

Significant clinical features in pediatric pneumonia

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Abstract

Background Pneumonia is the leading cause of childhood mortality in the world. Although WHO develops an algorithm for diagnosing pneumonia, many clinicians still under or overdiagnose this disease.

Objective To assess associations of cough, tachypnea, fever, and chest indrawing with pneumonia in children.

Methods This cross-sectional study was conducted using medical records of children aged less than 5 year old with one or more clinical signs of pneumonia such as cough, fever, tachypnea, and chest indrawing in Haji Adam Malik Hospital, Medan from January 2009 to December 2011. Pneumonia was diagnosed by pediatric respirologists based on history-taking, and physical, laboratory and radiology examinations. Patients with incomplete data were excluded. Data was analyzed by bivariate and multivariate analyses.

Results Of 420 subjects, the majority were aged 3 to 23 months and there were more boys than girls. Clinical signs assessed for were cough (82.9%), tachypnea (31%), fever (79.3%), and chest indrawing (40.2%). Age <24 months (OR 2.563; 95% CI 1.497 to 4.387), cough (OR 2.274; 95% CI 1.042 to 4.960), tachypnea (OR 2.249; 95% CI 1.282 to 3.947), and chest indrawing (OR 6.993; 95% CI 4.017 to 12.173) were significant predictors for pneumonia.

Conclusion Age less than 24 months, cough, tachypnea, and chest indrawing are significantly associated with pneumonia. [Paediatr Indones. 2013;53:37-41.]

Keywords: pneumonia, tachypnea, chest indrawing, fever, children

Acute respiratory infections (ARIs), especially pneumonia, in children under the age of five years, are the leading cause of childhood mortality in the world.^{1,2} It has been estimated that more than 150 million episodes of pneumonia occur yearly in children under five in developing countries, accounting for more than 95% of all new cases worldwide. Between 11 million to 20 million children with pneumonia required hospitalization, and more than 2 million died from the disease.^{1,3} Pneumonia was responsible for 19% of pediatric mortality cases in 2004. Three-quarters of the childhood pneumonia cases worldwide occurred in just 15 countries, among which Indonesia ranks sixth.³ The Indonesian Basic Health Research Report (*Riset Kesehatan Dasar*, RISKESDAS) 2007 noted that pneumonia prevalence was 5.22% and pneumonia was the main disease killer in children under five years.⁴ Pneumonia, a respiratory disease characterized by inflammation of the lung parenchyma, is usually caused by viruses, bacteria, or irritants.⁵ The bacterial pathogen *Streptococcus pneumoniae* is the leading cause of severe pneumonia among children across the developing world.³ Simple

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clinical signs, including respiratory rate, presence of retractions or nasal flaring, grunting, cyanosis, pallor, and general appearance have been used to assess the cardiorespiratory status of infants and children. However, their absence does not reliably exclude the possibility of serious cardiopulmonary disease or lower respiratory tract infections.⁶

The aim of this study was to assess the association of clinical features (cough, tachypnea, fever, and chest indrawing) to pneumonia in children.

Methods

This cross-sectional study was conducted in the H. Adam Malik Hospital Pediatric Ward from January 2009 to December 2011. Data was collected from patients' medical records. We included patients aged less than 60 months (5 years) with one or more clinical signs of pneumonia such as cough, fever, tachypnea, and chest indrawing. The diagnosis of pneumonia was assessed by a pediatric respirologist based on history-taking, as well as physical, laboratory and radiology examinations. Patients with incomplete data were excluded. Associations between pneumonia and the clinical features cough, tachypnea, fever, and chest indrawing were assessed by bivariate and multivariate analyses. Data was analyzed with SPSS version 17.0 software. Results were considered to be significant for $P < 0.05$ with a 95% confidence interval (CI). This

study was approved by the Medical Research Ethics Committee of the University of Sumatera Utara.

Results

During the study period there were 420 subjects who met the inclusion criteria. Most were in the age group of 3 to 23 months and there were more boys than girls. We found the following prominent clinical features in the subjects: cough (82.9%), tachypnea (31%), fever (79.3%), and chest indrawing (40.2%) as shown in **Table 1**.

