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Risk factors for severe pneumonia in under five children – A hospital based study

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Abstract:

Acute respiratory infections (ARI) range, in spectrum, from mild colds and coughs to life-threatening pneumonias. ARI particularly pneumonia is the major cause of morbidity and mortality among young children. It is estimated that more than 150 million episodes of pneumonia occur every year among children under five in developing countries, accounting for more than 95 per cent of all new cases worldwide. Between 11 million and 20 million children with pneumonia will require hospitalization, and more than 2 million will die from the disease. It is also important to note that incidence of pneumonia among children decreases with age. **Objective:** To identify some of the risk factors for severe pneumonia in under five children. **Materials & Methods:** Cross-sectional, observational, hospital based case-control study conducted at Vijayanagara Institute of Medical Sciences hospital, Bellary. The study period was one year from 1-02-2011 to 31-01-2012. **Results:** The significant socio-demographic risk factors were low education level of parents, low socioeconomic status, and incomplete immunization for age. Significant environmental risk factors were use of biomass fuel (OR-2.49 95% CI 1.7-3.7) and overcrowding (OR-2 95% CI 1.4-2.8). Significant nutritional risk factors were low birth weight (OR-1.5 95% CI 1.1-2.7), pre-lacteal feeding (OR-2.94 95% CI 1.9-4.5), lack of exclusive breast feeding for 4-6 months and malnutrition. On multivariate analysis younger age (p=0.019), incomplete immunization for age (p=0.00), low literacy level of mother (p=0.00) overcrowding (p=0.004), use of biomass fuels (p=0.00), prelacteal feeding (p=0.00), lack of exclusive breast feeding (p=0.00) and malnutrition (p=0.00) have shown significant association with severe pneumonia. The present study has identified various sociodemographic, nutritional and environmental risk factors for severe pneumonia which can be reduced by effective education of the community and through appropriate public health measures.

Key words: Children; Morbidity; Pneumonia; Risk factor; Under-five

Introduction

Children are considered susceptible to a host of disease and infections of respiratory tract, are most common cause of morbidity and mortality in young children [1]. Of the 10.5 million annual deaths world wide among children under 5 years of age, 2 million are due to pneumonia. Pneumonia in children is a major cause of concern in developing countries, because almost (99.9%) all child pneumonia deaths occur in these countries. In India an estimated 4 lakh pneumonia deaths occurs annually, which is highest among all the countries in the world. Childhood pneumonia has been identified as the major "forgotten killer of children" by the UNICEF & WHO [2]. Apart from infectious agent, child's genetic and immunological status certain other factors like malnutrition, low birth weight, and duration of breast feeding have been identified as pneumonia risks. Some other inciting factors are smoking habit of parents, parental literacy, household crowding, indoor smoke pollution [3,4] .

However, evidence on the association between these factors and pneumonia in children is scarce in this region. Therefore it was thought prudent to undertake this study to elucidate the major risk factors for severe pneumonia among under five children admitted in a Vijayanagara Institute of Medical Sciences Hospital, Bellary.

Objectives

To identify the risk factors for severe pneumonia in under five children.

Materials & Methods

The present hospital based case control study was carried out over a period of one year from 1-02-2011 to 31-01-2012 in Vijayanagara Institute of Medical Sciences Hospital, Bellary

Sampling procedure:

270 children suffering from severe or very severe pneumonia as ascertained by WHO criteria, of age below five years, of both genders, admitted in pediatrics wards taken as 'cases'. The WHO criteria for diagnosis of severe pneumonia is the presence of lower chest indrawing with respiratory rates of >60/min. in an infant less than 2 months, >50/min. in infants between 2- 12 months, >40/min. in a child 12 months upto 5 years. The presence of refusal of feeds, central cyanosis, lethargy or convulsions was taken as evidence of very severe pneumonia [5] .

An equal number of age-sex matched children coming for immunization to the same hospitals without previous history of severe or very severe pneumonia were taken as controls. Thus 270 cases and 270 controls (Total=540) constituted the study population.

Exclusion criteria:

Children having Congenital defects of heart and lungs, cleft lip & cleft palate, Foreign body aspiration, Parents not willing to co-operate, Immunocompromised states like HIV/AIDS.

