Clinico-aetiological profile of respiratory distress in children: A study from a rural tertiary care centre in North India

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Abstract

Introduction: Respiratory distress is a common cause of hospital admission in the paediatric population, which may be a manifestation of many underlying conditions. India is witnessing numerous changes in air quality, socio-economic trends and increased coverage in childhood immunisation.

Objectives: To describe the current picture of clinico-aetiological profile of north Indian children hospitalised because of respiratory distress.

Method: This was a cross sectional observational study carried out at a rural tertiary care centre in north Indian state of Uttar Pradesh. Children aged 1 month to 18 years, presenting with respiratory distress, were studied for their clinical, aetiological and socio-demographic profiles. Statistical analysis was done using SPSS version 21.

Results: A total of 180 children was enrolled. Male to female ratio was 1.57:1. Upper-lower socioeconomic class was significantly associated with mortality (p =0.02). Common aetiologies were bacterial pneumonia (38.8%), bronchiolitis (21.1%) and asthma exacerbation (15.5%). Majority of asthma related admissions were in the winter months. Respiratory system pathology was present in 76.7% cases.

***Conclusions*:** In this study of clinico-aetiological profile of north Indian children, hospitalised because of respiratory distress, infection was the most common aetiology. Children belonging to lower socioeconomic strata and unimmunised children constituted the majority of admissions. Asthma exacerbation in the winter months was as an important cause of morbidity in children.

(Key words: Respiratory distress, Infections, Anaemia, Pollution)

Introduction

Respiratory distress is an umbrella term used to depict a host of clinical features such as difficulty in breathing, increased respiratory rate and grunting[1]. Respiratory distress is a matter of global public health concern with special impact on health of children in developing countries[2,3]. Young children comprise more than 50% of total childhood respiratory distress admissions[4]. Infections are the most common cause for respiratory distress among children, but with a change in environment and increase in cases of allergy-related illnesses, the contribution of non-infectious causes of respiratory distress is increasing[5]. Also, mortality rates in lower middle-income countries are reportedly higher compared to those in upper middle-income countries, suggesting that respiratory distress associated mortality rates show an economic divide[3]. There are limited studies describing the clinico-aetiological profile of respiratory distress in Indian children. Understanding the aetiology and clinical profile of paediatric respiratory distress helps in formulation of suitable management and intervention strategies both at hospital and community levels.

Objectives

To describe the clinico-aetiological profile of patients admitted due to respiratory distress at a rural centre in Northern India.

Method

A cross-sectional observational study was conducted from July 2020 to December 2021 at a rural tertiary care centre in western part of Uttar Pradesh, a north Indian state.

Inclusion criteria: The study subjects included children 1 month to 18 years of age, admitted with respiratory distress in paediatric emergency.

Exclusion criteria: Patients in whom the aetiology could not be established due to any reason, or were

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known cases of congenital respiratory causes, were excluded from this study.

Entire course of illness was followed till discharge of patient from hospital or death of the patient.

Sample size was calculated from the formula: Sample size= Z^2 (PQ)/E^2 where Z^2 is standard normal variable taken as 1.96, P is prevalence (taken from previously published literature)[6], Q is (100-P) and E is absolute error taken as 5%. Minimum sample size of 85 patients was required for this study.

Routine haematological, biochemical, radiological investigations and management were carried out on a case-to-case basis. Nutritional status was assessed according to World Health Organisation (WHO) classification of malnutrition in age group less than 5 years and Indian Academy of Paediatrics (IAP) anthropometry charts (2015) in age group more than 5 years[7,8]. Patients with anaemia were classified according to the WHO classification of anaemia in children[9]. Respiratory distress was defined as per WHO[10]. Severity of respiratory distress was classified as mild, moderate and severe[11].

Ethical issues: The study was approved by the Institutional Ethics Committee of the Teerthanker Mahaveer University, Maradabad, Uttar Pradesh, India (No. TMMC&RC/IEC/19-20049) dated 19.12.2019. Prior written informed consent was obtained from the parents of the patients included in this study.

