *Lancet Infect. Dis*. 2020;20: 60–79
9. Jakhar SK, Pandey M, Shah D, Ramachandran VG, Saha R, Gupta N, et al. Etiology and Risk Factors Determining Poor Outcome of Severe Pneumonia in Under-Five Children. *Indian Journal of Pediatrics*. 2018 Jan 1;85(1):20-24. 56
10. Kasundriya SK, Dhaneria M, Mathur A, Pathak A. Incidence and Risk Factors for Severe Pneumonia in Children Hospitalized with Pneumonia in Ujjain, India. *International Journal of Environmental Research and Public Health*. 2020 Jan;17(13):4637.
11. Sriram G, Satyanarayana A. Study on clinical profile and risk factors associated with pneumonia. *Int J Contemp Pediatr* 2019 Sept;6(5):1926-1930.
12. Murali Rao G, Kumar R, Deepti B. The Clinical Profile of Severe Pneumonia and Study if the Role of Risk Factors Associated with Severe Pneumonia in Children Aged between 6 months to 5 Years. *Scholars Journal of Applied Medical Sciences*.2017; 5(8D):3238-3247.
13. Champatiray J, Satapathy J, Kashyap B, Mondal D. Clinico-Aetiological Study of Severe and Very Severe Pneumonia in Two Months to Five Years Children in a Tertiary Health Care Centre in Odisha, India. *Journal of Clinical and Diagnostic Research*. 2017;11(9): SC06-SC10

14. WHO Child Growth Standards and the Identification of Severe Acute Malnutrition in Infants and Children: A Joint Statement by the World Health Organization and the United Nations Children's Fund. Geneva: World Health Organization;2009
15. Nutrition sub-committee of Indian Academy of Pediatrics 1971-72.Report of Convenor, Indian Pediatr 1972,9: 360.
16. Saleem S.M., Jan S.S. Modified Kuppuswamy socioeconomic scale updated for the year 2021. Indian Journal of Forensic and Community Medicine, 2021;8(1): 1-3.
17. Saha S, Hasan M, Kim L, Farrar JL, Hossain B, Islam M et al. Epidemiology and risk factors for pneumonia severity and mortality in Bangladeshi children < 5 years of age before 10-valent pneumococcal conjugate vaccine introduction. BMC Public Health. 2016;16(1):1233