International Journal of Contemporary Pediatrics
Ogaziechi KO et al. Int J Contemp Pediatr. 2020 Jan;7(1):34-41
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20195722

Original Research Article

Prevalence of hypoxaemia and its associated factors in children with pneumonia seen at a tertiary hospital in Southeast Nigeria

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Received: 19 September 2019
Revised: 17 November 2019
Accepted: 20 November 2019

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ABSTRACT

Background: Hypoxaemia is a common complication and a significant predictor of death from pneumonia in children under five years of age. Knowledge of the prevalence of hypoxaemia and clinical signs associated with it may guide use of oxygen in the management of childhood pneumonia in resource-poor settings. This study was carried out to determine the prevalence of hypoxaemia in children with pneumonia and assess the relation between hypoxaemia and age, duration of illness and clinical signs.
Methods: This was a descriptive cross-sectional study undertaken between 1st July 2016 and 27th April 2017. Children with pneumonia, aged 2-59 months, who attended Federal Medical Centre, Owerri and met the inclusion criteria, were recruited into the study. Subject evaluation included history and physical examination. Their blood oxygen saturation was determined by pulse oximetry and value less than 90% indicated hypoxaemia.
Results: Out of the 144 children with pneumonia, 93(64.6%) were males and 51(35.4%) females giving a male to female ratio of 1.8:1. Median age was 8 months and mean weight (SD) was 8.6 kg (3.6). The overall prevalence of hypoxaemia was 17.4%. Hypoxaemia prevalence was significantly higher in infants (p=0.026) and severe pneumonia (p<0.0001). There was statistically significant association between hypoxaemia and lower chest in-drawing, nasal flaring, suprasternal recession, grunting, lethargy, tachypnoea and tachycardia. With adjustment for confounding variables, only lower chest in-drawing (OR: 9.672; p=0.004), lethargy (OR: 8.103; p=0.020) and grunting (OR: 4.960; p=0.050) predicted hypoxaemia in pneumonia. Each of these signs had a poor combination of sensitivity and specificity.
Conclusions: Hypoxaemia is common in childhood pneumonia. Though some clinical signs are significantly associated with hypoxaemia in childhood pneumonia, they may be unreliable in predicting hypoxaemia. Therefore, pulse oximeters should be provided in every health facility for accurate detection of hypoxaemia.

Keywords: Childhood pneumonia, Hypoxaemia, Predictors, Pulse oximetry

INTRODUCTION

Hypoxemia is a serious complication of diseases of the respiratory and cardiovascular systems.[1] The World Health Organization (WHO) defines hypoxemia as arterial blood oxygen saturation of less than 90%, measured by percutaneous pulse oximetry.[2] It is a major predictor of mortality in childhood pneumonia.[3,4] Pneumonia is an acute inflammation of the lung parenchyma due to pathogenic micro-organisms or a

disease condition characterized by fever, respiratory symptoms and clinical or radiographic evidence of lung parenchymal involvement.[5,6] It is most prevalent in South Asia and sub-Saharan Africa.[5] An estimated 6 million children under 5 years of age suffer from pneumonia yearly in Nigeria and the disease accounts for 17% of under-five mortality.[7] Pneumonia is caused by bacteria, viruses or fungi which invade the lungs through inhalation or hematogenous spread.[3] Hypoxaemia in pneumonia results from impaired gas exchange due to parenchymal inflammation that leads to ventilation-perfusion mismatch, intra pulmonary shunt and increased gas diffusion barriers.[3] Prolonged hypoxaemia in turn leads to tissue hypoxia, multi-organ dysfunction and failure, and death.[5]

Studies in the developing countries found prevalence of hypoxaemia in pneumonia of between 3-50%.[8-12] The risk is higher in infants as well as children with severe pneumonia.[6,12-14] Clinical signs such as central cyanosis, severe chest in-drawing and grunting have been found to be significantly associated with hypoxaemia.[6,10,12,15] However, their ability to predict hypoxaemia is low.[1,6] Definitive methods of assessing hypoxaemia are Arterial Blood Gas (ABG) analysis and pulse oximetry. Pulse oximetry assesses blood oxygen saturation non-invasively while ABG analysis is an invasive procedure that measures partial pressure of oxygen in the arterial blood.[16,17] Studies have shown some good correlation between the two.[17,18]

Blood oxygen saturation is not routinely determined in children with pneumonia in many primary and secondary health care facilities in Nigeria due to unavailability of pulse oximeters; thereby leading to either under use or overuse of oxygen. Therefore, this present study aimed to determine the prevalence of hypoxaemia in children aged 2-59 months with pneumonia and assess the relation between hypoxaemia and age, duration of illness and clinical signs.

