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Relation between Pulse Oximetry and the Clinical Profile of Children with Pneumonia

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Abstract

Background: Failure to seek early care and delays in hospital diagnosis are commonly acknowledged determinants of mortality in childhood pneumonia with a higher proportion specially in under developed countries like Bangladesh. Rather than detecting pneumonia by only signs, pulse oximetry may be a useful tool in ensuring the most efficient use of oxygen therapy, which is especially important in resource-limited settings. The aim of this study was to assess the relation between pulse oximetry and the clinical profile of children with pneumonia. **Material & Methods:** This cross-sectional type of descriptive study was conducted in Department of Pediatric, Rangpur Medical Collage and Hospital, Rangpur from July 2014 to June 2016. This study was carried out on 205 Children aged 2-59 months suffering from pneumonia inpatient and outpatient of Pediatric department. **Results:** It was observed that majority (91.7%) patients had cough184(89.8%) had breathing difficulty and 173(84.4%) patients had fast breathing. It was observed that majority (92.2%) patients had ability to cry while examined. Majority (90.7%) patients had crepitations. Three (1.5%) patients was found pallor of palms, 178 (86.8%) patients were heart rate ≥100 beats per minute, 196(95.6%) were capillary refill time <3 second, 4(2.0%) hepatomegaly >2 cm and 131(63.9%) had temperature ≥ 38 °C. It was observed that Hypoxemia (≤90%) was found 51(24.9%) of the patients. The mean SpO2 was found 88.6±4.7 percent with range from 70 to 99 percent. **Conclusions:** Cough, breathing difficulty and fast breathing are most common signs of children with pneumonia. Through pulse oximetry test, the prevalence of hypoxaemia was found in 24.9% children.

Keywords:- Pulse Oximetry, Clinical Profile, Children and Pneumonia.

INTRODUCTION

One of the most frequent causes of morbidity and a substantial cause of death among children under the age of five is pneumonia.[1] One of the most serious complications of pneumonia is hypoxaemia, which is linked to an increased risk of mortality with increasing severity.[2] Compared to children who are not hypoxemic, children who have pneumonia are five times more likely to die.[3] Researchers defined hypoxaemia from <96.6% to <90% oxygen

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saturation at sea level and <85% to <88% at higher altitudes.[4] For the sake of convenience, a few ongoing multicenter international clinical studies for the treatment of pneumonia use cut-offs of <90% at sea level and <88% at higher altitudes to identify hypoxaemia.[5] By pulse oximetry, hypoxemia was defined by the WHO as SaO2 below <90%.[6] Pulse oximetry is also advised by the WHO's Integrated Management of Childhood Illness (IMCI) guidelines for detecting critically unwell kids with hypoxemia who need hospital referrals.[7,8,9] Pulse oximeters are infrequently seen at frontline institutions in low- and middle-income countries, despite their potential to lower mortality.[10,11,12,13] Pulse oximetry has been utilized in experimental and clinical settings to identify hypoxaemia since it is a quick, portable, non-invasive, and accurate way to measure Sp02.[14] Lower mortality risk has been linked to appropriate oxygen therapy based on PO results rather than only clinical indicators of severity.[15] Low blood oxygen saturation, or hypoxaemia, has been found to be a measure of severity and a predictor of morbidity and death in children with respiratory illnesses. It can be seen in a range of different diseases, including pneumonia.[16] However, in low- and middle-income country (LMIC) settings, hypoxaemia is typically diagnosed solely based on clinical findings. As a result, many of these children have a poor prognosis because healthcare professionals are unable to quickly identify and refer these children, whose lives are in danger.[17] Although pulse oximetry is a proven and non-invasive tool for diagnosing children with hypoxaemia, in countries with limited resources, pulse oximeters are rarely accessible outside of higher-level clinics.[7] Hypoxemia is one of the most deadly side effects of pneumonia.[15] Because different researchers have used different criteria, a study found a broad range of hypoxemia prevalence (31 percent - 72 percent), depending on the severity of the disease.[4] According to studies from Kenya, Zambia, and Zimbabwe, children with hypoxia have a risk of dying that is between 1.4 and 4.3 times greater than that of children without it.[5,18] Clinical symptoms, blood gas analysis, or pulse oximetry are three ways to find hypoxemia. The majority of writers now consider pulse oximetry as a reliable, secure, non-invasive, straightforward, and reproducible detection method.[2] Additionally, it has been discovered that the use of pulse oximetry outperforms the use of clinical symptoms alone in identifying hypoxaemia.[19,20] It may be a useful tool in ensuring the most efficient use of oxygen therapy, which is especially important in resource-limited settings. Clinical signs of pneumonia, such as tachypnoea, inability to drink or breast feed and head- nodding, used in the IMCI algorithm, are not able to identify hypoxic children with severe pneumonia as precisely as pulse oximetry.[21] Consequently, many children with severe pneumonia are dying because hypoxaemia is not adequately recognised and/or oxygen therapy is unavailable.[22] This study is aimed to assess the relation between pulse oximetry and the clinical profile of children with pneumonia.

