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Original Research Article

Risk factors responsible for lower respiratory tract infections in children aged under five: a hospital based study

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ABSTRACT

Background: Lower respiratory tract infections (LRTI) contribute significantly in terms of hospital admission and mortality. Along with attempts to improve treatment modalities, it is imperative to identify risk factors that will aid in prevention of these infections.
Methods: This was a case-control study done in tertiary care hospital, Cuttack, enrolling inpatients between 2 months to 5 years with symptoms suggestive of LRTI as cases. Those with tuberculosis, aspiration pneumonia, asthma and nosocomial infections were excluded. After obtaining consent, questionnaire was administered to parents, regarding their socio-demographic and other relevant details. Data analysis was done using statistical software Epi Info™, version 6 and association of each variable with LRTI assessed with chi-square test.
Results: A total of 314 children were enrolled in the study, with 158 being cases. The case-fatality rate was 23% and 53.8% suffered from complications, the most common being respiratory failure. A significant association was seen between LRTI and social variables namely maternal literacy(p-value<0.005), socioeconomic status (p-value<0.001) and number of children (p-value<0.001), housing pattern (p-value<0.001), fuel used at home (p-value=0.003), ventilation adequacy (p-value=0.004), presence of separate kitchen at home (p-value=0.0009) and presence of overcrowding (p-value<0.001) and individual factors improper breastfeeding(p-value<0.005) and weaning(p-value=0.03), malnutrition (p-value<0.001), vitamin A deficiency(p-value=0.03) and history of respiratory infection in mother (p-value=0.025) or siblings(p-value=0.048).
Conclusions: The burden of lower respiratory tract infections can be substantially reduced by prevention using the identification of risk factors such as housing patterns, education of parents and improved nutrition of the children, and measures to combat the same, at each level.

Keywords: Lower respiratory tract infections, Respiratory infections, Under fives

INTRODUCTION

Since long, child mortality is a sensitive indicator of a country's socio-economic development. Even though India has made significant improvements in decreasing under five mortality and infant mortality, it is still a matter of concern, especially in the lesser flourishing states in the country. One of the leading cause of death in the under five children in our country continues to be acute respiratory infections, secondary to preterm related complications, accounting to 15.9% of the deaths.[1] In India, hospital records from high mortality states that upto 13% of inpatients deaths in paediatric wards are due to ARI.

According to recent WHO/UNICEF data, about 20% of all deaths in children under five years are due to acute lower respiratory infections (pneumonia, bronchiolitis

and bronchitis); 90% of these deaths are due to pneumonia. Studies have shown that up to 19% of children hospitalized with pneumonia die in India.[2]

Most schemes under the government, at the grass root level especially under IMNCI, do not attempt to distinguish between the different lower respiratory tract infections, but rather focus on the severity of the disease, labelling it under the broad term.[3] On the other hand, most studies focus on the etiology, diagnosis of individual diseases and their treatment. However, in view of the high mortality and morbidity along with hospitalisation expenditures, there arises need to review the various risk factors that could lead to the same.

Previous studies have suggested a link between breastfeeding, birth weight, nutritional status and other socio-demographic features in relation to lower respiratory tract infection.[4-6]

Seeing the always changing spectrum of these infections in the country, regular updates regarding the risk factors are needed from time to time, in order to revise the measures that should be imparted and instilled into the community, such that the fight against lower respiratory tract infections can be begun at every level.

METHODS

This study is a case-control study, conducted in Department of Pediatrics, SVPPGIP and SCBMCH, from December 2018 to November 2019. Prior permission from the institutional ethical committee was obtained and verbal informed consent was taken from person accompanying the ARI child; preferably the mothers were interviewed.

Inclusion and exclusion criteria

Children between 2months to 5 years admitted in ward with signs and symptoms of lower respiratory tract infections like cough increased respiratory rate, difficulty in breathing, wheeze, crepitation, chest indrawing, chest pain, and expectoration. The children with tuberculosis, bronchial asthma, aspiration pneumonia and hospital acquired illness are excluded in this study. Controls included in the study were children due to non-respiratory problems during the study period.

Method of collection of data

For both cases and controls a detailed history was done according to a predesigned proforma to elicit various potential risk factors. The association between lower respiratory tract infections with socio-demographic characteristics, medical conditions and environmental variables were studied.

