Original Article

Comparison of Acute Illness Observation Scale (AIOS) & Chest X-Ray in Children with Acute Respiratory Infection

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Abstract: Acute respiratory infection (ARI) is a major source of morbidity and mortality in both the developing and developed worlds and remains the most important cause of hospital visit. For the early recognition of severity and prompt treatment of ARI, Acute illness observation scale (AIOS) an illness severity scale developed by P.L.McCarthy on the basis of simple observation was used in the current study. This study is a hospital based cross-sectional study conducted in 40 children aged between 2 month to 59 month with ARI. AIOS score was calculated for every child, classified according to Integrated Management of Neonatal and Childhood Illness (IMNCI) and Chest X-ray (CXR) was taken on the day of evaluation and the results were correlated. On the basis of the AIOS score the children were stratified. The relationship between AIOS score and the X-ray abnormalities were studied. There were 27 children who scored 10 with no signs of respiratory distress. In the 6 children who scored 11-15 there was mild to moderate distress and there were 7 children with severe distress who scored >=16. In the X-ray, radiological abnormalities like pneumonia, hyperinflation and pleural effusion was present in 32 children of which 59.4% of children scored <=10, 18.8% scored 11-15 and 21.9% of the children scored >=16. The prevalence of radiological pneumonia among the study population was 72.5%, out of which non end point consolidation (51.73%) was the most common radiological type of pneumonia. On illness severity as assessed by IMNCI classification severe pneumonia (40%) was the most common followed by pneumonia (37.5%) and no pneumonia (22.5). On statistical analysis it was found that AIOS score is not Significant in predicting abnormal radiological findings (P value=0.119) however there is significant association between AIOS scoring and IMNCI classification of ARI in illness severity assessment (P value<0.001). Further AIOS scoring was 100% specific in predicting pneumonia, severe pneumonia or both. However it has sensitivity of 93.8% in predicting severe pneumonia, less sensitive (13.3%) in predicting pneumonia and has sensitivity of 54.8% in predicting both pneumonia and severe pneumonia. It has highest accuracy (96%) in predicting severe pneumonia whereas 45.8% accuracy in predicting pneumonia and 65% accuracy in predicting pneumonia and severe pneumonia in ARI in under 5 children.

Keywords: Acute respiratory infection (ARI), acute illness, IMNCI

1. INTRODUCTION

In both the developing and developed worlds, acute respiratory infection (ARI) is a major source of morbidity [1]. It is the most common reason parents take their children to see the physician and for attending an emergency department with a medical problem [2]. ARI is the acute onset of at least one of the following four respiratory symptoms, cough or sore throat or shortness of breath or crazy and a clinician's judgment that illness is due to infection [3]. In low and middle-income nations, the incidence and prevalence of ARIs are much higher than in high-income countries. According to the World Health Organization (WHO), ARI- related deaths in children under the age of five years (excluding deaths due to measles, pertussis, and newborn deaths) accounted for around 2.1 million every year, or nearly 20% of all pediatric deaths. ARI kills over 10.8 million children each year [4]. According to estimates, ARI killed 1.9 million children, 70% of whom lived in Africa and Southeast Asia [5]. The incidence of ARI stands first in Southeast Asia causing more than 80% of all the incidences along with Sub-Saharan African countries [6]. ARI is responsible to cause death of about 28,000 children in Nepal each year [7]. In the year 2074/75 BS ARI incidence was 592 per 1000 under 5 children out of which 10.5% were categorized as pneumonia cases and 0.29% were severe pneumonia cases [8]. The incidence of pneumonia at national level was 66 per 1000 under five children. Likewise, highest ARI incidence was seen at Sueur Pac him (992/1000 Under-5 children) followed by carnal (927/1000 Under-5 children) and least at Province 3 (439/1000 Under-5 children) [9]. Kant Children's Hospital's unpublished hospital records showed overwhelming burden of ARI. Over one year duration out of 7520 inpatients, 12.85% (967) were children with ARI. Out of which 97.31% (941cases) were children with pneumonia and 0.41% (4 cases) were children with severe pneumonia [10]. Although no data was available for Out-patient Department (OPD) and Emergency (ER) ARI cases, ARI remains one of the most common causes of hospital visit [11]. Prompt understanding of wellbeing of a child with ARI is essential for triage, early referral, hospitalization and initiating treatment interventions in developing countries [12]. In this regard use of acute illness observation scale (AIOS) developed by McCarthy is a three-point scale for six ordinal variables and total score ranges from 6-30. It is a validated clinical index of quantifying risk of serious bacterial infection in children 36 months or younger presenting with febrile illnesses [13]. AIOS focuses on six easily observed factors (quality of cry, reaction to stimulation by parent, state variation, color, hydration and response to social overtures) that taken together are a sensitive indicator of serious illness children [14]. A discriminate function analysis revealed that these six items when used together had a specificity of 88% and sensitivity of 77% for serious illness [15]. The sensitivity of the six-item model for serious illness when combined with history and physical examination was 92% [16]. Acute illness observation scale is a useful tool in predicting abnormal radiological findings in children from 2-59 months with acute respiratory illness and thus in the emergency or OPD setting whom to send for Chest X-ray (CXR) can be determined by the use of AIOS score [17]. CXR is indicated when clinical criteria suggest pneumonia or other lower respiratory tract infections [18]. No other laboratory investigations have been shown to be sufficiently accurate to play a definitive role in identifying children with pneumonia or have a greater influence on management decisions than the chest X-ray [19]. WHO working group—"WHO Standardization of Interpretation of Chest Radiographs" (WHO-SICR) developed a standardized radio-logical diagnosis of CAP attempting to characterize it [20]. And it includes three entities alveolar pneumonia, non-alveolar pneumonia, and no infiltrate, consolidations, or effusions [21]. ARI being the most common cause of hospital visit in children with significant mortality and morbidity, AIOS in ARI helps in predicting the severity of illness [22]. Further AIOS is useful tool on predicting abnormal radiological findings in ARI, thus on the basis of this whom to send for X-ray or not can be determined thus reducing the unnecessary radiation exposure [23]. In rural setting where X-ray facility is not available radiological abnormality can be