Objectives

To assess the relation between pulse oximetry and the clinical profile of children with pneumonia.

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MATERIAL AND METHODS

This cross-sectional type of descriptive study was conducted in Department of Pediatric, Rangpur Medical Collage and Hospital, Rangpur from July 2014 to June 2016. This study was carried out on 205 Children aged 2-59 months suffering from pneumonia inpatient and outpatient of Pediatric department. All the clinical information was obtained by preformed structured questionnaire. During the physical examination, arterial oxygen saturation was recorded in all cases using a portable, electrical pulse oximeter (NONIN Model- 7500, USA) with the sensor device placed over the finger (index or middle) or the big toe. A reading was noted down. Hypoxemia was defined as an arterial oxygen saturation of <90% recorded by pulse oximeter. Pneumonia cases were then categorized into two groups-

- Pneumonia with hypoxemia
- Pneumonia without hypoxemia

Statistical analyses were carried out by using the Statistical Package for Social Sciences version 20.0 for Windows (SPSS Inc., Chicago, Illinois, USA). A descriptive analysis will be performed for all data. The mean values were calculated for continuous variables. The quantitative observations were indicated by frequencies and percentages. Unpaired t-test was used to compare continuous variables between hypoxemic and non-hypoxemic children. Chi-square test and fisher's exact test was used to compare categorical data like clinical signs and symptoms. Sensitivity, specificity, accuracy, positive predictive value (PPV), negative predictive value (NPV), and positive or negative likelihood ratios (+ LR) for different clinical signs and symptoms in predicting the hypoxemia in children with pneumonia were evaluated. Multiple logistic regression analysis were used to determine; which of the clinical sings and symptoms would be an independent predictors for predicting the hypoxemia in children with pneumonia. Results were summarized as odds-ratios (OR) and their respective 95% confidence interval (CI). A "p" value <0.05 was considered as significant.

Inclusion Criteria

- Children aged 2 - 59 months suffering from pneumonia on the basis of WHO guideline-2005

Exclusion Criteria

- Age under 2 months and ≥60 months.
- Any patients having precodial murmur.
- H/O repeated breathlessness.
- Playful children with breathlessness and rhonchi
- Children with underlying pathology such as congenital heart disease, asthma and severe malnourishment (60% standard weight for age)
- Parents unwilling to give informed written consent

RESULTS

[Table 1] shows socio demographic characteristics of the study patients, it was observed that almost three fourth (72.2%) patients belonged to age 2-11 months. The mean age was found 9.2±10.0 months with range from 2 to 59 months. Almost two third (64.9%) patients were male and 72(35.1%) were female. Male female ratio was 1.8:1. Majority (93.2%) patients come from rural area, 189(92.2%)

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patients had weight ≤10 kg, 140(68.3%) had sever pneumonia and 65(31.7%) had pneumonia. [Table 2] shows symptoms and sign of the study patients, it was observed that majority (91.7%) patients had cough, 184(89.8%) had breathing difficulty, 173(84.4%) patients had fast breathing, 114(55.6%) had fever, 110(53.7%) had excessive crying, 104(55.6%) had severely reduced feeding, 96(46.4%) inability to drink or feed and 89(43.4%) had irritability. Other results depicted are in this table. [Table 3] shows general examination of the study patients, it was observed that majority (92.2%) patients had ability to cry while examined, 143(69.8%) had movement during examination, 112(54.6%) were restless or irritable, 8(3.9%) were abnormally sleepy and 6(2.9%) were lethargic/ unconscious. [Table 4] shows the distribution of the study patients by respiratory signs. Majority (90.7%) patients had crepitations, 123(60.0%) had rhonchi, 104(50.7%) had head nodding, 91(44.4%) had nasal flaring and 80(39.0%) intercostal indrawing, 39 (19.0%) had lower chest indrawing. Other results depicted are in this table. Distribution of the study patients by physical signs is shown in [Table 5]. Three (1.5%) patients was found pallor of palms, 178 (86.8%) patients were heart rate ≥100 beats per minute, 196(95.6%) were capillary refill time <3 second, 4(2.0%) hepatomegaly >2 cm and 131(63.9%) had temperature ≥ 38 °C. [Table 6] shows peripheral oxygen saturation of the study patients, it was observed that Hypoxemia (≤90%) was found 51(24.9%) of the patients. The mean SpO2 was found 88.6±4.7 percent with range from 70 to 99 percent.