Outcome of the cases in terms of primary and secondary outcomes were studied. Primary outcome in terms of mortality and secondary in terms of complication and number of days of hospitalization were studied.

Definitions used in the study were as follows:

Crowding

- More than 2 persons sharing a child's bedroom.[7,8]

Standards of ventilation[9]

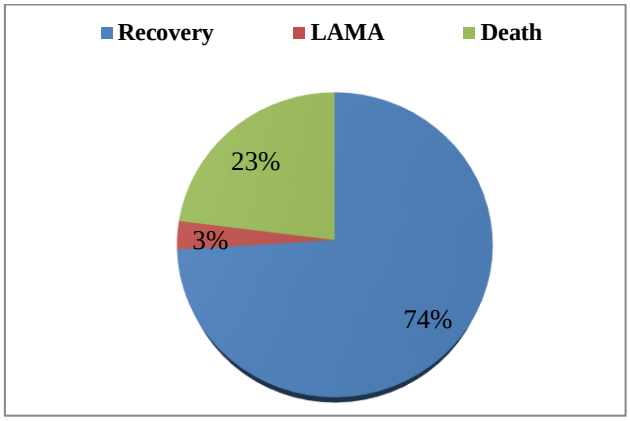
- Cubic space- Different workers have advocated standards for the minimal fresh air supply ranging from 33 to 3,000 cu. ft per hour per person
- Air change- It is recommended that in living rooms, there should be 2 or 3 air changes in one hour
- Floor space- The optimum floor space requirements per person vary from 50 to 100 sq. feet.

Data analysis

The statistical software Epi Info™, version 6, was used for statistical analysis. Association of each of the categorical variable with ARI was assessed with chi-square test and p-value <0.05 was considered as statistically significant.

RESULTS

A total of 314 children were enrolled in the study, out of which 158 were cases. 65% of the total population were in the age group between 2 months and 1 year, with the male to female ratio being 1.49. Moreover, 60% belonged to rural background with almost half (47%) of mothers being literate. A small proportion of population i.e. 13% and 7% had grade 1 or 2 malnutrition and greater than or equal to grade 3 malnutrition.



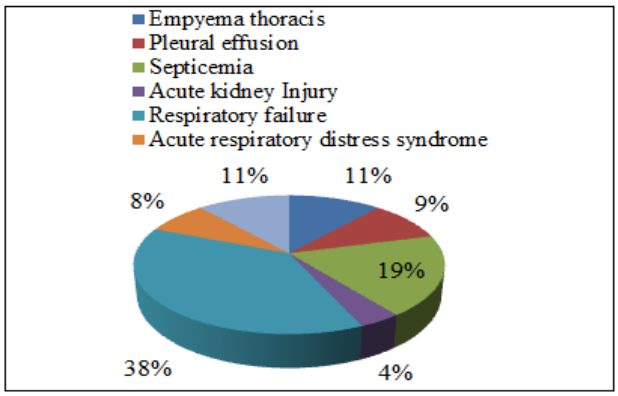
LRTI – Lower respiratory tract infections
LAMA- Leave against Medical Advice

Figure 1: Primary outcome of the LRTI cases.

The primary outcome of the cases with lower respiratory tract infection showed a case fatality of 23 %.(Figure1) In terms of secondary outcome, 53.8% of the cases

suffered from complications, the most common one being respiratory failure (Figure 2).

Various demographic factors were studied in order to find an association with risk of lower respiratory tract infections namely age-group (p-value=0.5), sex (p-value=0.43), residence (p-value=0.08), literacy of the mothers (p-value<0.005), socioeconomic status of family (p-value<0.001) and number of children (p-value<0.001).



LRTI- lower respiratory tract infection

Figure 2: Complications of the LRTI cases.

Social factors significantly associated included housing pattern (p-value<0.001), fuel used at home (p-value=0.003), ventilation adequacy (p-value=0.004), presence of separate kitchen at home (p-value=0.0009) and presence of overcrowding (p-value<0.001). Details are mentioned in Table 1 and 2.

