

# Prevalence of hypoxemia & its determinates in children with Acute Lower Respiratory infection

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## Abstract

**Introduction:** Acute lower respiratory tract infections (LRTIs), most commonly pneumonia, are one of the major reasons for which children are brought to the hospitals. Effective reduction of mortality due to pneumonia is possible if children suffering from pneumonia are treated appropriately and promptly. Hypoxemia is the most serious manifestation and strong risk factor for mortality among children with acute lower respiratory tract infections. Early detection and treatment of hypoxemia is important in the management of these children. So in our study, we tried to determine prevalence of hypoxemia in children with acute respiratory tract infections. **Methods:** It was a prospective cross sectional study on 150 children aged 2 months- 60 months with acute respiratory symptoms (<14 days). The children who fulfilled the inclusion criteria were evaluated and examined thoroughly and their data was recorded in a pretested proforma. Statistical analysis was done with IBM SPSS 18. **Results:** Present study revealed prevalence of hypoxemia to be 35.3% with no significant correlation of age. **Conclusion:** Hypoxemia is present in almost one third of <5 children admitted with acute LRTIs and it is significantly associated with immediate outcome. Therefore sufficient measures should be employed to detect and manage hypoxemia.

**Keywords:** Hypoxemia, Pulse Oxymeter, Pneumonia, Hemoglobin.

## Introduction

Acute respiratory tract infections are among the major causes of preventable morbidity and mortality worldwide, with most of the deaths occurring among below five years children in developing countries [1]. WHO estimates that pneumonia is the leading cause of death in children under five years of age, killing over 2 million of children annually, accounting for about 20% of deaths in children under 5 years [2,3].

Acute respiratory tract infections are important cause of morbidity in children, responsible for about 30-50% of visits to health facilities and for 20-40%of admissions to the hospitals. In India acute respiratory tract infections are one of the major reasons for which children are brought to the hospitals. Effective reduction in mortality due to pneumonia is possible if children suffering from pneumonia are treated

appropriately and promptly. Hypoxemia is a serious manifestation of severe respiratory illness in children and a risk factor for mortality. As per the studies case fatality rate is inversely related to oxygen saturation [4].

Oxygen therapy improves the outcome with moderate or severe acute respiratory tract infection and in those with hypoxemia, the severity of hypoxemia correlates with outcome. Such an association between hypoxemia and pneumonia suggest that its early detection and treatment are important aspects in the management of children with acute respiratory tract infections.

Pulse oxymetry is a noninvasive and accurate method of measuring oxygen saturation but is expensive, so may not be available in all health care facilities in developing countries like India. So we are dependent on clinical signs to identify hypoxemia. For this reasons various symptoms and signs have been evaluated in many studies, for their ability to predict hypoxemia[4-

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9]. We determined the prevalence of hypoxemia in children with acute respiratory tract infection admitted in pediatrics emergency department of a teaching institute so as to ascertain proportion of children who might get benefited by oxygen therapy before or during referral.

## Material and Method

Study Design: Prospective cross sectional study

**Place of study:** Department of Pediatrics, of a medical college in central India.

**Study Period:** One year.

### Inclusion criteria

1. Children aged 2 to 60 months with respiratory symptoms of <14 days duration.
2. Children whose parental consent was obtained for inclusion in study.

### Exclusion criteria

1. Children having chronic respiratory diseases as asthma, bronchiectasis.
2. Children with congenital heart disease.

## Observations

The study showed that out of 150 children included in the study, majority of patients were in the age group of 2-12 months (table 1). The mean age of these children was  $12.29 \pm 13.90$  with variance of 193.34 58. 54% of patients were male and 46% were females.

The common presenting symptoms were fever in 84% children followed by fast breathing(60%), irritability(52%), inability to drink(38%), unusual sleepiness(24%) and convulsion( 2.7%).

Fifty eight percent (58%) patients had hemoglobin(Hb) more than 10 gm% and rest of the patients had Hb less than 10 gm%. X-ray chest findings in majority of patients were suggestive of consolidation (55.3%) followed by hyperinflation (26%) [table 2].

Out of the study subjects 64.7% patients had oxygen saturation of 95-100 and total prevalence of hypoxemia was found to be 35.3%.