Materials used:

_ Electronic baby scale (KORUKA, resolution-10gms, capacity 20kgs)

_ Electronic baby scale (EAGLE, resolution-100gms, capacity 120kgs)

_ Pediatric stethoscope

_ Infantometer

_ Stadiometer

_ Digital watch

Methodology

Permissions were obtained from the head of the department of paediatrics and all unit heads, Superintendents of VIMS hospital. Verbal informed consent of the child's mother /caretaker was obtained for both the cases and controls. Data regarding age, sex, domicile, parent's literacy, parent's occupation, monthly income, family type was obtained.

A detailed history of relevant symptoms was taken. History of immunization, breast feeding and weaning was elicited from parents/ informant and verified by checking the records wherever available. History of respiratory infections in the family members in the preceding 2 weeks, history of smoking by family members and details of cooking fuel used was recorded. Details of the housing conditions were also obtained.

A detailed examination in each child was done. Respiratory rate was measured for one minute when the child was quiet by looking at the abdominal movement or lower chest wall. Height and weight were recorded and malnutrition was graded

according to Indian academy of Pediatrics (IAP) classification. Data thus collected was recorded in a pretested and prestructured proforma designed for the study with suitable modifications after pilot study.

Statistical analysis

Data was managed on Microsoft(r) Excel spreadsheet, all the entries were double checked and analysis was performed using SPSS version 15 software package [6]Association of each of the categorical variable with severe or very severe pneumonia (outcome variable) was assessed with chi-square test and the strength of their association was computed by unadjusted odds ratio (95% confidence interval). Subsequently, these variables were simultaneously subjected to multiple logistic regression model to determine the significant independent risk factors.

Results

The socio demographic characters of cases and controls shown in table-I

Among 270 cases, 203 (75.2%) were completely immunized for age, 52 (19.3%) were incompletely immunized for age and 15 (5.5%) were unimmunized.

Among controls, 249 (92.2%) were completely immunized for age 17, (6.3%) were incompletely immunized and 4 (1.5%) were unimmunized. There was a significant association between immunization and risk of pneumonia with odds ratio of 3.9 (95% CI 2.3 -6.6) for non immunization/incomplete immunization for age.

Among 270 cases, 39 (14.4%) were exposed to respiratory infection in family members within in the past 2 weeks, and 231 (85.6%) were not exposed to respiratory infections and among controls 53(19.6%) were exposed there was no statistically significant association ($\chi 2$ =2.56 p >0.05).

The table shown below says that parents literacy status was significantly associated with the risk of severe pneumonia.

196 (72.6%) cases belonged to lower class (class IV +V), 67 (24.8%) cases belonged to middle class (class II +III) and only 7 (2.6%) cases belonged to upper class (Class I). A statistically significant association was found between social class and severe pneumonia. The odds ratio was 1.4 (95% CI 0.5-3.5) for highest versus middle income group and 2.8 (95% CI 1.1-7.0) for highest and lowest income groups. This shows the higher incidence of severe pneumonia among middle and lower class children when compared to children belonging to upper socio economic class [7,8] .

The association between housing and severe pneumonia was not statistically significant expect overcrowding and fuel for cooking.

Among cases, 87 (32.2%) and controls 71 (26.3) were exposed to parental smoking. This shows the association was not statistically significant.

Association with low birth weight babies, prelacteal feeding, exclusive breast feeding shown in the table - IV

Malnutrition was present in 132 cases with 95 (35.2%) having Grade I malnutrition, 23 (8.5%) with Grade II, 10 (3.7%) with grade III and 4 (1.5%) with grade with grade IV malnutrition. Malnutrition was present in only 33 controls with 27 (10%) having Grade I and 6 (2.2%) having Grade II while none had Grade III and Grade IV malnutrition. There was a significant association between nutritional status and severe pneumonia.

Cough was the most common symptom present in 266 (98.5%) cases, followed by hurried breathing in 257 (95.2%) and fever in 248 (91.8%) cases. 123 (45.5%) cases had refused feeding and wheezing was present in 30 (11.1%) cases. Crepitations were present in all the 270 (100%) cases, chest retractions were seen in 235 (87%) cases and rhonchi in 114 (42.2%) cases. Convulsions were present in 12 (4.4%) cases, cyanosis in 14 (5.2%) cases and stridor in 10 (3.7%) cases.

Out of 181 male cases, 145 (80.1%) were diagnosed with severe pneumonia and 36 (19.9%) with very severe pneumonia. Out of 89 female cases 66 (74.2%) had severe pneumonia and 23 (25.8%) had very severe pneumonia.