METHODS

This study was carried out at the Federal Medical Centre, Owerri; a tertiary hospital that serves as both a first level and referral facility for the entire Imo State and its environs in Southeast Nigeria. The EPU and CHOP Clinic are the main first points of service to all pediatric patients. The EPU has 19 beds and an average of 70 admissions per month.

The Children Outpatient Clinic is run daily by a clinical team of consultants, residents and house officers with an average of 1400 patients seen in a month. The radiology department of the hospital is open for diagnostic imaging all day. Investigations such as radiography, ultrasonography and computed tomography are offered. The work force of the department includes consultants, resident doctors and radiographers. Study design was a descriptive cross-sectional study.

Sampling technique

Consecutive patients presenting at the EPU or CHOP clinic between 1st July 2016 and 27th April 2017 who met the inclusion criteria were recruited until the calculated sample size of one hundred and forty-four (144) was achieved.

Study subjects involved children aged 2-59 months with pneumonia defined by presence of cough and/ or difficulty with breathing plus tachypnoea and/ or lower chest in-drawing in addition to lobar consolidation, patchy infiltrate or pleural effusion on chest radiograph whose parents or guardians gave informed consent were recruited while children presenting with wheeze or rhonchi, stridor, a history of foreign body or chemical aspiration precipitating the presenting clinical features, pre-existing lung or heart disease or features of shock were excluded. This was to reduce the chances of recruiting children with bronchial asthma, bronchiolitis, upper airway obstruction or aspiration pneumonitis; exclude other disease conditions that can cause hypoxaemia and reduce the chances of obtaining false pulse oximetry values.

Study procedure/data collection

All children who presented to the EPU or CHOP Clinic of the hospital, with cough and/or difficulty with breathing, and tachypnoea and/or lower chest in-drawing who fulfilled the inclusion criteria above were consecutively recruited. Biodata of the children including age and sex as well as duration of illness were obtained and recorded in a data sheet. Duration of illness was taken as the interval in days, between onset of cough or difficulty in breathing, whichever occurred first and presentation to EPU or CHOP clinic of the hospital. Physical examination was then carried out. Weight was measured using bassinet weighing scale (Salter 180, Salter Housewares, UK) for children less than 24 months old and standing scale (RGZ-160, Ma-donax, England) for those 24 months old and above. The weighing scales were reset at zero before each measurement. Children were weighed naked (those less than 24 months old) or with minimal clothing (those 24 months old and above) and with their foot wears removed. The weights of children who could not stand still on the scale were obtained by subtracting their caregivers' weights from the combined weights of the children and their caregivers.

The children were also assessed for the presence of fever, tachypnoea, tachycardia, lower chest in-drawing, central cyanosis, nasal flaring, suprasternal recession, intercostal recession, subcostal recession, head nodding, grunting, lethargy, impaired consciousness, convulsion, inability to feed or drink, dull or stony dull note on chest percussion, reduced or bronchial breath sound and crepitations on chest auscultation.

Children with any of the following signs were classified as having severe pneumonia according to the WHO

classification of pneumonia severity: central cyanosis, grunting, head nodding, inability to breastfeed or drink, lethargy, impaired consciousness and convulsion. Those without any of these signs were classified as having non-severe pneumonia. Physical examination to classify severity of pneumonia did not include pulse oximetry.

Arterial blood oxygen saturation of each of the children was determined using a percutaneous pulse oximeter (Spectro2TM 10, Smiths Medical ASD, Inc, USA) with appropriately sized hinged probe. This was done at the time of presentation before oxygen therapy was instituted as required. The probe was attached to a steady, non-greasy or oily finger. The Light Emitting Diode (LED) and the photo detector of the probe were attached to the dorsal and ventral surfaces of the finger, respectively and left for at least one minute before a reading was taken. Any child with value less than 90% was hypoxaemic.

Chest radiographs of the children were taken, and each was interpreted jointly by two radiologists. Children whose chest radiographs showed lobar consolidation, patchy infiltrate or pleural effusion were then recruited as subjects. Nutritional status of each of the subjects was determined using the WHO weight-for-age (z-scores) child growth standards. They were classified as severely underweight (z-score <-3), underweight (z-score: -3 to <-2), normal (z-score: -2 to 2) or above normal (z-score >2).