Table 1. Subjects' characteristics (n=420)

Characteristics	n	%
Age, n (%)		
0 – 2 month(s)	43	(10.2)
3 – 23 months	199	(47.4)
≥ 24 months	178	(42.4)
Gender, n (%)		
Male	231	(55.0)
Female	189	(45.0)
Fever, n (%)		
Yes	333	(79.3)
No	87	(20.7)
Cough, n (%)		
Yes	348	(82.9)
No	72	(17.1)
Tachypnea, n (%)		
Yes	130	(31.0)
No	290	(69.0)
Chest indrawing, n (%)		
Yes	169	(40.2)
No	251	(59.8)

Table 2. Bivariate analysis for subjects with pneumonia

Variables	Pneumonia		OR	95% CI	P value
	Yes	No			
Age, n					
< 24 months	123	119	4.378	2.789 to 6.871	0.001
≥ 24 months	34	144			
Gender, n					
Boy	81	150	0.803	0.540 to 1.194	0.278
Girl	76	113			
Fever, n					
Yes	133	200	1.746	1.039 to 2.933	0.034
No	24	63			
Cough, n					
Yes	146	202	4.008	2.038 to 7.883	0.001
No	11	61			
Tachypnea, n					
Yes	86	44	6.029	3.839 to 9.467	0.001
No	71	219			
Chest indrawing, n					
Yes	120	49	4.378	2.789 to 6.871	0.001
No	37	214			

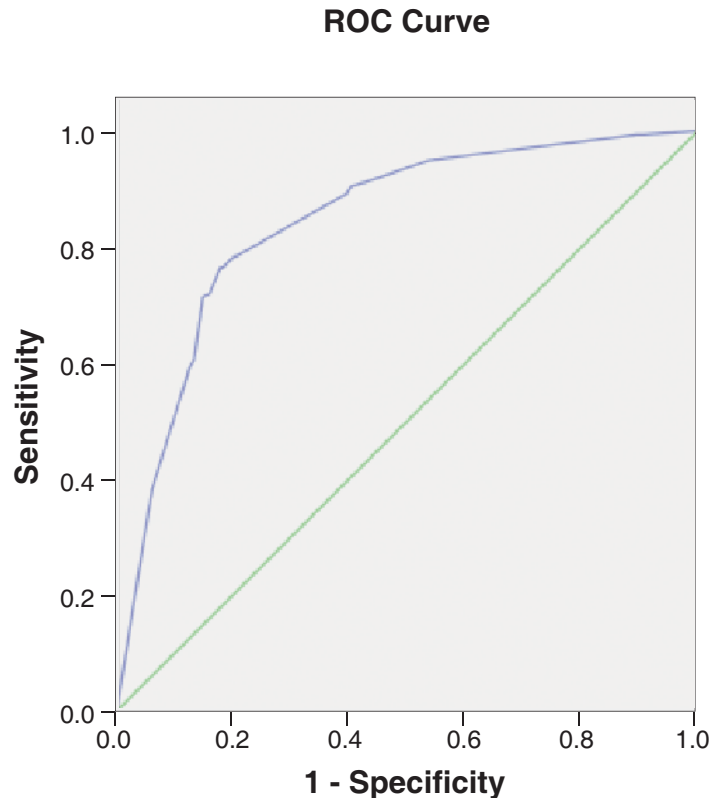
Table 3. Multivariate analysis for variables found to be significantly associated with pneumonia by bivariate analysis