Majority of patients (table 3) were diagnosed to have very severe pneumonia (30%), pneumonia (29%) and acute bronchiolitis (26%). On assessing the outcome, 82.7% patients were discharged after successful treatment, 12.7% patients left against medical advice and 6 died during treatment, leading to mortality rate of 4%.

The difference in mortality of hypoxemic and non hypoxemic children was statistically significant with  $p < 0.001$  (table 4).

Present study showed that hypoxemia was present in 36.85% of infants 2 months to 12 months and 30.7% of children aged between 13 months to 60 months. Total prevalence of hypoxemia was 35.3%. (figure 1). Age difference was not found significant among hypoxemic and non-hypoxemic group.

3. Children who were referred after cardio pulmonary resuscitation.

4. Children whose parental consent could not be obtained.

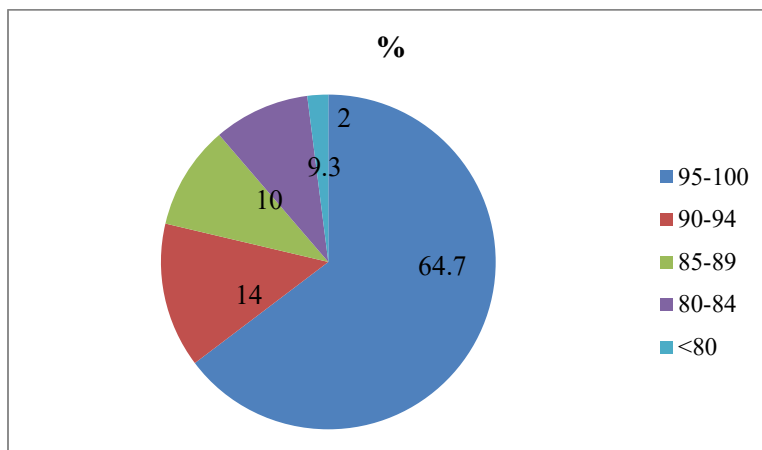
At admission, presenting complaints with duration were recorded from the caregiver of the child in the pre-tested clinical record, based on F-IMNCI program.

Clinical examination was done with emphasis on respiratory signs. Oxygen saturation was measured at finger or toe with LOTUS-500 pulse oximeter while the patient was breathing room air. Cut off value of oxygen saturation <95% was decided for diagnosis of hypoxemia [10,11].

Study subjects were further classified in to diagnostic categories of pneumonia, acute bronchiolitis, croup, pleural effusion, acute asthma or WALRI (Wheeze Associated Respiratory Tract Infections).

Patients with pneumonia were classified in to very severe pneumonia, severe pneumonia and pneumonia as per the F-IMNCI classification [12]. Investigations done were hemoglobin, complete blood counts, arterial blood gas analysis, chest x-ray.

**Fig 1: Distribution of oxygen saturation in children with LRTI:**



**Table-1: Distribution of age in hypoxemic and non hypoxemic children**

Age in months	N	Hypoxemic (%)	Non Hypoxemic (%)
2-12	111	41(36.9)	70(63.1)
13-24	24	8(33)	16(67)
25-36	5	1(20)	4(80)
37-48	4	0	4(100)
49-60	6	3(50)	3(50)
Total	150	53	97

(p value 0.636)

**Table-2: Investigations and their significance in hypoxemia**

Investigations	Parameters	hypoxemic		Non hypoxemic		P value
		n	%	n	%	
Hemoglobin	Hb<10gm%	33	62.26	30	30.9	0.000
X-ray findings	Consolidation	34	68	49	50	0.265
	Hyperinflation	9	18	30	30.9	
	Normal	4	8	15	15.46	
	Collapse	2	4	3	3	
	Pleural effusion	1	2	0	0	
ABGA	Ph< 7.35	37	78.7	13	17.5	0.000
	pO2<80	31/47	65.9	3	3.6	0.005

**Table 3: Distribution of diagnosis in hypoxemic and non hypoxemic group**

Diagnosis	Total	Hypoxemic(%)	Non –Hypoxemic (%)
Very severe pneumomia	45	33(73)	12(27)
Severe pneumomia	11	3(27)	8(73)
Pneumomia	44	2(4.5)	42(95.5)
Acute bronchiolitis	40	9(22.5)	31(77.5)
Pleural effusion	3	1(33)	2(67)
Acute asthma	3	3(100)	0
Croup	4	2(50)	2(50)
Total	150	53	97