The proper functioning of the pulse oximeters was ensured by using them on two apparently healthy persons each day. In addition, their batteries were changed promptly when indicated. The probe of the pulse oximeter was cleaned with alcohol swab after use on each subject. Research assistants who were house officers underwent training on physical examination relevant to the study. The training included bedside demonstration sessions and evaluation of their performance. All study subjects were treated with antibiotics. Oral antibiotics were prescribed for the outpatients while intra venous antibiotics were administered to admitted ones. Those with hypoxaemia received intranasal oxygen. Supportive therapy was also offered as appropriate.

Ethical considerations

The approval for the study was obtained from the Ethics Committee of the FMC Owerri. A written informed consent was obtained from the parent or guardian of each of the prospective study subjects before recruitment.

Data analysis

Data collected were entered into the computer and analyzed using the Statistical Package for Social Science (SPSS) version 20.0 for windows. Prevalence of hypoxemia was expressed as percentages. Association of hypoxemia with age, duration of symptoms and clinical signs was determined using Chi-square with Fisher's exact test applied as appropriate. The sensitivity and specificity of each clinical sign with significant association with hypoxemia were calculated. These clinical signs were further subjected to binary logistic regression analysis to determine their ability to independently predict hypoxemia. Results are presented in tables and a chart. Level of significance was 0.05.

RESULTS

General characteristics of study subjects

During the study period, a total of 1294 and 3987 children aged 2-59 months were seen in EPU and CHOP clinic, respectively. Of the 142 and 164 children in EPU and CHOP respectively, who presented with clinical features suggestive of pneumonia, 78 and 66 met the inclusion criteria and were recruited for the study, giving a total of 144 subjects. Ninety-three were males and 51, females with male to female ratio of 1.8: 1. The ages ranged from 2 to 54 months with a median of 8 months. A greater proportion of the subjects (64.6%) were infants and there was decreasing frequency with increasing age group. Weight of the subjects ranged from 3.0 kg to 20.0 kg with mean weight (SD) of 8.6 kg (3.6). Children with under nutrition accounted for 14.6% of the study subjects. Majority (83.3%) of the subjects had non-severe pneumonia.

Prevalence of hypoxemia

Arterial oxygen saturation values measured ranged from 51% to 99% with Mean±SD and mode of 94% ±6.7 and 97%, respectively. Hypoxemia (blood oxygen saturation <90%), occurred in 25 children (17.4%).

Clinical features in study subjects

The commonest clinical sign was tachypnoea (86.8%). None of the children had cyanosis, head nodding, impaired consciousness or convulsion.

Chest radiographic findings in the subjects

One hundred and forty-two (98.6%) children had patchy infiltrates on chest radiograph, 1(0.7%) each had lobar consolidation and pleural effusion.

Association of age, sex and weight with hypoxemia

The prevalence of hypoxemia was higher in infants (22.6%) than in older children (7.8%). This difference was statistically significant (χ^2= 4.986; p= 0.026) (Table 1).

Duration of symptoms and hypoxemia

Hypoxemia occurred most in children with duration of symptoms between 4 and 6 days and least in those, 7 days or more. The differences were, however, not statistically significant (Table 2) (χ2=1.480; p= 0.477).

Severity of pneumonia and hypoxemia

Prevalence of hypoxemia was higher in severe pneumonia than non-severe pneumonia (Table 3). This was statistically significant. ($\chi2$=27.193; p<0.0001). There was a statistically significant difference in range of oxygen saturation between children with non-severe pneumonia and those with severe pneumonia (Table 3) ($\chi2$=29.490; p<0.0001) (Table 4).

Table 1: Relationship between age and sex of subjects and presence of hypoxaemia.