By using multiple logistic regression analysis, the factors which were found to be significant with p value <0.05 are, younger age (p=0.019), incomplete immunization for age (p=0.00), low literacy level of mother (p=0.00) overcrowding (p=0.004), use of biomass fuels (p=0.00), prelacteal feeding (p=0.00), lack of exclusive breast feeding (p=0.00) and malnutrition (p=0.00).

Discussion

The present study is a hospital based case control study carried out in Bellary aimed at identifying the risk factors for severe pneumonia.

Table 1: The socio demographic characters of cases and controls

1. Age distribution			
Age (months)	Cases (%)	Controls (%)	Total (%)
0-11	79(29.2)	77(28.5)	156(28.9)
12-23m	65(24.1)	63(23.3)	128(23.7)
24-35	51(18.9)	54(20.0)	105(19.4)
36-47	32(11.9)	35(13.0)	67(12.4)
48-59	43(15.9)	41(15.2)	84(15.6)
$\chi 2$ =0.32 df=5 p > .05 not Significant			
2. Sex wise distribution of study subjects			
Sex	Cases(%)	Controls(%)	Total(%)
Male	181(67.1)	179(66.3)	360(66.7)
Female	89(32.9)	91(33.7)	180(33.3)
$\chi 2$ =0.03 p > .05 not Significant			
3. Urban /Rural distribution of study subjects			
Domicile	Cases(%)	Controls(%)	Total(%)
Rural	170(63)	149(55.2)	319(59.0)
Urban	100(27)	121(44.8)	221(41.0)
$\chi 2$ = 3.38 p > .05 not Significant			
4. **Distribution of study subjects by religion**			
Religion	Cases(%)	Controls(%)	Total(%)
Hindus	236(87.4)	221(81.9)	457(84.6)
Muslims	34(12.6)	49(18.1)	83(15.4)
$\chi 2$ = 3.2 p >.05 not significant			
5. Distribution of study subjects by type of family			
Family	Cases(%)	Controls(%)	Total(%)
Nuclear	175(64.8)	156(57.8)	331(61.3)
Joint	54(20.0)	66(24.4)	120(22.2)
3 generation	41(15.2)	48(17.8)	89(16.5)
Total	270(100.0)	270(100.0)	540(100)
$\chi 2$ =2.84 p >.05 not significant			

Table 2: Distribution of study subjects by parents educational level

1. Mother's literacy			
Mother's literacy	Cases (%)	Controls (%)	Total (%)
Illiterate	94(34.8)	52(19.3)	146(27.1)
Primary	70(25.9)	63(23.3)	133(24.6)
High school	55(20.4)	59(21.9)	114(21.1)
Puc/Graduate	51(18.9)	96(35.5)	147(27.2)

χ^2 =26.3 p <.0.001 significant			
2. Father's literacy			
Father's literacy	Cases (%)	Controls (%)	Total (%)
Illiterate	88(32.6)	59(21.9)	147(27.2)
Primary	72(26.7)	65(24.1)	137(25.4)
High school	59(21.9)	55(20.4)	114(21.1)
PUC	43(15.9)	76(28.1)	119(22.0)
Graduate	08(02.9)	15(05.6)	23(04.3)
χ^2 =17.5 p < 0.002 significant			
3.Socio economic Class[7]			
SES	Cases (%)	Controls (%)	Total(%)
Class I	07(02.6)	15(5.6)	22(04.1)
Class II	28(10.4)	39(14.4)	67(12.4)
Class III	39(14.4)	66(24.4)	105(19.4)
Class IV	87(32.2)	61(22.6)	148(27.4)
Class V	109(40.4)	89(33.0)	198(36.7)
χ^2 =18.2 p < 0.001 significant			

Table 3: Distribution of study subjects by Housing

1. Type of housing			
Housing	Cases (%)	Controls (%)	Total(%)
Kaccha	121(44.8)	108(40)	229(42.4)
Semipucca	79(29.3)	73(27.1)	152(28.1)
Pucca	70(25.9)	89(32.9)	159(29.5)
χ^2 =3.2 p >.05 not significant			
2. Type of floor			
Floor	Cases (%)	Controls (%)	Total(%)
Mud	43(15.9)	32(11.9)	75(13.9)
Cow dung	38(14.1)	26(09.6)	64(11.9)
Cement/tiles	189(70.0)	212(78.5)	401(74.2)
χ^2 =5.18 p>0.05 not significant			
3. Overcrowding[9]			
Overcrowding	Cases (%)	Controls (%)	Total
Yes	115(42.6)	73(27.1)	188(34.8)
No	155(57.4)	197(72.9)	352(65.2)
χ^2 =14.39 p< .001 significant			