Variables	B	Df	OR	95% CI Exp(B)	P value
Step 1(a) Age	0.959	1	2.610	1.519 to 4.485	0.001
Fever	-2.380	1	0.788	0.410 to 1.514	0.474
Cough	0.864	1	2.373	1.078 to 5.226	0.032
Tachypnea	0.832	1	2.298	1.304 to 4.051	0.004
Chest indrawing	1.963	1	7.121	4.077 to 12.436	0.001
Constant	-2.869	1	0.057		0.001
Step 2(a) Age	0.941	1	2.563	1.497 to 4.387	0.001
Cough	0.821	1	2.274	1.042 to 4.960	0.039
Tachypnea	0.811	1	2.249	1.282 to 3.947	0.005
Chest indrawing	1.945	1	6.993	4.017 to 12.173	0.001
Constant	-2.955	1	0.050		0.001

A formulation model for possible use as a diagnostic tool was made based on this data:

$$Y = -2.995 + 0.941 (\text{age}) + 0.821 (\text{cough}) + 0.811 (\text{tachypnea}) + 1.945 (\text{chest indrawing})$$

Scoring to be used: age < 24 months: yes (1), no (0); cough: yes (1), no (0); tachypnea: yes (1), no (0); chest indrawing: yes (1), no (0).

**Figure 1.** ROC of model for diagnosing pneumonia based on the presence of clinical features

As shown in **Table 2**, gender was not significantly associated with pneumonia. However, age (especially less than 24 months), fever, cough, tachypnea, and chest indrawing had significant associations with pneumonia.

Multivariate analysis with backward stepwise regression was used to identify pneumonia markers of greater statistical significance. All variables in bivariate analysis with significant at $P < 0.25$ were included in multivariate analysis. Bivariate analysis revealed

that some independent variables (age, fever, cough, tachypnea, and chest indrawing) had P values < 0.25.

Table 3 shows the results of the backward logistic regression analysis and Hosmer-Lemeshow goodness-of-fit. We found that age, cough, tachypnea, and chest indrawing were significant markers in pneumonia, but fever was not.

Area under the curve of the receiver-operator characteristic (ROC) for this model was 0.843 (95%CI 0.804 to 0.882) (**Figure 1**). The results of the Hosmer-Lemeshow goodness-of-fit test analysis was 0.553 and the Nagelkerke R² value was 0.442, indicating a good model.

Discussion

Over the three year period of this study, we found that pneumonia occurred more often in children aged 3 to 23 months. Similarly, other studies reported pneumonia to occur more often in those aged less than 2 years.^{7,8} However, another study reported that pneumonia occurred more often in 4 to 6 year-olds.⁹

Pneumonia can be clinically defined as the presence of lower respiratory tract dysfunction in association with radiographic opacity. The WHO has promoted an algorithm to assess children who present with cough and fever. This algorithm, based on the presence of tachypnea, considers an increased respiratory rate to indicate pneumonia. The presence of suprasternal, subcostal or intercostal retractions indicates greater severity.¹⁰

Tachypnea is often used as a clinical marker for pneumonia in patients of all ages.¹¹ Tachypnea measurement has good reproducibility compared to observation of retractions or auscultatory findings of crackles or wheezes.¹⁰ Some studies reported that tachypnea was a poor predictor for pneumonia in children, especially with a disease duration of < 3 days.^{11,12} However, other studies reported that tachypnea, especially in infants, was highly specific and greatly increased the likelihood of pneumonia, when present.² In our study, tachypnea and chest indrawing were two significant markers in children with pneumonia. In addition, cough was found in 93% of pneumonia patients.

Fever was found in 79.3% of our subjects, but was not a significant predictor for pneumonia. Lozano *et*

al. also found that body temperature was not a significant predictor for pneumonia, but the duration of fever, especially more than 5 days, was significant.¹³ In contrast, other studies found that fever was a significant predictor for pneumonia.^{9,14}

Gender was not significantly associated with pneumonia, based on bivariate analysis, similar to a study by Kollef *et al.*¹⁵ Cough, tachypnea and chest indrawing were good markers for pneumonia, in agreement with a study by Neuman *et al.* that reported these same clinical features as good indicators of pneumonia.⁹

In conclusion, we find that age < 24 months, tachypnea, chest indrawing, and cough are significant markers for pneumonia. If two or more of these clinical features are observed, we recommend evaluating the patient for pneumonia.

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