Variable		Oxygen saturation status N/ (%)		Total N/ (%)	χ^2	p-value
		Hypoxemia	No Hypoxemia			
Age group (Months)	2-12	21(22.6)	72(77.4)	93(100.0)	6.296	0.178
	13-24	2(6.9)	27(93.1)	29(100.0)		
	25-36	2(18.2)	9(81.8)	11(100.0)		
	37-48	0(0.0)	9(100.0)	9(100.0)		
	49-60	0(0.0)	2(100.0)	2(100.0)		
	Total	25(17.4)	119(82.6)	144(100.0)		
Age group	Infants	21(22.6)	72(77.4)	93(100.0)	4.986	0.026
	Older children	4(7.8)	47(92.2)	51(100.0)		
	Total	25(17.4)	119(82.6)	144(100.0)		
Sex	Male	19(20.4)	74(79.6)	93(100.0)	1.724	0.189
	Female	6(11.8)	45(88.2)	51(100.0)		
	Total	25(17.4)	119(82.6)	144(100.0)		
Nutritional Status (Weight-for-Age z-scores)	Above normal	0(0.0)	2(100.0)	2(100.0)	3.625	0.305
	Normal	20(16.5)	101(83.5)	121(100.0)		
	Underweight	4(36.4)	7(83.6)	11(100.0)		
	Severely underweight	1(10.0)	9(90.0)	10(100.0)		
	Total	25(17.4)	119(82.6)	144(100.0)		

Table 2: Influence of duration of symptoms on presence of hypoxaemia.

Symptom duration (Days)	Oxygen saturation status N/ (%)		Total N/ (%)	χ^2	p-value
	Hypoxemia	No Hypoxemia			
≤ 3	8(13.6)	51(86.4)	59(100.0)	1.480	0.477
4-6	10(22.7)	34(77.3)	44(100.0)		
≥ 7	7(17.1)	34(82.9)	41(100.0)		
Total	25(17.4)	119(82.6)	144(100.0)		

Table 3: Relationship between severity of pneumonia and presence of hypoxaemia.

Severity of Pneumonia	Oxygen saturation status N/ (%)		Total N/ (%)	χ^2	p-value
	Hypoxemia	No Hypoxemia			
Non-Severe	12(9.9)	109(90.1)	121(100.0)	27.193	0.000
Severe	13(56.5)	10(43.5)	23(100.0)		
Total	25(17.4)	119(82.6)	144(100.0)		

Table 4: Association of oxygen saturation range and severity of pneumonia.

Oxygen Saturation Range (%)	Severity of Pneumonia N/ (%)		Total N/ (%)	χ^2	p-value
	Non-Severe	Severe			
>95	77(90.6)	8(9.4)	85(100.0)	29.490	0.000
90-95	32(94.1)	2(5.9)	34(100.0)		
75-89	11(47.8)	12(52.2)	23(100.0)		
<75	1(50.0)	1(50.0)	2(100.0)		
Total	121(84.0)	23(16.0)	144(100.0)		

Table 5: Relationship between clinical and radiological signs and presence of hypoxaemia.

Sign	Oxygen Saturation Status N (%		Total N/ (%)	χ^2	p-value	Sensitivity (%)	Specificity (%)
	Hypoxemia	No Hypoxemia					
Fever	15(16.0)	79(84.0)	94(100.0)	0.372	0.542		
Tachypnoea	25(20.0)	100(80.0)	125(100.0)	4.598	0.045Ŧ	100.0	16.0
Tachycardia	13(27.1)	35(72.9)	48(100.0)	4.744	0.029	52.0	70.6
Lower Chest In-drawing	22(24.7)	67(75.3)	89(100.0)	8.793	0.003	88.0	43.7
Nasal Flaring	18(25.0)	54(75.0)	72(100.0)	5.857	0.016	72.0	54.6
Suprasternal Recession	7(50.0)	7(50.0)	14(100.0)	11.515	0.003Ŧ	28.0	94.1
Intercostal recession	23(19.0)	98(81.0)	121(100.0)	1.433	0.368Ŧ		
Subcostal recession	21(18.3)	94(81.7)	115(100.0)	0.322	0.570		
Grunting	9(64.3)	5(35.7)	14(100.0)	23.801	0.000Ŧ	36.0	95.8
Lethargy	8(66.7)	4(33.3)	12(100.0)	22.182	0.000Ŧ	32.0	96.6
Inability to Feed or drink	1(50.0)	1(50.0)	2(100.0)	1.506	0.318Ŧ		
Dull chest percussion	0(0.0)	1(100.0)	1(100.0)	0.212	1.000Ŧ		
Stony dull chest percussion	0(0.0)	1(100.0)	1(100.0)	0.212	1.000Ŧ		
Reduced breath sound	0(0.0)	1(100.0)	1(100.0)	0.212	1.000Ŧ		
Bronchial breath sound	0(0.0)	1(100.0)	1(100.0)	0.212	1.000Ŧ		
Crepitations	19(20.4)	74(79.6)	93(100.0)	1.724	0.189		
Lobar consolidation	0(0)	1(100)	1(100)	0.212	1.000Ŧ		
Patchy Infiltrate	25(17.6)	117(82.4)	142(100)	0.426	1.000Ŧ		
Parapneumonic effusion	0(0)	1(100)	1(100)	0.212	1.000Ŧ		

Table 6: Independent association of clinical signs with hypoxaemia.