predicted on the basis of AIOS score and treatment plan can be started including early referral [24]. As there has been limited study in our context this study will be conducted to compare the AIOS score with CXR in children with ARI [25].

2. MATERIALS & METHOD

The study was carried out after the thesis proposal has been accepted by the Institutional Review Board (IRB) of National Academy of Medical Sciences (NAMS) Cross sectional study. Emergency and OPD of Kant Children's Hospital, Maharajgunj, Kathmandu. Children who has visited Emergency or OPD with ARI from June 2021 to March 2022 Cases who has visited Emergency or OPD with ARI during the study period were enrolled until the required sample size was met. A predesigned preform was used as data collection sheets from N= 40 respondents. All the proformas were thoroughly reviewed for completeness of data. Data was entered in MS Excel version 10. Proper data cleaning was done. Then the data was transferred to SPSS software version 26, Chicago and was analyzed with the assistance of qualified statistician. Data was presented in table, graphical and narrative form as per the requirement. Microsoft word and Excel was used to generate graphs, tables etc. General characteristics, common symptoms were represented as number and percentage. Frequency of abnormal AIOS score was calculated along with frequency of abnormal x-ray findings. Fisher exact test was used fo find the correlation of AIOS with CXR and IMNCI. P value <0.05 was considered as significant correlation. All the data were password protected with access only to investigator (me) and supervisor. Patient identity was kept confidential and the data will be destroyed after 5 years of completion of research.

3. RESULTS & DISCUSSION

3.1 Results Interpretation

This was a hospital based cross-sectional study conducted to study the correlation between AIOS and CXR in children with ARI. This study was conducted over a period of 12 month in pediatric OPD and emergency department of Kant Children hospital. In this study a total of 40 children aged between 2 month to 59 month fulfilling the inclusion criteria were enrolled.

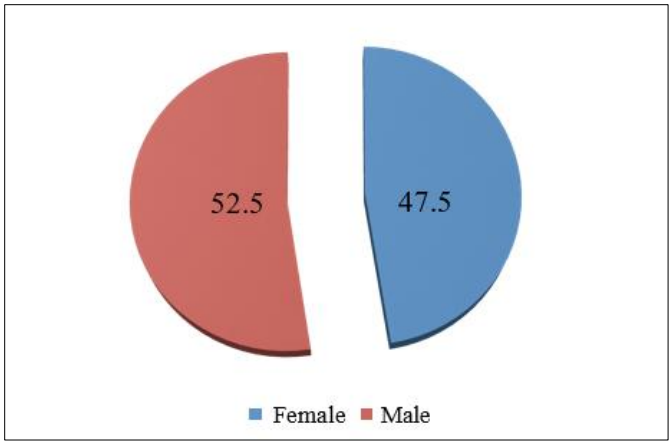

Figure 01: Pie chart showing Sex Distribution

The sex distribution in this study had a male preponderance. Male children were 21 (52.5%) and female children were 19 (47.5%). Male to female ratio of was 1.10:1.

