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Research Article

PREDICTIVE VALUE OF TACHYPNEA IN THE DIAGNOSIS OF BRONCHOPNEUMONIA IN THE PEDIATRIC POPULATION

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Abstract:						
Background: Pneumonia is the leading cause	e of morbidity and mortality in chi	ldren less than 5 years of age (Rudan,				
et al. 2008). Studies on the values of tachypn	ea in the diagnosis of pneumonia i	in children are limited (Shah, Bachur,				
Kim & Neuman 2010).						
Objective: To identify the clinical predictive values of age related tachypnea in children with radiographic evidence						
of bronchopneumonia.						
Methods: A retrospective cohort study was conducted at Dr. Soliman Fakeeh Hospital. The aim of the study was to						
seek an association between respiratory rate and radiographic pneumonia in the pediatric age group. Data was						
collected and analyzed in IBM SPSS Version	20.					
Results: It was found that there was statistical significance in the likelihood ratio of a relationship between respiratory						
rate and radiographic pneumonia in the infant age group $\begin{bmatrix} G^2(1, N = 215) = 4.252, p = .039 \end{bmatrix}$. The results were						
also significant for tachypnea in the todaler	age group $[x^2(1, N = 334) = 6.5]$	01, p = .011]. Approximately 94% of				
tachypheic toadiers had pheumonia.	·, 1 ·,· 1·,· 1					
Conclusion: Due to the high level of specific	city and positive predictive value,	evaluation of respiratory rate for age				
related tachyphea may be useful in the assess	ment of pneumonia risk among chi	uaren in settings with underprivueged				
resources.	1					
Key woras: Tacnypnea, bronchopneumonia,	predictive value, pediatrics					
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INTRODUCTION:

Pneumonia is the leading cause of morbidity and mortality in children less than 5 years of age (Rudan, et al. 2008). Despite the high incidence of childhood pneumonia worldwide, data is limited regarding the ability to diagnose and predict the clinical course of pneumonia (Florin, French, Zorc, Alpern, &Shah 2013). Studies on the value of tachypnea in the diagnosis of pneumonia in children are limited (Shah, Bachur, Kim & Neuman 2010). As of 2015, it has been estimated that approximately 120-156 million cases of acute lower respiratory tract infections occur worldwide and result in 1.4 million deaths with more than 95% of the morbidities in lower and middle income countries (Lazzerini, Sonego, & Pellegrin 2015). In a recent study, it was found that children under the age of five years suffering from severe pneumonia associated with hypoxia had a higher chance of having age related tachypnea (Alwadhi, Dewan, Malhorta, Shah, & Gupta 2017).

We therefore found it appropriate to conduct this study to identify the clinical predictive values of age related tachypnea in children with radiographic evidence of bronchopneumonia.

METHODS:

Study Design:

A retrospective cohort study was conducted at Dr. Soliman Fakeeh Hospital in the port city of Jeddah, Saudi Arabia. The aim of the study was to seek an association between respiratory rate and radiographic pneumonia in the pediatric age group.

Participants and Enrollment:

Data was extracted retrospectively from, OASIS, the hospital electronic medical record operating system, between the dates of January 1, 2014 to December 18, 2018. Inclusion criteria were any pediatric patient that presented to the hospital with documented respiratory rate and pulse oxygen saturation and with physician diagnosed bronchopneumonia. Patients were excluded from the study if a chest x-ray was not done to show evidence of bronchopneumonia.

Outcomes and Definitions:

Patients were stratified into five categories based on age related respiratory rates as determined by the 2018 PALS study guide for age related respiratory rates (RR) (Aehlert 2018). The age categories were: less than one year of age (infant), one to three years (toddler), four to five years (preschooler), six to 12 years (school aged child), and 13 to 18 years of age (adolescent).

Tachypnea was defined as a respiratory rate (RR) greater than 61 breaths per minute in the first age group, > 41 in the second group, > 35 in the third, > 31 in the fourth and > 17 in the fifth category. Hypoxemia was considered as a pulse oxygen saturation less than 95% across all age groups.

Data Collection and Analysis:

Data was collected and analyzed in IBM SPSS Statistics version 20. Pearson Chi square(x^2), Chisquare likelihood ratio (G^2) and Fisher's exact appropriate tests were applied to compare the rate of radiological pneumonia among children with and without age-defined. Results were defined in terms of sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV). A probability below 0.05 was regarded as statistically significant. The strength of association between tachypnea and radiological evidence of bronchopneumonia was determined by the Phi correlation coefficient. Each age group RR was analyzed for association with hypoxemia using the Chi-square test.

RESULTS:

A total of 755 patients were enrolled in the study and were diagnosed to have clinical bronchopneumonia based on history and physical examination. The toddler age group constituted approximately 44% of the studied population and infants were around 29%. The adolescent age group did not contribute significantly to the study since only one participant qualified (Figure 1).



Figure 1: Distribution of Participants Based on Age

Age group

The study showed that 85% of those enrolled were found to have radiographic evidence of bronchopneumonia.