Clinical sign	B	S.E.	OR	95% CI	P value
Lower chest in-drawing	2.269	0.786	9.672	2.072-45.140	0.040
Nasal flaring	0.288	0.637	1.334	0.383-4.646	0.651
Suprasternal recession	0.917	0.780	2.502	0.542-11.548	0.240
Grunting	1.601	0.815	4.960	1.003-24.521	0.050
Lethargy	2.092	0.897	8.103	1.397-46.980	0.020
Tachypnoea	19.832	8998.821	410237744.2	0.000	0.998
Tachycardia	0.776	0.598	2.174	0.673-7.02	0.194

B: Coefficient of Regression. S.E: Standard Error. CI: Confidence Interval. OR: Odds Ratio

Clinical and radiological signs and hypoxemia

Tachypnoea, tachycardia, lower chest in-drawing, nasal flaring, suprasternal recession, grunting and lethargy were significantly associated with hypoxemia. Of these, tachypnoea had the highest sensitivity (100%) while lethargy had the highest specificity (96.6%). Each of the clinical signs had a poor combination of sensitivity and specificity. None of the chest radiographic patterns was significantly associated with hypoxemia (Table 5). Independent predictors of hypoxemia: Following subjection of the clinical signs with significant association with hypoxemia, to binary logistic regression analysis, only lower chest in-drawing (OR: 9.672; P=0.004), lethargy (OR: 8.103; p=0.020) and grunting (OR: 4.960; p=0.050) independently predicted hypoxemia in the study subjects (Table 6).

DISCUSSION

Hypoxemia is an important predictor of mortality and known to be highly prevalent in children with pneumonia

in developing countries. This study found a relatively high prevalence (17.4%) of hypoxemia in children younger than five years with pneumonias. While it is higher than the prevalence rates of 10.5% and 11.7% reported by Emordi et al, and Junge et al, respectively, it is lower than 19.3%, 41.5% and 49.2% recorded respectively by Kuti et al, Ibraheem et al, and Orimadegun et al.[8-12] These variations may be a result of differences in methodology. The lower prevalence rate reported by Emordi et al, may be a result of small sample size and nonuse of chest radiographs in confirming clinical assessment of pneumonia thereby increasing possibility of considering conditions with low risk for hypoxemia as pneumonia.[8] For Junge et al, the recorded lower prevalence may be due to possibly missed subjects with hypoxemia on presentation as patients admitted overnight were only recruited the next morning at which time oxygen might have been administered to those who needed it.[11] Only children with severe and very severe pneumonia were recruited in the study by Kuti et al, which probably accounted for the reported higher prevalence of hypoxemia relative to the current study.[12] The recruitment of only admitted children by Ibraheem et al, and Orimadegun et al, in whom occurrence of hypoxemia was more common may explain the higher hypoxemia prevalence rates in both studies.[9,10] The relatively high prevalence rate of hypoxemia in this present study underscores the significance of evaluating children presenting to hospitals with symptoms and signs of pneumonia.

In contrast to older children, the respiratory system of infants is more susceptible to respiratory compromise leading to hypoxaemia.[19,20] Infants have ribs that are horizontally oriented, a chest wall that is soft and highly compliant, and predominantly type II muscle fibers that are more prone to fatigue.[20,21] These cause greater reduction in tidal volume and functional residual capacity than in older children and adults under several pathological conditions including pneumonia.[20,21] This explains why hypoxemia was significantly higher in infants than in older children in this present study. Basnet et al, Kuti et al, and Sah et al, reported similar findings.[4,12,13] Therefore, blood oxygen saturation of every infant with pneumonia should be promptly determined for early detection and treatment of hypoxemia. It is expected that, in addition to ventilation-perfusion mismatch and impaired gas diffusion barriers that also occur in well-nourished children with hypoxemia, malnourished children would have low tidal volume due to poor muscle activity, a situation that increases the risk of hypoxemia. Nutritional status was not significantly associated with hypoxemia in the study. This finding is similar to those by Ibraheem et al and Kuti et al.[9,12] The reason for this finding is not clear. However, it is possible that increase in respiratory rates in these children may have effectively compensated for the low tidal volume.