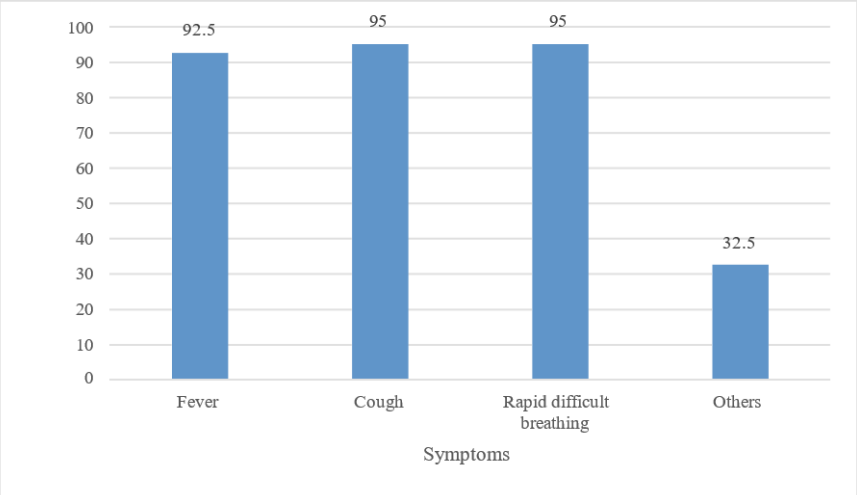

Figure 02: Distribution of children according to symptoms

Out of 40 children's cough and rapid or difficulty in breathing (breathlessness) was found in 38 (95%) children followed by fever in 37 (92.5%) children and 13 (32.5%) children had other symptoms including convulsion, inability to drink,, lethargy or grunting.

Table 01: Distribution of children according to signs

Signs	Number (n)	Percentage (%)
Tachypnea	31	77.5
Intercostal /subcostal recession	16	40
Nasal flaring	15	37.5
Grunting	4	10
Cyanosis	5	12.5
Lethargy	12	30
Convulsion	1	2.5
Inability to drink	5	12.5
Abnormal Capillary refill time (>2 sec)	4	10
Decreased breath sounds	20	50
Bronchial breathing	15	37.5
Crepitation's	32	80
Wheeze	10	25

Table shows the most common signs noted were crepitation's (80%), age adjusted tachypnea (77.7%), decreased breath sound (50%), followed by retraction (40%) and nasal flaring (37.5%).

Table 02: AIOS Score findings in studied children

AIOS Score	Number(n)	Percentage (%)
≤10	27	67.5
11-15	6	15
≥16	7	17.5
Total	40	100

Out of 40 children in the study 27 (67.5%) children had AIOS score less than 10 whereas 7 (17.5%) children had score greater than 15 and 6 (15%) children had score of 11-15.

Table 03: Chest X ray finding in studied children

Investigation		Number (N)	Percentage (%)
CXR	Normal	8	20
	Abnormal	32	80
Total		40	100

In this study maximum number of children 32 (80%) had abnormal chest X-ray including pneumonia, hyperinflation and pleural effusion but normal Chest X-ray was found in 8 (20%) children.

Table 04: Radiological pneumonia in study population.

Pneumonia	Number (N)	Total Percentage (%)	Percentage among Pneumonia(%)
End-point Consolidation	14	35	48.27
Non-end point Consolidation	15	37.5	51.73
Total	29	72.5	100

Table shows the prevalence of radiological pneumonia among the studied children which was 72.5%, out of which non end point consolidation (51.73%) was the most common radiological type of pneumonia.

Table 05: AIOS correlation with chest X ray.

Chest X-ray	AIOS score						Total	p
	≤10		11-15		≥16			
	n	%	n	%	N	%		
Normal	8	100	0	0	0	0	8	
Abnormal	19	59.4	6	18.8	7	21.9	32	* 0.119

Fisher exact test, P valuve <0.05 is significant

Fisher exact test was used to find the p value to find the correlation between AIOS score and Chest X-ray finding. With a p value of 0.118 which is more than 0.05 it is not statistically significant.