Statistical analysis: Entire clinical and laboratory data were collected in a structured proforma and data were compiled in a Microsoft Excel sheet. Statistical analysis was carried out by SPSS package version 21. For statistical evaluation of continuous data, t-test and for categorical data Chi-square test were employed. For statistical significance, the p-value was set at <0.05.

Results

A total of 212 patients were initially enrolled in the study. According to study protocol, 32 patients were excluded and finally 180 subjects aged 1 month to 18 years were included in the final analysis (Figure 1).

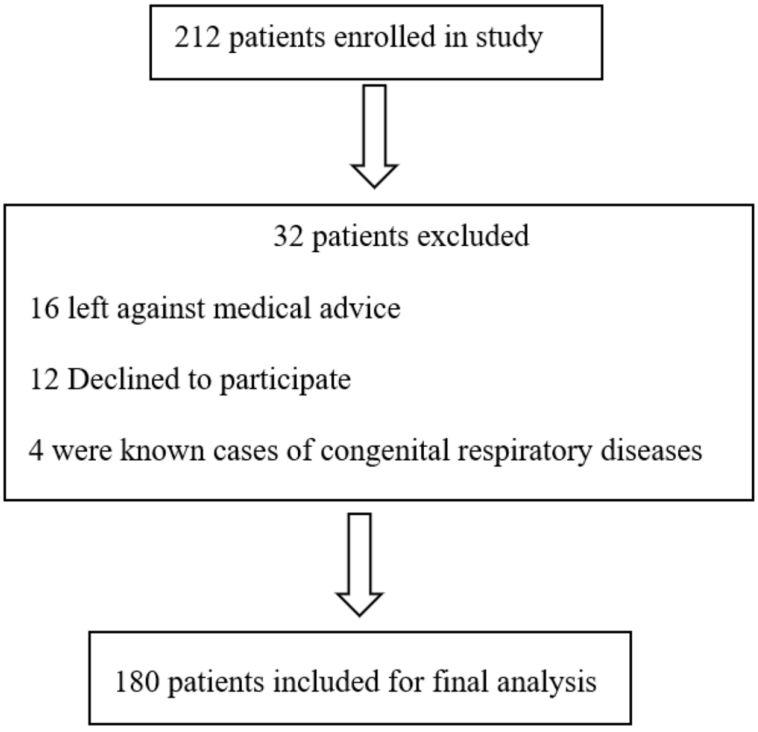

Figure 1: flow diagram of study

Table 1 shows the socio-demographic profile of patients in this study. The male to female ratio was 1.57:1.

Table1: ***Socio-demographic profile of patients in this study (n=180)***

Socio-demographic profile	Number (%)
Age	
1 month -1 year	36 (20.0)
>1 year-5 years	68 (37.8)
>5 years -10 years	62 (34.4)
>10 years	14 (07.8)
Gender	
Male	110 (61.1)
Female	70 (38.9)
Geographical distribution	
Rural	88 (48.9)
Urban	92 (51.1)
Method of cooking food	
Stove – Liquefied petroleum gas (LPG) only	104 (57.7)
Wood and others	76 (42.2)
Smoke emitting industry (brass industry) within 1km	
Present	78 (43.3)
Absent	102 (56.7)
Socio-economic status - Modified Kuppuswamy scale[12]	
Upper class (I)	0
Upper middle class (II)	0
Lower middle class (III)	09 (05.0)
Upper lower class (IV)	131 (73.0)
Lower class (V)	40 (22.0)
Immunization status	
Completely immunized	46 (25.6)
Partial immunization	118 (65.6)
Unimmunized	16 (08.9)
Nutritional status[7,8]	
Normal	100 (55.5)
Moderate acute malnutrition	76 (42.2)
Severe acute malnutrition	04 (02.3)
Anaemia[9]	
Normal	42 (23.3)
Mild anaemia	40 (22.3)
Moderate anaemia	90 (50.0)
Severe anaemia	08 (04.4)

Table 2 shows the distribution of the study population according to the severity of respiratory distress.