Hypoxemia is expected to occur more in prolonged and complicated cases of pneumonia. Nevertheless, in pneumonia caused by virulent organisms, hypoxemia may occur very early in the illness. There is also a challenge in determining the onset of pneumonia in children whose symptoms were initially due to an upper respiratory tract infection. Upper respiratory tract infections may rapidly progress to pneumonia thereby increasing the likelihood of hypoxemia occurring earlier in the illness or it may make a slower progression with hypoxemia developing later. Furthermore, prior use of antibiotics before presentation may partially treat the infection and influence the occurrence of hypoxemia. In this study, duration of symptoms before presentation did not have significant effect on the occurrence of hypoxemia in paediatric pneumonia and is consistent with the findings of Kuti et al, in the Gambia.[12] Nevertheless, presence of hypoxemia should be assessed in all cases of pneumonia regardless of their duration.

Risk of complications including hypoxemia is expected to increase with increasing severity of pneumonia. In addition, complications such as convulsion, impaired consciousness and lethargy as seen in severe pneumonia may lead to hypoventilation and a further decrease in oxygen saturation. Prevalence of hypoxemia was higher in severe than non-severe pneumonia and there was a statistically significant difference in oxygen saturation range between severe and non-severe pneumonia. Basnet et al, in Nepal and Mwaniki et al, in Kenya, recorded similar results.[4,14] Therefore, an assumption of presence of hypoxemia may be made in children with clinical features of severe pneumonia if pulse oximeters are not available.

Clinical predictors of hypoxemia in pneumonia vary among studies.[10,12,22] Lethargy, lower chest in-drawing and grunting reported in this study differ from findings in other studies.[10,12,22] Ibraheem et al, reported lower chest in-drawing, restlessness, bronchial breath sound and tender hepatomegaly as predictors of hypoxaemia.[22] In the study by Kuti et al, it was grunting and cyanosis while Orimadegun et al, recorded lower chest in-drawing and nasal flaring.[10,12] Though there were differences in sample size and characteristics of subjects among these studies, the findings suggest that clinical signs are unreliable in predicting hypoxemia in pneumonia. This inference is supported by the poor combinations of sensitivities and specificities of the clinical signs recorded in the current and earlier studies.[4,15,22] While a clinical sign with high sensitivity is able to identify more cases of pneumonia with hypoxemia, its relatively low specificity implies increased likelihood for misdiagnosis and unnecessary oxygen therapy. The reverse occurs when sensitivity is low and specificity, high. Lower chest in-drawing predicted hypoxemia in most of the cited studies and in the current study.[10,22] This suggests that the suspicion of hypoxemia is stronger in the presence of lower chest in-drawing than other signs.

Findings in this study support the importance of determining blood oxygen saturation in children with pneumonia using pulse oximeter. In facilities where pulse oximeters are not available, presence of lower chest in-drawing, lethargy and/or grunting may be indications for oxygen therapy.

CONCLUSION

Hypoxaemia in pneumonia is common in children and is more prevalent in infants and in severe pneumonia but it is not affected by sex or duration of illness. Lower chest in-drawing, lethargy and grunting are independent predictors of hypoxaemia in pneumonia. However, reliability is low. Assessment of arterial oxygen saturation should be made using pulse oximeter given the poor combination of sensitivities and specificities of clinical signs and this should be provided in all health facilities. Nevertheless, lower chest in-drawing, lethargy and grunting may be used as indications for oxygen therapy for children with pneumonia if pulse oximeters are not available.

ACKNOWLEDGEMENTS

Author acknowledge patients and their guardians for their patience and co-operation and the staff of the department of Pediatrics, Federal Medical Centre, Owerri for their support.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional research Ethics Committee of Federal Medical Centre Owerri (approval number: FMC/OW/HREC/37) before commencement of the study.