Table 1: Distribution of the study patients by socio demographic characteristics (n=205)

Socio demographic characteristics		Number of patients	Percentage
Age (months)	2-11	148	72.2
	≥12	57	27.8
	Mean±SD	9.2±10.0	
	Range (min, max)	2, 59	
Sex	Male	133	64.9
	Female	72	35.1
Residence	Urban	14	6.8
	Rural	191	93.2
Weight (kg)	≤10	189	92.2
	11-20	7	3.4
	>20	9	4.4
Pneumonia	Severe pneumonia	140	68.3
	Pneumonia	65	31.7

Table 2: Distribution of the study patients by symptoms and sign (n=205)

Symptoms and signs	Number of patients	Percentage
Cough	188	91.7
Breathing difficulty	184	89.8
Fast breathing	173	84.4

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Fever	114	55.6
Excessive crying	110	53.7
Severely reduced feeding	104	55.6
Inability to drink or feed	96	46.4
Irritability	89	43.4
Unusually sleepy	4	2.0

Table 3: Distribution of the study patients by general examination status (n=205)

General examination status	Number of patients	Percentage
Ability to cry while examined	189	92.2
Movement during examination	143	69.8
Restless or irritable	112	54.6
Abnormally sleepy	8	3.9
Lethargic/ unconscious	6	2.9

Table 4: Distribution of the study patients by respiratory signs (n=205)

Respiratory signs		Number of patients	Percentage
Crepitations		186	90.7
Rhonchi		123	60
Head nodding		104	50.7
Nasal flaring		91	44.4
Intercostal indrawing		80	39
Lower chest indrawing		39	19
Bronchial breath sound		4	2
Diminished breath sounds		4	2
Central cyanosis		3	1.5
Wheeze		2	1
Continuous grunting		2	1
Respiratory rate (bpm)			
2-11 month	<50	0	0
	≥50	56	27.3
12-59 month	<40	0	0
	≥40	149	72.7

Table 5: Distribution of the study patients by physical signs (n=205)

Physical signs		Number of patients	Percentage
Pallor of palms	Present	3	1.5
	Absent	202	98.5
Heart rate (bpm)	<100	27	13.2
	≥100	178	86.8
Capillary refill time (sec)	<3	196	95.6

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	≥3	9	4.4
Hepatomegaly (cm)	>2	4	2
	≤2	201	98
Temperature (°C)	< 38	74	36.1
	≥38	131	63.9

Table 6: Distribution of the study patients by peripheral oxygen saturation (n=205)

Peripheral oxygen saturation (%)	Number of patients	Percentage
≤90 (hypoxemia)	51	24.9
>90 (non hypoxemia)	154	75.1
Mean±SD	88.6±4.7	
Range (min, max)	70, 99	

DISCUSSION

This descriptive study was carried out with an aim to evaluate the clinical signs and symptoms of hypoxemia in children with pneumonia and to measure arterial oxygen saturation with pulse oximetry in children with pneumonia aged 2-59 months. A total of 205 children aged 2-59 months suffering from pneumonia at Department of Pediatric, Rangpur Medical Collage Hospital, Rangpur, during July 2014 to June 2016, were included in this study. In this current study it was observed that almost three fourth (72.2%) patients belonged to age 2-11 months and the mean age was 9.2±10.0 months with ranged from 2 to 59 months. Abdulkadir et al.[23] found the mean age was 9.2±10.0 months with ranged from under 60 months and most (56.0%) of the children with pneumonia were aged <12 months Overall, 119 (59.5%) patients were male. In this current series it was observed that pneumonia was more common in male subjects, where almost two third (64.9%) patients were male and 35.1% were female and male to female ratio was 1.8:1. Similarly, Abdulkadir et al.[23] found overall, 59.5% patients were male, which is similar with the present study.