Table 3 gives the aetiology of respiratory distress and its distribution in the study population. Primarily respiratory system involvement was in 76.7% in study cases.

Table 4 gives the profile of patients admitted with the two chief morbidities of asthma and pneumonia.

Table 2: ***Distribution of study population according to severity of respiratory distress (n=180)***

Severity of respiratory distress	Number (%)
Mild	70 (38.9)
Moderate	96 (53.3)
Severe	14 (07.8)

Table3: ***Aetiology of respiratory distress and its distribution in the study population***

Aetiology	Number (%)
Pneumonia	70 (38.8)
Bronchial Asthma	28 (15.5)
Bronchiolitis	38 (21.1)
Pulmonary tuberculosis	08 (04.4)
Meningitis	18 (10.0)
Congenital heart disease	08 (04.4)
Diabetic ketoacidosis	06 (03.3)
Poisoning	04 (02.2)

Table 4: ***Profile of asthma and pneumonia patients***

Feature	Asthma *(n=28)*	Pneumonia *(n=70)*
Area of residence near smoke emitting industry – n (%)*	18 (64.2)	43 (61.4)
Winter season (December to February) admissions – n (%)	20 (71.4)	38 (54.2)
Need of invasive mechanical ventilation – n (%)	03 (10.7)	09 (12.8)
Severity of respiratory distress – n (%)		
a) Mild	08 (28.5)	40 (42.8)
b) Moderate	12 (43.0)	25 (35.7)
c) Severe	08 (28.5)	05 (24.0)
Outcome – n (%)		
a) Survival	28 (100.0)	67 (97.2)
b) Mortality	0 (0)	03 (02.8)

**The study place caters to general population and a large portion of it coming from areas of brass industry, and the local area of this metal industry is heavily polluted*[13]*. For study purpose 'near' criteria was kept as those residing within 1 kilometre of metal industrial area of the city.*

There was a history of fever in 76.7% cases. Relevant investigations were done in all cases at the time of admission and laboratory evidence of acute infection was seen in all these cases at the time of admission. Blood culture showed growth in 20 cases out of which *Staphylococcus aureus* was cultured in 4 cases, *Streptococcus pneumoniae* in 12 and *Escherichia coli* in 4 cases.

Out of 16 cases which were mechanically ventilated, 4 expired. All patients with mild and moderate respiratory distress survived and were successfully discharged from hospital. Overall survival rate of patients admitted with respiratory distress was 97.7%. Out of the 4 patients who expired, three were diagnosed with bacterial pneumonia and one case had kerosene oil pneumonitis.

The average duration stay of all patients was 8 days (median) with 5-14 days interquartile range. One patient expired within 24 hours, while other 3 patients expired within 48-72 hours of hospital stay. Of the patients that expired, 2 were in >1 to 5-year age group and 2 in >5-10 years age group. All patients in other age groups had a favourable outcome and were discharged home. Lower socio-economic status, malnutrition and under-immunization were significantly associated with mortality due to respiratory distress (Table 5).

Table 5: ***Risk factors for mortality***

Feature	Outcome of respiratory distress			*p*-value
	Number of cases	Survived n (%)	Died n (%)	
Age group				
1 month -1 year	36	36 (100.0)	0 (0)	
>1 year-5 years	68	66 (97.1)	02 (02.9)	0.851
>5 years -10 years	62	60 (96.7)	02 (03.2)	
>10 years	14	14 (100.0)	0 (0)	
Socio-economic status[12]				
Upper class (I)	0	0 (100.0)	0 (0)	
Upper middle class (II)	0	0 (100.0)	0 (0)	0.020
Lower middle class (III)	10	08 (80.0)	02 (20.0)	
Upper lower class (IV)	132	130 (98.5)	02 (01.5)	
Lower class (V)	38	38 (100.0)	0 (0)	
Nutritional status[7,8]				
Normal	100	100 (100.0)	0 (0)	
Moderate acute malnutrition	76	75 (98.7)	01 (01.3)	<0.001
Severe acute malnutrition	04	01 (25.0)	03 (75.0)	
Immunization status				
Completely immunized	46	46 (100.0)	0 (0)	
Partial immunization	118	116 (98.3)	02 (01.7)	0.045
Unimmunized	16	14 (87.5)	02 (12.5)	