On the other hand, history of respiratory tract infections in mother of the child (p-value=0.025) or in the sibling (p-value=0.048) also increased the risk of lower respiratory tract infections in children. Additionally, the adequacy of weaning and exclusive breastfeeding till 6 months were also found to be significant protective factors, with p-value being <0.005 and 0.031. Furthermore, grade of malnutrition (p-value<0.0001) and Vitamin A deficiency (p-value=0.03) also increased the vulnerability of the child to lower respiratory tract infections.

However, complete immunisation, whether it be in accordance with national immunisation schedule or including optional vaccines, failed to form a significant association. Similarly, prematurity and presence of congenital birth defects also were not significantly associated with lower respiratory tract infection (P-value=0.03).

Table 1: Social and demographic variables assessed as risk factors for LRTI in the study.

Variable		Cases (n=158)	Controls (n=156)	X^2 value	p-value
Age group	2 months- 1 year	100 (63%)	104 (67%)	0.393	0.5307
	1-5years	58 (37%)	52 (33%)		
Sex	Male	98 (62%)	90 (58%)	0.6134	0.4335
	Female	60 (38%)	66 (42%)		
Residence	Rural	102 (65%)	86 (55%)	2.9046	0.088
	Urban	56 (35%)	70 (45%)		
Literacy status of mothers	Literate	66 (42%)	101 (65%)	16.6362	0.000045
	Illiterate	92 (58%)	55 (35%)		
Socioeconomic status	Lower	73 (46%)	39 (25%)	44.3637	<0.00001
	Upper-lower	73 (46%)	58 (37%)		
	Lower-middle	10 (7%)	36 (23%)		
	Upper-middle	2 (1%)	23 (15%)		
Maturity at birth	Term	131 (83%)	138 (88.5%)	1.9695	0.16
	Preterm	23 (17%)	18 (11.5%)		
Immunization	Adequate	153 (97%)	154 (99%)	1.2763	0.2586
	Inadequate	5 (3%)	2 (1%)		
Exclusive breastfeeding (4-6 months)	Yes	112 (71%)	129 (83%)	6.1319	0.0132
	No	46 (29%)	27 (17%)		
Appropriate weaning	Yes	90 (57%)	126 (81%)	20.7228	0.000005
	No	68 (43%)	30 (19%)		
Malnutrition	Absent	110 (70%)	140 (90%)	20.6548	0.000033
	Grade 1/2	28 (18%)	12 (8%)		
	Grade≥3	20 (12%)	4 (2%)		
Congenital defects	Yes	11 (7%)	7 (4.5%)	0.6545	0.4185
	No	147 (93%)	149 (95.5%)		

Table 2: Housing variables assessed as risk factors for LRTI in this study.

Housing Variables		Cases (n=158)	Controls (n=156)	X^2	p-value
Housing pattern	Mud	98 (62%)	48 (31%)	6.883	<0.0001
	Cement	60 (38%)	108 (69%)		
Cooking fuel	LPG	69 (44%)	94 (60%)	8.6498	0.003271
	Others	89 (56%)	62 (40%)		
Overcrowding	Present	94 (59.5%)	36 (23%)	42.9094	<0.0001
	Absent	64 (40.5%)	120 (77%)		
Ventilation	Adequate	105 (66.5%)	126 (81%)	8.2702	0.00403
	Inadequate	53 (33.5%)	30 (19%)		
Separate kitchen	Present	114 (72%)	136 (87%)	10.9237	0.000949
	Absent	44 (28%)	20 (13%)		

DISCUSSION

In modern times, owing to the high mortality and hospital admissions due to lower respiratory tract infections (LRTI), the focus of most studies has shifted primarily to the diagnostic modalities and treatment guidelines and options available for such cases. Though the sheer need for these studies cannot be refuted, it poses a significant load to the medical fraternity, employing massive economic resources and manpower. It is well known that prevention is better than cure, and applying the same to this scenario, would mean identifying risk factors present in the society or at the individual level, such that prime focus can be imparted to them, in order to arrest the development of such disease in the primordial level.

This study employs 158 cases, admitted with lower respiratory tract infection, against 156 non-LRTI cases, in an attempt to assess the significant risk factors for the same.

This study reveals a significant difference in the rates of LRTI in families based on the literacy of the mother, number of children in the family and the socioeconomic status.