In this present series it was observed that majority (93.2%) patients come from urban area and 92.2% patients had weight ≤10 kg. In this current study it was observed more than two third (68.3%) of the children had severe pneumonia, 31.7% had pneumonia. In this study it was observed that majority (91.7%) patients had cough, 55.6% fever, 84.4% fast breathing, 89.8% breathing difficulty, 43.4% irritability, 50.7% severely reduced feeding and 53.7% had excessive crying. Ahammad & Amin,[24] found the clinical symptoms and signs were evaluated for their ability to predict hypoxaemia. Oxygen saturation was determined by pulse oximeter. Hypoxaemia was defined as oxygen saturation less than 90%. Clinical predictors were evaluated by and also by determining sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV). Few combination models were also evaluated for their ability to predict hypoxaemia. Regarding the general examination status, it was observed that majority (92.2%) patients had ability to cry while examined, 69.8% had movement during examination, 54.6% were restless or irritable, 3.9% were abnormally sleepy and 2.9% were

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lethargic/ unconscious. Similarly, Ayieko & Graham.[25] found the general status was very poor with children being comatose sensitivity was somewhat improved (49% – 68%) but specificity was poor in two of the three studies (<80%) Onyango et al.[26] Studies from Gambia, Peru and Kenya found signs reflecting the general status (impaired arousability, inability to feed, no spontaneous movement or not able to cry) to be associated with hypoxaemia.[26,27,28,29] Regarding the respiratory signs it was observed that most (90.7%) of the patients had crepitations, 19.0% lower chest indrawing, 60.0% rhonchi, 50.7% head nodding and 44.4% had nasal flaring. Clinical signs that appeared predictive were lower chest wall indrawing, nasal flaring, central cyanosis, irregular breathing, deep breathing, stridor, auscultatory crackles, dullness on percussion, respiratory rate ≥ 60 breaths per min, weak pulse volume, delayed capillary refill (≥ 3 s), heart rate < 80 beats per min, impaired consciousness with a Blantyre coma scale < 3, prostration, convulsion on admission, restlessness and hypothermia.[30] In another study Basnet et al.[31] reported that the clinical signs, if the child was lethargic, had nasal flaring, central cyanosis, grunting, chest indrawing, tachypnea, tachycardia, fever or crepitations on auscultation, significant association with hypoxemia was found. In this present study, Three (1.5%) patients was found pallor of palms, 86.8% patients had heart rate ≥100 beats per minute, 95.6% capillary refill time <3 second, 2.0% hepatomegaly >2 cm and 63.9% had temperature ≥38 °C. Almost similar findings were also observed by Ahammad & Amin.[24] Children with pneumonia often presented with hypoxaemia and remained hypoxaemic for longer compared to those without pneumonia. Children with pneumonia present with inflammation in the lung parenchyma and often experience increased oxygen demand and inadequate oxygen supply due to the reduction of diffusion of oxygen at the level of the blood gas barrier at alveolar region of respiratory zone of lung leading to hypoxaemia. In this current study, shows peripheral oxygen saturation of the study patients, it was observed that three fourth (24.9%) patients were SpO_2 ≤90 (hypoxemia) percent. The mean SpO_2 was found 88.6±4.7 percent with range from 70 to 99 percent. Prevalence of hypoxemia 38.0% observed by Basnet et al.[31] which is comparable with the current study. Abdulkadir et al.[23] found the prevalence of hypoxaemia among the children was 41.5% and their mean SpO2 was 90.4%±8.9%. Children with hypoxaemia spent a longer duration receiving supplemental oxygen compared with those without hypoxaemia. Ayieko & Graham,[25] reported in their study that the prevalence of hypoxaemia, determined by pulse oximetry, ranged from 31% to 72%, depending on the definition of hypoxaemia used, which differ with the current study, may be due to the studies were carried out and the lack of a uniform definition of hypoxaemia. There are wide differences in the criteria used for defining hypoxaemia even among studies conducted at the same altitude as well as geographical variations, racial, ethnic differences, and genetic causes.

Limitations of the study

In this study, all patient couldn't be recruited at the time of emergency admission which would yield better result. The study was uni-centered and short duration due to time constraint. So, generalization may not be achieved without

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multi centered and long duration study for seasonal and altitude variation. Confounders like bronchiolitis, asthama and other related reasons were poorly addressed. The present study was conducted at a very short period of time. Small sample size was also a limitation of the present study. Therefore, in future further study may be under taken with large sample size.