Table 4: Distribution of study subjects by post natal period

1. By birth weight			
Birth weight	Cases (%)	Controls (%)	Total (%)
< 2.5 kg	89(33)	65(24.1)	154(28.5)
>2.5 kg	181(67)	205(75.9)	386(71.5)
χ^2 = 5.23 p <0.05 significant			
2. H/o prelacteal feeding			
PF	Cases (%)	Controls (%)	Total(%)
Given	86(31.9)	37(13.7)	123(22.8)
Not given	184(68.1)	233(86.3)	417(77.2)
χ^2 = 25.28 p < .0001 significant			
3. Duration of exclusive breast feeding			
EBF	Cases (%)	Controls (%)	Total(%)
<4 months	61(37.0)	28(14.7)	89(25.0)
4-6 months	70(42.4)	145(76.3)	215(60.6)
>6 months	34(20.6)	17(09.0)	51(14.4)
χ^2 = 42.5 p < .0001 significant			

Table 5: Multiple Logistic regression (Multivariate analysis)

Variables	**Model fitting Criteria 2 log likelihood of Reduced Model**	**Likelihood Ratio Test**		
		Chi square	**Df**	**Sig**
Sex	483.041	0.031	1	0.86
Locality	485.674	2.664	1	0.103
Religion	483.733	0.723	1	0.395
Family type	485.737	2.727	2	0.256
Immunization	508.371	25.361	2	.000 (HS)
family members	483.919	0.909	1	0.34
Father's literacy	491.179	8.169	4	0.086
Mother's literacy	511.35	28.34	4	.000 (HS)
SES	489.359	6.349	4	0.175
Type of house	483.392	0.382	2	0.826
Floor	486.576	3.566	2	0.168
Crowding	491.189	8.179	1	.004 (HS)
Cooking fuel	505.084	22.074	1	.000 (HS)
Kitchen	483.148 .	138	1	0.71
Parental smoking	484.469	1.459	1	0.71
Birth wt	483.198	0.188	1	0.665
Prelacteal feed	507.963	24.953	1	000 (HS)
EBF	497.438	14.428	1	.000 (HS)
Nutrition	558.668	75.658	4	.000 (HS)

In the present study severe pneumonia was more common among infants but there was no statistical significance. In a study by Cunha et al it was reported that age less than one year was a risk factor for respiratory morbidity [10] Shah et al [11] have also reported that incidence rates for ARI are highest in younger children. In a study by Thamer KY et al[12] it was shown that early infancy less than 2 months of age has a highly significant association with severe ARI. This might be due to the fact that in young children immunity is not well established, and also because of narrow airways, relatively short bronchial tree and incomplete development of lungs [13] .

More number of male children were affected by severe pneumonia than females, similar results were obtained by Thamer KY et al [12] In a study conducted in Sri Lanka [14], male sex was a significant risk factor for ALRTI and also in a study conducted in Nigeria [15], it was observed that incidence was higher in boys than in girls.

However, in the present study there was no statistically significant association and the possibility of gender bias in seeking care cannot be ruled out which may have lead to male preponderance.

Majority of cases in our study were from rural area and there was no significant association between domicile and severe pneumonia. This may be due to the fact that hospitals in which our study is undertaken are the main speciality centers in this area and severe ARI cases from rural areas are referred, while less severe cases are usually managed at primary centers. Similar results were reported by Thamer KY et al [12].

Majority of cases in our study were Hindus, however there was no statistically significant association between religion and severe pneumonia. This is probably the reflection of distribution of local population where Hindus are a predominant group.

In our study more number of cases were from nuclear families, and there was no statistically significant association between the type of family and severe pneumonia.

There was a statistically significant association between immunization and risk of severe pneumonia. Children who were completely immunized for age were less likely to get the disease compared to children who are unimmunized / partially immunized for age (OR 3.9). Similar results were reported by Broor S et al [16], Thamer KY[12], Savitha[17]. This is because immunization against measles and pertusis may prevent infections that can lead to pneumonia as a complication, and also probably because mothers utilizing immunization services are better aware of health care facilities and probably seek early consultations for illness in their Children, which probably avoids severe illness.

Low educational level in mothers was found to be associated with increased risk of ALRI hospitalizations and mortality in a study in Brazil [18], Cunha et al [10].