P =0.341

**Table 4: Distribution of Outcome in hypoxemic and non hypoxemic group**

Outcome	Hypoxemic		Non Hypoxemic	
	N	%	N	%
Death	6	11.3	0	0
Lama	10	18.8	9	9.27
Discharge	37	69.8	87	89.6
Other			1	1.03

**P<0.001**

Table depicted that 11.3% deaths were reported among hypoxemic patients and no death reported in nonhypoxemic group. This was statistically significant.

## Discussion

A plausible gold standard for the presence of severe disease in acute lower respiratory tract infections is the presence of hypoxemia. Treatment guidelines recommend that in a child with pneumonia admitted for inpatient care, pulse oxymetry, a non invasive estimate of arterial oxygen, should be used to guide oxygen therapy [10,11,13].

But due to limited resources as an alternative, recent studies have suggested a range of respiratory and non respiratory signs that predict hypoxemia, thus guiding referral for or administration of oxygen therapy.

In our study 150 children aged between 2 to 60 months presenting with respiratory symptoms were evaluated for the prevalence of hypoxemia.

Our study showed hypoxemia in 36.95% patients in infants 2-12 months and 30.7% of children aged 13 to 60 months. Age difference was not found significant in hypoxemic and non hypoxemic group similar to some previous studies [16,17].

While in a study done by Singhi S et al in subjects aged 2-59 month, hypoxemia was more frequent (16.1%) in infants 2-11 months as compared to children 12-59 months with p-value 0.05. This difference may be due to difference in sample size [16].

The overall prevalence of hypoxemia is 35. 3% in our study while in a study done by Singhi S et al it was 11.9% [16]. Rakesh Lodha et al and Supartha et al found 25.7% and 17.5%.respectively in their studies [17,18].

This variance can be explained by differences in definition of hypoxemia, location (whether in the emergency room, inpatient ward or outpatient clinic) and the altitude where the study was conducted.

The distribution of hypoxemia in various diagnosis groups was assessed. It was found that the prevalence of hypoxemia was 73% in children with very severe pneumonia, 27% in severe pneumonia, 22.5% in bronchiolitis. We found insignificant correlation between various groups and hypoxemia (p=0.341). This is contrary to results from previous studies on hypoxemia in acute (LRTIs). The principal mechanism for hypoxemia of acute respiratory infection is mismatch between ventilation and perfusion in areas of pneumonic consolidation.

Lung compliance decreases leading to increased work required for ventilation. Dehydration from fever and inability to drink, lead to hemoconcentration, peripheral underperfusion and increase metabolic acidosis leading to compensatory hyperventilation, which limits its usefulness in assessing the degree of hypoxemia despite its usefulness in guiding the degree of systemic disturbance.

In the present study there was significant correlation of Hb less than 10 gm % with hypoxemia (p<0.000). On ABGA both low pH and pao<sub>2</sub> was significantly associated with hypoxemia. But x-ray findings were not significantly associated with hypoxemia.

According to our study presence of hypoxemia is predictive of short term mortality, indicating that the detection and treatment of hypoxemia may be crucial part of clinical management of these severely ill children in hospital. Conversely absence of hypoxemia predicts a low risk of death, even in the presence of radiological pneumonia.

This correlated well with the study by Onyango et al where short term mortality was 3-4 times greater in hypoxemic children [1].

The clear association of hypoxemia with mortality suggests that the detection and effective treatment of hypoxemia with oxygen are important aspects in the management of critically ill patients.

### Conclusion

Present study revealed prevalence of hypoxemia to be 35.3% and difference in mean age for hypoxemic and non hypoxemic group was not statistically significant. As almost one third children with pneumonia have hypoxemia, the availability of oxygen should be ensured at primary health centers located in the most peripheral areas.

This will definitely help in decreasing the mortality occurring due to pneumonia. Mortality rate was 11.3% in the hypoxemic group which is statistically significant. Thus presence of hypoxemia is predictive of short term mortality, indicating that the detection and treatment of hypoxemia may be a crucial part of clinical management of severely ill children in hospital.

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