CONCLUSIONS

Cough, breathing difficulty and fast breathing are most common signs of children with pneumonia. Major physical signs observed among the participants was increased heart beat per second (≥100 bpm), decreased capillary refill time, and high temperature. The difference of these physical signs between the hypoxemia group and non-hypoxemia group were statistically significant. Through pulse oximetry test, the prevalence of hypoxaemia was found in 24.9% children.

REFERENCES

1. Basnet S, Adhikari RK, Gurung CK. Hypoxemia in children with pneumonia and its clinical predictors. Indian J Pediatr. 2006;73(9):777-81. doi: 10.1007/BF02790384.
2. Mower WR, Sachs C, Nicklin EL, Baraff LJ. Pulse oximetry as a fifth pediatric vital sign. Pediatrics. 1997;99(5):681-6. doi: 10.1542/peds.99.5.681.
3. Laman M, Ripa P, Vince J, Tefuarani N. Can clinical signs predict hypoxaemia in Papua New Guinean children with moderate and severe pneumonia? Ann Trop Paediatr. 2005;25(1):23-7. doi: 10.1179/146532805X23317.
4. Lozano JM. Epidemiology of hypoxaemia in children with acute lower respiratory infection. Int J Tuberc Lung Dis. 2001;5(6):496-504.
5. Qazi S. Oxygen therapy for Acute Respiratory Infection in young children. Indian Pediatr. 2002;39:909-13.
6. Orimadegun AE, Ogunbosi BO, Carson SS. Prevalence and predictors of hypoxaemia in respiratory and non-respiratory primary diagnoses among emergently ill children at a tertiary hospital in south western Nigeria. Trans R Soc Trop Med Hyg. 2013;107(11):699-705. doi: 10.1093/trstmh/trt082.
7. Duke T, Subhi R, Peel D, Frey B. Pulse oximetry: technology to reduce child mortality in developing countries. Ann Trop Paediatr. 2009;29(3):165-75. doi: 10.1179/027249309X12467994190011.
8. Duke T, Wandi F, Jonathan M, Matai S, Kaupa M, Saavu M, et al. Improved oxygen systems for childhood pneumonia: a multihospital effectiveness study in Papua New Guinea. Lancet. 2008;372(9646):1328-33. doi: 10.1016/S0140-6736(08)61164-2.
9. Duke T, Peel D, Wandi F, Subhi R, Sa'avu Martin, Matai S. Oxygen supplies for hospitals in Papua New Guinea: a comparison of the feasibility and cost-effectiveness of methods for different settings. P N G Med J. 2010;53(3-4):126-38.
10. Floyd J, Wu L, Hay Burgess D, Izadnegahdar R, Mukanga D, Ghani AC. Evaluating the impact of pulse oximetry on childhood pneumonia mortality in resource-poor settings. Nature. 2015;528(7580):S53-9. doi: 10.1038/nature16043.
11. Fashanu C, Mekonnen T, Amedu J, Onwundiwe N, Adebiyi A, Omokere O, et al. Improved oxygen systems at hospitals in three Nigerian states: An implementation research study. Pediatr Pulmonol. 2020;55 Suppl 1:S65-S77. doi: 10.1002/ppul.24694.
12. Graham H, Bakare AA, Fashanu C, Wiwa O, Duke T, Falade AG. Oxygen therapy for children: A key tool in reducing deaths from pneumonia. Pediatr Pulmonol. 2020;55 Suppl 1(Suppl 1):S61-S64. doi: 10.1002/ppul.24656.
13. Shittu F, Agwai IC, Falade AG, Bakare AA, Graham H, Iuliano A, et al. Health system challenges for improved childhood pneumonia case management in Lagos and Jigawa, Nigeria. Pediatr Pulmonol. 2020;55 Suppl 1(Suppl 1):S78-S90. doi: 10.1002/ppul.24660.
14. McCollum ED, Bjornstad E, Preidis GA, Hosseinipour MC, Lufesi N. Multicenter study of hypoxemia prevalence and quality of oxygen treatment for