Mothers form the first line of care in the family- their own knowledge on hygiene and sanitation, disease and home remedies and also in detection of the minor changes in her children at the onset of illness, shapes the attitude towards health in her children, along with the outcome of the diseases. Similar to this study, Victora et al, Prajapati et al, and Savitha et al, also found a significant association of LRTI with the education of mothers.[4-6]

The link between LRTI and number of children could possibly be consequent to the fact that increasing number of children in the same house, apart from aiding to overcrowding, also establishes a chain of interpersonal spread of respiratory pathogens. In this study, a significant association was established, which was comparable to the results in study done by Victora et al.

A significant association was also seen in the study, with socioeconomic status, with the risk for respiratory infection decreasing with increasing social class, similar to the studies done by Savitha et al, Dhanjaya et al and Bhagat et al.[4,5,10,11]

Presence of overcrowding and inadequate ventilation were also found to be important risk factors, with p-value in this study being <0.001 and 0.004 respectively. Poor housing conditions harbour an environment where there is lack of cross-ventilation and overcrowding; initiate a chain of indoor pollution and easy transmission by respiratory droplets due to close proximity. Various other studies have also cautioned against overcrowding and lack of adequate ventilation, as precautionary measure against lower respiratory tract infections.[4-6,10,12] They also form the basis for various housing standards that have been proposed.

Adding to these factors, further aggravating the condition are the absence of separate kitchen at home (p-value=0.0009) and the housing pattern i.e. mud or cement (p-value<0.001), which was similar to studies done by Sikolia et al and Dhanjaya et al.[10,13] Dampness of mud floor, along with cracks and crevices, harbour infection and predispose to lower respiratory tract infection, as compared to cement, which can be cleaned well. Presence of the separate kitchen isolates the fumes from the cooking stove and gas, such that children are less exposed to such noxious fumes that can be damaging to their respiratory tract. Furthermore, the fuel used at home, especially non-LPG ones, by contributing to indoor pollution, also predisposed children to LRTI, in this study, in accordance with studies done by Ladomenou F et al, and Smith KR et al.[14,15]

Nutritional history also had a lot to contribute to the risk for lower respiratory tract infections, in terms of breastfeeding practices and weaning. Exclusive breastfeeding till 6 months conferred significant protection and showed a significant negative association with lower respiratory tract infection in this study (p-value=0.031), similar to Broor et al.[16] On the other hand,

improper weaning practices including premature or delayed weaning, inadequate weaning and improper food used for weaning, also showed an increased tendency for lower respiratory tract infections, in this study. A significant association between weaning status and acute respiratory infection (ARI) was also reported by Pore et al in their study conducted among under-fives of Solapur.[17]

Various community based studies such as Delhi study by Chhabra P et al, observed that severe malnutrition was a significant contributor of ARI in children under-five years and study by Das PK et al, opined that malnutrition is significantly associated with occurrence of ARI among under-five children.[18,19] Malnutrition, especially higher grades also showed a significant association with lower respiratory tract infection, in this study. Vitamin A deficiency, specifically, also showed a higher propensity to cause LRTI, p-value being 0.03.

However, this study failed to establish an association between immunisation and LRTI, contrary to the studies by Savitha et al and Pore et al.[4,17]

Overall, it would be apt to say that lower respiratory tract infection is not just a matter in the hands of physicians, but a significant load of these lie in patient's personal and community measures, starting from feeding practices to housing patterns. Thus, it would be of much importance to improve housing standards of the people, especially in terms of housing material, ventilation and spacing. Preferential, and if feasible, exclusive use of LPG instead of other cooking fuels should be promoted, to avoid indoor pollution. With the help of government schemes, family and support groups should be educated regarding breastfeeding and optimum weaning practices followed by concepts of nutrition rich food. Strengthening the peripheral services under the cover of National Health Mission and IMNCI, along with early detection and prompt initiation of treatment, will aid in reducing the incidence and morbidity associated with various lower respiratory tract infections, which in turn, will reap great leaps in reduction of under-five and infant mortality in the country.

CONCLUSION

The problem of lower respiratory tract infection remains deep-rooted in the society, with various social, demographic and individual risk factors- parental illiteracy, lower socioeconomic class, malnutrition, inadequate breastfeeding and weaning, overcrowding, to name a few. The burden of such infections need a comprehensive approach, which deal with not only the diagnosis and treatment of such conditions, but also prevention at the primary and community level.

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