In the infant age group, all the participants who were tachypneic were also hypoxemic and had evidence of radiographic pneumonia. However only 40.5% of those with pneumonia were hypoxic and tachypneic $[G^2(1, N = 38) = 1.022, p = .312]$. On the other hand, 96.9% of infants without pneumonia had a normal saturation and normal RR and only 7.6% of infants with pneumonia were tachypneic despite normal saturation [$G^2(1, N = 177) = .979, p = .322$].

It was found that there was statistical significance in the likelihood ratio of a relationship between respiratory rate and radiographic pneumonia in the infant age group [$G^2(1, N = 215) = 4.252, p = .039$].

In the toddler category, 91.9% of tachypneic toddlers were hypoxemic and had pneumonia. There was a statistically significant positive association between normal saturation and normal RR with a normal chest x-ray $[G^2(1, N = 273) = 7.233, p = .007]$. The There was a positive statistical significance in the relationship between RR and radiographic pneumonia in toddlers $[x^2(1, N = 334) = 6.501, p = .011]$.

Although most of the tachypneic preschoolers and school age children were hypoxemic and had pneumonia, there was no statistical significance to associate respiratory rate and the presence of pneumonia in either group.

Although the p values were statistically significant, the phi correlation coefficient for tachypnea in the toddler age group was .140. This correlate with a slightly positive association of respiratory rate with radiographic evidence of bronchopneumonia.

Table 1: Distribution of signs based on Sensitivity and Specificity							
Sign	Sensitivity%	Specificity%	PPV%	NPV%	P- Value		
Age Group: Infant							
Infant RR (N= 215)	14.3	97	96.3	17	.039		
RR and Hypoxemia (N=38)	40.5	100	100	4.3	.312		
RR and Normal SPO2 (N=177)	7.6	96.9	91.7	18.8	.322		
Age Group: Toddler							
Toddler RR (N= 334)	26.8	90	93.8	17.8	.011		
RR and Hypoxemia (N=61)	59.6	25	91.9	4.2	.532		
RR and Normal SPO2 (N=273)	18.5	95.7	95.5	19.2	.007		
Age Group: Preschooler							
Preschooler (N=92)	22.1	86.7	89.5	17.8	.728		
RR and Hypoxemia (N=12)	60	50	85.7	20	.795		
RR and Normal SPO2 (N=80)	16.4	92.3	91.7	17.6	.387		
Age Group: School Age Child							
School Age children (N= 113)	15.2	100	100	14.3	.209		
RR and Hypoxemia (N=24)	52.2	100	100	8.3	.232		
RR and Normal SPO2 (N=89)	3.9	100	100	15.1	.326		

The allocation of patients with and without pneumonia with combinations of RR and SPO2 is shown in Table

1. Overall, the results were significant for tachypnea in the infant and toddler age groups.

DISCUSSION:

We retrospectively examined the association between tachypnea with radiographic pneumonia among 755 children presenting to our hospital who had a chest xray obtained for possible pneumonia. The association of radiographic pneumonia and tachypnea was significant only in the infant and toddler age groups. This is probably due to the fact that the majority of the participants were in these categories.

This study had a high specificity and lack of sensitivity for tachypnea in the infant and toddler age groups similar to the study done by Mullholland, Olinsky, & Shann in 1990 and unlike the study done by Kushwah, Verma, & Gaur in 2018.

The systematic review and meta-analysis conducted by Lazzerini, Marzia, et al. in 2015, supported the regular use of pulse oxygen saturation to aid in recognition children with increased morbidity due to acute lower respiratory tract infections.

The generalizability of our study may be limited because our study was conducted in a region of Saudi Arabia where there is widespread access to healthcare and clinicians are more likely to see patients earlier in the course of their illness and with less advanced pneumonias. In addition, the port city of Jeddah accommodates a massive variety of expatriates not found elsewhere in the country and it is considered as the main entryway to the pilgrims hosted by Saudi Arabia, therefore the sample size in our study may not be reflective of the population in other areas of the country.

Moreover, we did not exclude children with underlying medical conditions that may affect the respiratory rate such as congenital heart disease and neuromuscular disorders. Although some patients presented with symptoms indicative of pneumonia such as fever or cough, patients that did not undergo chest radiography were not included in the study. Furthermore, respiratory rate was not adjusted for temperature.

Since there is no ideal standard for the definition of pneumonia we included equivocal radiographs to decrease the chance of missing a child with radiographic pneumonia. Due to the minimal enrollment in the adolescent age group, we did not have the statistical power to evaluate the association between tachypnea and radiographic pneumonia among children between 13 to 18 years of age.

CONCLUSION:

In the modern health care setting, tachypnea is not a sensitive indicator of pneumonia and may be aided by the supplementation of pulse oxygen saturation. Due to the high level of specificity and positive predictive value, evaluation of respiratory rate for age related tachypnea may be useful in the assessment of pneumonia risk among children in settings with underprivileged resources. Further studies should focus on more rural areas of Saudi Arabia with fewer medical resources and should include a larger sample. Medical facilities should strive to have pulse oximetry available in all areas.

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