REFERENCES

1. Barrett KE, Barman SM, Boitano S, Brooks HL. Gas transport and pH in the lung. In: Ganong's Review of Medical Physiology. 23rd ed. New York: McGraw-Hill; 2010: 609-624.
2. World Health Organisation. Pocket book of hospital care for children: Guidelines for the management of common childhood illnesses. 2nd ed. Geneva: World Health Organisation; 2013.
3. Bennett NJ, Domachowske J. Pediatric pneumonia. New York: Medscape, LLC; c1994-2017. Available at: www.medscape.com/article/967822. Accessed 8th December 2014.
4. Basnet S, Adhikari RK, Gurung CK. Hypoxaemia in children with pneumonia and its clinical predictors. Indian J Pediatr. 2006;73:777-81.
5. World Health Organisation. Pneumonia. Geneva: World Health Organisation; 2014. Available at: www.who.int/mediacentre/factsheets/fs331. Accessed 14th November 2014.
6. Olowu A, Elusiyan JB, Esangbedo D, Ekure EN, Esezobor C, Falade AG, et al. Management of community acquired pneumonia (CAP) in children: Clinical practice guidelines by the Paediatrics Association of Nigeria (PAN). Nigerian J Paediatr. 2015;42(4):283-92.
7. Aderele WI, Johnson BR. Pneumonias. In: Azubuike JC, Nkanginieme KEO (eds.) Paediatrics and Child Health in a Tropical Region. 2nd ed. Owerri: African Educational Services; 2007: 425-441.
8. Emodi IJ, Ikefuna AN, Ubesie AC, Chukwu BF, Chinawa JM. Assessment of clinical features and haematocrit levels in detection of hypoxaemia in sick children. Afr J Resp Med. 2011 Sep 1;7(1).
9. Ibraheem RM, Johnson WB, Abdulkarim AA. Relationship between some risk factors of pneumonia and hypoxaemia in hospitalised Nigerian children. Afr J Resp Med. 2014 Sep 1;10(1).
10. 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 Royal Soci Tropical Med Hygiene. 2013 Sep 23;107(11):699-705.
11. Junge S, Palmer A, Greenwood BM, Kim Mulholland E, Weber MW. The spectrum of hypoxaemia in children admitted to hospital in The Gambia, West Africa. Trop Med Inter Health. 2006 Mar;11(3):367-72.
12. Kuti BP, Adegoke SA, Ebruke BE, Howie S, Oyelami OA, Ota M. Determinants of oxygen therapy in childhood pneumonia in a resource-constrained region. ISRN Pediatr. 2013 Jun 2;2013.
13. Sah HD. Study of predictors of hypoxaemia in children with pneumonia. Nepal Med Coll J. 2013;9:1-8.
14. 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 Org. 2009;87:263-70.
15. Kushwa MS, Verma YS, Gaur A. Clinical predictors of hypoxaemia in children with WHO classified pneumonia. Int J Contemp Pediatr. 2018;5:1-7.
16. Frankel LR. Monitoring techniques for the critically ill infant and child. Nelson Textbook of Pediatrics. 17th ed. Philadelphia, PA: Saunders. 2004: 273-276.
17. Razi E, Akbari H. A comparison of arterial oxygen saturation measured both by pulse oximeter and arterial blood gas analyzer in hypoxemic and non-hypoxemic pulmonary diseases. Turkish Resp J. 2006 Aug;7(2):43-7.
18. Jose B, Lodha R, Kabra SK. Comparison of two new generation pulse oximeters with arterial oxygen saturation in critically ill children. Ind J Pediatr. 2014;81:1297-301.
19. Hall JE, Guyton AC. Principles of gas exchange; diffusion of oxygen and carbon dioxide through the respiratory membrane. In: Guyton and Hall Textbook of Medical Physiology. 13th ed. Philadelphia: Elsevier; 2016: 517-526.

20. Sarnaik AP, Heidemann SM. Respiratory pathophysiology and regulation. In: Kliegman RM, Stanton BF, St. Geme JW, Schor NF, Behrman RE (eds) Nelson Textbook of Pediatrics. 19th ed. Philadelphia: Elsevier; 2011: 1419-1421.
21. Springer SC. Pediatric Respiratory Failure. New York: Medscape, LLC; c1994-2017. Available at: www.medscape.com/article/908172. Accessed 2nd April 2015.
22. Ibraheem RM, Johnson WBR, Abdulkarim AA. Hypoxaemia in hospitalised under-five Nigerian children with pneumonia. West Afr J Med. 2014;33:37-43.

Cite this article as: Ogaziechi KO, Ogoke CC, Chukwuka JO, Nwolisa EC, Achigbu KI. Prevalence of hypoxaemia and its associated factors in children with pneumonia seen at a tertiary hospital in Southeast Nigeria. Int J Contemp Pediatr 2020;7:34-41.