However in a case control study by Victora CG [19], father's education was more strongly correlated than the mother's education. Parents, particularly mothers who have more education are more likely to seek appropriate and early care for illnesses in their children.

A statistically significant association was found between social class and severe pneumonia. The odds ratio was 1.4 for highest versus middle income group and 2.8 for highest and lowest income group. This shows that the risk of severe pneumonia increases as the socioeconomic status worsens. In a study by Rahman MM et al [20], poverty was significantly associated with occurrence of pneumonia. Biswas et al [21] revealed per capita income was significantly associated with ARI.

There was no significant association between type of house, type of floor and severe pneumonia. Similar results were obtained by Broor S et al [16]. But studies conducted by Sikolia et al [22] and Savitha et al [17]have shown a significant association between housing conditions and respiratory infections.

In the present study there was a statistically significant association between overcrowding and severe pneumonia with an odds ratio of 2. Overcrowding may increase the probability of transmission of infections among family members.

Similar results were obtained in a study in BangladesH [20] and India [17] and studies conducted by CG Victora et a l[19].

Use of biomass fuels for cooking was found to be significant risk factor with an odds of 2.49. Biomass fuels (wood, crop residues, animal dung) coal and other media (kerosene) are predominant contributors to indoor air pollution. These are burnt in simple stoves with incomplete combustion generating a lot of toxic products that adversely affect specific and non specific local defenses of the respiratory tract. The risk is highest for mothers and young children due to longer stay indoor and close proximity during cooking. Added to this, 12% of

cases did not have a separate kitchen and cooking was done in living place, leading to bulk of emissions being released into living area.

In a systematic review and meta-analysis of 24 studies by Mukesh et al [23], it has been shown that risk of pneumonia in young children is increased by exposure to unprocessed solid fuels by a factor of 1.8. Similar studies conducted by Bruce N et al[24]and Smith KR[25] have shown same result.

Environmental tobacco smoke is another indoor pollutant that reduces local defense mechanisms and predisposes children to respiratory illness [26,27].

In the present study history of parental smoking was not significantly associated with severe pneumonia. This may be because, majority of smokers in the families were fathers and the exposure of children due to smoking by fathers may be limited because of relatively greater time spent by fathers outside the house.

Children with a history of low birth weight appeared to have more risk of severe pneumonia with an odds of 1.5. This result is in agreement with Taylor et al[28]Chan et al[29].This might be due to poor pulmonary function and low immunity in LBW babies which makes them more liable to have ARI mainly in its severe form[30].The administration of prelacteal feeds and lack of exclusive breast feeding for first four to six months were independent risk factors for severe pneumonia. Similar results were found in other studies[17].

In a study on ALRI specific mortality relative to breast fed infants, those, who also received artificial milk had a risk of 1.6 and non-breast fed infants a risk of 3.674. Among children hospitalized with pneumonia in Rwanda, breast feeding was associated with a 50% reduction in case fatality [31].

Presence of malnutrition was significantly associated with ALRI in the present study similar to other studies [14,17]. A study in New Delhi revealed severe malnutrition as the predictor of mortality in ALRI in under five children [32]. Overall, malnutrition is associated with a two to three fold increase in mortality from ALRI [33].

In the present study incomplete immunization for age, low education level of parents, low socioeconomic status, overcrowding, use of biomass fuel, low birth weight, prelacteal feeding, lack of exclusive breast feeding for 4-6 months and malnutrition were found to be independent risk factors for severe pneumonia by univariate analysis.

In order to find out the effect of interaction between multiple variables, multiple logistic regression analysis was done.

The logistic regression model can be written as:

$$\text{Probability of an event} = \frac{1}{1+e^{-Z}}$$

Where Z is the linear constant.

$Z= B_0+B_1X_1+B_2X_2\ldots\ldots\ldots\ldots..+B_p X_n$

Where B_0 & B_1 are coefficients estimated from the data.

X_1, $X_2\ldots\ldots\ldots X_n$ are the independent variables and 'e' is the base of the natural logarithm approximately 2.178.

In logistic regression the parameters of the model are estimated by using the maximum likelihood method. Based on the estimates of B_0, B_1, $B_2 \ldots B_n$ we predict the probability of the event. In our study dependent variables have two values: 0 and 1, where 0 means cases and 1 means controls.