Discussion

A total of 180 children was enrolled, including children aged 1 month to 18 years. Majority (57.8%) were aged ≤5 years. Almost all studies have shown younger children to be most affected[14-16]. These findings reinforce the fact that respiratory distress is an important cause of morbidity and mortality in children <5 years of age[17]. There was a male predominance in our study with a male to female ratio of 1.57:1. Similar results were obtained in a study by Ganeshan LS, *et al*[18].

Lower socio-economic status (SES) children comprised the largest fraction in the study group. The relationship between lower SES and risk of respiratory illnesses is well-documented[19-21]. High prevalence of overcrowding, under-immunization, malnutrition and poor health access are well documented factors in poor families in earlier studies too[19-21]. In the present study, nearly three fourths of children were either incompletely immunized or totally unimmunized. Differences of immunization status in different studies can be explained due to different geographical areas. Unimmunized children are more prone to respiratory infections. Other studies have demonstrated similar findings[18]. With the advent of pneumococcal vaccine in the national immunisation schedule, it is hoped that admissions due to respiratory illness can be further brought down. However, that can happen only when the vaccination coverage is increased. Anaemia and malnutrition are factors which decrease immunity and increase the propensity to infections and other illnesses. Similar observations were made by Lekshminarayan A, *et al*[14], Raghuram AS *et al*[15] and Nagaram PP, *et al*[16].

In this study, clinically moderate and severe respiratory distress (WHO classification) was present in 96 (53.3%) and 14 (7.8%) children respectively. Anand AL, *et al*[21] found 41.7% to have severe distress. Differences in severity of respiratory distress in different studies could be dependent on the time of arrival, primary care sought and other clinico-demographic factors.

Most patients were admitted in winter months (when the pollution levels in north India have been showing a huge surge in the last 10 years)[22]. Irrespective of differences in proportions and spectrum of different aetiologies in different studies, pneumonia seems to be the most dominant aetiology, similar to this study. Notably, asthma cases were also a significant portion of the study population. The industrial areas dealing with smoke emitting furnaces in close vicinity of residential houses of lower socioeconomic strata pose a severe health hazard[23]. Out of the 28 patients with severe asthma who were admitted during this study, 3 had to be ventilated and all three survived (Table 4). Bisgaard H, *et al*[23] and Devulapalli CS[24] have shown similar findings. More than 75% of the asthma exacerbation patients were residents of the smoke emitting brass industry areas. Though Yadav B, *et al*[25] reported pneumonia as the most common aetiology, studies by Strickland MJ *et al*[26] and Rabinovitch N, *et al*[27] showed that there is a confounding effect of respiratory infections on short-term air pollution exposure and asthma so that it is difficult to diagnose asthma as it clinically confused with wheeze associated infections.

In this study, mortality was reported in 4 (2.2%) cases. All 4 patients were not completely immunized and had anaemia and malnutrition. Aetiology was found to be bacterial pneumonia and kerosene pneumonitis. A previous study by Morrow PE[28] reported higher mortality rates due to pneumonia and other aetiologies in high air pollution areas. High survival rate of 97.8% reported in our study can be attributed to earlier time of presentation, mild distress at the time of presentation in maximum cases and lower culture positivity rate.

The study had some limitations. The sample size was small (due to Covid-19 pandemic induced disturbance as our hospital was acquired for dedicated Covid-19 services) because of which results cannot be generalised to the entire paediatric population of India. Also, in this study there were no cases from upper socio-economic strata population, so it is difficult to comment on profile of respiratory distress in higher socioeconomic strata.

Conclusions

In this study of clinico-aetiological profile of north Indian children hospitalised because of respiratory distress, infections were the most common aetiology. Children belonging to the lower socioeconomic strata and unimmunised children constituted the majority of admissions. Asthma exacerbation in winter months due to increased pollution has emerged as an important cause of morbidity in children.

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