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hospitalized Malawian children. Trans R Soc Trop Med Hyg. 2013;107(5):285-92. doi: 10.1093/trstmh/trt017.
15. Duke T, Blaschke AJ, Sialis S, Bonkowsky JL. Hypoxaemia in acute respiratory and non-respiratory illnesses in neonates and children in a developing country. Arch Dis Child. 2002;86(2):108-12. doi: 10.1136/adc.86.2.108.
16. Subhi R, Adamson M, Campbell H, Weber M, Smith K, Duke T; Hypoxaemia in Developing Countries Study Group. The prevalence of hypoxaemia among ill children in developing countries: a systematic review. Lancet Infect Dis. 2009;9(4):219-27. doi: 10.1016/S1473-3099(09)70071-4.
17. Emdin CA, Mir F, Sultana S, Kazi AM, Zaidi AK, Dimitris MC, et al. Utility and feasibility of integrating pulse oximetry into the routine assessment of young infants at primary care clinics in Karachi, Pakistan: a cross-sectional study. BMC Pediatr. 2015;15:141. doi: 10.1186/s12887-015-0463-z.
18. Balasubramanian S, Suresh N, Ravichandran C, Dinesh Chand GH. Reference values for oxygen saturation by pulse oximetry in healthy children at sea level in Chennai. Ann Trop Paediatr. 2006;26(2):95-9. doi: 10.1179/146532806X107421.
19. Stein RT, Marostica PJ. Community-acquired pneumonia: a review and recent advances. Pediatr Pulmonol. 2007;42(12):1095-103. doi: 10.1002/ppul.20652.
20. Principi N, Esposito S. Management of severe community-acquired pneumonia of children in developing and developed countries. Thorax. 2011;66(9):815-22. doi: 10.1136/thx.2010.142604.
21. Alwadhi V, Dewan P, Malhotra RK, Shah D, Gupta P. Tachypnea and Other Danger Signs vs Pulse Oximetry for Prediction of Hypoxia in Severe Pneumonia/Very Severe Disease. Indian Pediatr. 2017;54(9):729-734. doi: 10.1007/s13312-017-1163-6.
22. Rao YK, Midha T, Kumar P, Tripathi VN, Rai OP. Clinical predictors of hypoxemia in Indian children with acute respiratory tract infection presenting to pediatric emergency department. World J Pediatr. 2012;8(3):247-51. doi: 10.1007/s12519-012-0365-1.
23. Lodha R, Bhadauria PS, Kuttikat AV, Puranik M, Gupta S, Pandey RM, et al. Can clinical symptoms or signs accurately predict hypoxemia in children with acute lower respiratory tract infections? Indian Pediatr. 2004;41(2):129-35.
24. Rahman AE, Hossain AT, Nair H, Chisti MJ, Dockrell D, Arifeen SE, et al. Prevalence of hypoxaemia in children with pneumonia in low-income and middle-income countries: a systematic review and meta-analysis. Lancet Glob Health. 2022;10(3):e348-e359. doi: 10.1016/S2214-109X(21)00586-6.
25. Ayieko P, English M. In children aged 2-59 months with pneumonia, which clinical signs best predict hypoxaemia? J Trop Pediatr. 2006;52(5):307-10. doi: 10.1093/tropej/fml036.
26. Onyango FE, Steinhoff MC, Wafula EM, Wariua S, Musia J, Kitonyi J. Hypoxaemia in young Kenyan children with acute lower respiratory infection. BMJ. 1993;306(6878):612-5. doi: 10.1136/bmj.306.6878.612.
27. Weber MW, Usen S, Palmer A, Jaffar S, Mulholland EK. Predictors of hypoxaemia in hospital admissions with acute lower respiratory tract infection in a developing country. Arch Dis Child. 1997;76(4):310-4. doi: 10.1136/adc.76.4.310.
28. Usen S, Weber M, Mulholland K, Jaffar S, Oparaugo A, Omosigho C, et al. Clinical predictors of hypoxaemia in Gambian children with acute lower respiratory tract infection: prospective cohort study. BMJ. 1999;318(7176):86-91. doi: 10.1136/bmj.318.7176.86.
29. Lozano JM, Steinhoff M, Ruiz JG, Mesa ML, Martinez N, Dussan B. Clinical predictors of acute radiological pneumonia and hypoxaemia at high altitude. Arch Dis Child. 1994;71(4):323-7. doi: 10.1136/adc.71.4.323.
30. Mwaniki MK, Nokes DJ, Ignas J, Munywoki P, Ngama M, Newton CR, et al. Emergency triage assessment for hypoxaemia in neonates and young children in a Kenyan hospital: an observational study. Bull World Health Organ. 2009;87(4):263-70. doi: 10.2471/blt.07.049148.
31. Basnet S, Adhikari RK, Gurung CK. Hypoxemia in children with pneumonia and its clinical predictors. Indian J Pediatr. 2006;73(9):777-81. doi: 10.1007/BF02790384.

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