The independent variables included were both qualitative and quantitative such as age, sex, domicile, religion, type of family, immunization status, history of respiratory infections in family members, parents' literacy level, SES, type of house, type of floor, overcrowding, type of cooking fuel, type of kitchen, parental smoking, birth weight, history of prelacteal feeding, exclusive breast feeding and malnutrition.

The chi square statistic is the difference in –2 log likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

In this study 20 independent variables have been included in the model. With p value <0.05 as significant, younger age (p=0.019), incomplete immunization for age (p=0.00), low literacy level of mother (p=0.00) overcrowding (p=0.004), use of biomass fuels (p=0.00), prelacteal feeding (p=0.00), lack of exclusive breast feeding (p=0.00) and malnutrition (p=0.00) have shown significant association with severe pneumonia.

Some of the variables which had shown association in univariate analysis were found to be significant by multivariate analysis. Although these variables can be considered as independent risk factors, the interaction among these factors is also an important risk factor for the development of severe pneumonia.

Conclusion and Recommendations

The present study identifies – Incomplete immunization for age, low education level of parents, low socioeconomic status, overcrowding, use of biomass as fuel for cooking, low birth weight, prelacteal feeding, lack of exclusive breast feeding for 4-6 months and malnutrition as significant risk factors for severe pneumonia in under five children by univariate analysis. By multivariate analysis it was found that younger age, incomplete immunization for age, low educational level of mother, overcrowding, use of biomass fuels for cooking, prelacteal feeding, lack of exclusive breast feeding and malnutrition were found to be significant risk factors for severe pneumonia.

Information on risk factors, along with feasibility and cost considerations, is essential for guiding preventive strategies against severe respiratory infections in children.

1. Socioeconomic factors represent the ultimate determinants of a large proportion of the burden of severe ARIs, but interventions against factors such as low income or low educational levels fall outside the scope of the health sector. Available epidemiological evidence, however, should be used to support the political struggle against inequality.

2. Possible effective interventions for reducing respiratory morbidity and mortality due to environmental factors include anti-smoking campaigns, and improved biomass-burning stoves, as well as birth spacing and improved housing to reduce crowding.

3. Regarding nutritional factors, low birth weight, malnutrition, and lack of breast-feeding constitute independent risk factors for pneumonia and interventions include efficient antenatal care, promotion of breast feeding, and appropriate MCH and family welfare services. It should be noted that most of the above interventions would 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.

Summary

Two hundred seventy cases of severe or very severe pneumonia admitted to pediatrics wards of VIMS hospital, Bellary during a period of one year and equal number of age and sex matched controls coming for immunization to the same hospitals were studied to identify some of the risk factors for severe pneumonia.

1. In this study 156 (28.9%) were infants with 79 (29.2%) cases and 77 (28.5%) controls. Out of 270 cases 67.1% were males and 32.9% were females.

2. 63%children from rural area had severe pneumonia when compared to 55.2% children from urban area.

3. There was no significant association between religion and severe pneumonia.

4. Majority of 175 (64.8%) cases were from nuclear family. There was no significant association between type of family and severe pneumonia.

5. There was a significant association between immunization and risk of pneumonia and children who were unimmunized or partially immunized had 3.9 times higher risk of developing the disease.

6. There was no significant association between history of respiratory infections in family members and severe pneumonia.

7. Mothers' literacy status was significantly associated with the risk of severe pneumonia. Fathers' literacy status was also significantly associated with severe pneumonia.

8. A statistically significant association was found between social class and severe pneumonia.

9. Type of house did not show any significant association with severe pneumonia.

10. Overcrowding increased the risk of developing severe pneumonia by 2 times.

11. There was a significant association between type of cooking fuel and severe pneumonia, with odds ratio 2.49 for biomass fuels. There was no significant association between type of kitchen and severe pneumonia.

12.Parental smoking is not very significant in causing the pneumonia.

13.The association was found to be significant and cases having history of low birth weight had 1.5 times higher risk of developing severe pneumonia.

14.There was a significant association and cases who were given prelacteal feeds had 2.94 times higher risk of developing severe pneumonia

15.There was a significant association between duration of exclusive breast feeding and risk of severe pneumonia.

16. There was a significant association between malnutrition and severe pneumonia.

By multivariate analysis it was found that younger age, incomplete immunization for age, low

educational level of mother, overcrowding, use of biomass fuels for cooking, prelacteal feeding, lack of exclusive breast feeding and malnutrition were found to be significant risk factors for severe pneumonia in under five children.

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