Table 06: Distribution of studied children according to IMNCI ARI classification

IMNCI	Number(n)	Percentage %
No pneumonia	9	22.5
Pneumonia	15	37.5
Severe pneumonia	16	40
Total	40	100

Out of 40 studied children, 16 (40%) children had severe pneumonia followed by pneumonia and no pneumonia in 15 (37.5%) children 9 (22.5%) children.

Table 07: Comparison of AIOS with IMNCI in illness severity assessment

IMNCI	AIOS						Total	P
	≤10		11-15		≥16			
	N	%	n	%	N	%		
No Pneumonia	9	100	0	0	0	0	9	
Pneumonia	15	100	0	0	0	0	15	
Severe pneumonia	3	18.8	6	37.5	7	43.8	16	* < 0.001

Fisher exact test, P value <0.05 is significant

This table shows the P value for the correlation between AIOS score and IMNCI ARI classification in illness severity assessment, which came out to be <0.001which is statistically significant.

Table 08: Sensitivity and Specificity of AIOS in predicting Pneumonia and severe pneumonia according to IMNCI

IMNCI	AIOS		
	Sensitivity	Specificity	Accuracy
Pneumonia	13.3	100	45.8
Severe pneumonia	93.8	100	96
Pneumonia and Severe Pneumonia	54.8	100	65

Table shows the sensitivity, specificity and accuracy of AIOS score in predicting Pneumonia and Severe pneumonia and it was found out that AIOS scoring was 100% specific in predicting pneumonia, severe pneumonia or both. However it has sensitivity of 93.8% in predicting severe pneumonia, less sensitive (13.3%) in predicting pneumonia and has sensitivity of 54.8% in predicting both pneumonia and severe pneumonia. Further it has highest accuracy (96%) in predicting severe pneumonia whereas 45.8% accuracy in predicting pneumonia and 65% accuracy in predicting pneumonia and severe pneumonia.

3.2 DISCUSSION

In both the developing and developed worlds, acute respiratory infection (ARI) is a major source of morbidity [26]. Pneumonia continues to be the biggest killer worldwide of children under five years of age [27]. Although the implementation of safe, effective and affordable interventions has reduced pneumonia mortality from 4 million in 1981 to just over one million in 2013, pneumonia still accounts for nearly one-fifth of childhood deaths worldwide [28].In the pre vaccination era, bacteria were the predominant cause of childhood pneumonia whereas in post vaccination era virus and atypical organisms are the predominant causes of childhood pneumonia and this changing epidemiology might have changed the clinical predictors as well as radiological appearance of childhood pneumonia which need to reassessed for the clinical diagnosis and management of childhood pneumonia [29]. ARI being the most common cause of hospital visit in children with significant mortality and morbidity, AIOS in ARI helps in predicting the severity of illness [30]. Further AIOS is useful tool on predicting abnormal radiological findings in ARI, thus on the basis of this whom to send for X-ray or not can be determined thus reducing the unnecessary radiation exposure [31]. This hospital based cross sectional study was done to compare Acute Illness Observation Scale and Chest X-ray in children with Acute Respiratory Infection [32]. This study was conducted for 12 months from June 2021 to March 2022 in outpatient and emergency unit of the Pediatric department of Kant Children Hospital. During this 12 month period, a total of 40 children aged between 2 months- 59 months and presenting with fever or cough or difficulty in breathing of <2 weeks duration were screened for the presence of clinical pneumonia [33]. In the present study among 40 children included in this study 21(52.5%) children were male and remaining 19 (47.5%) were female with Male, female ratio of 1.10:1. Similar findings was found in a study done by Peasant and et al with 59% male and 41% female with male: female ratio of 1.4:1 [33]. However in the study showed a higher percentage of male as 64.42% and 65.8% respectively. Similar findings of high male preponderance was found in study possible reason for high male preponderance in the current study might be because of male dominance in our part of world and so male child is the preferred gender for being taken to the hospital [34]. Regarding symptomatology, in this study cough and breathlessness was present in 38(95%) children. This is comparable with studies conducted, cough and breathlessness was present in 100% whereas fever was present in 88%. In the study, fever and cough was present in 100% whereas breathlessness was present in 57% of the studied children. In our study, crepitation's on auscultation (80%) and tachypnea (77.5%) were the important signs for making a clinical diagnosis of pneumonia. Paradox have observed that tachypnea and chest retractions were highly specific signs in detecting Pneumonia. So, by these findings it implies that a complete respiratory examination with auscultation is absolutely necessary to prevent the misdiagnosis and overenthusiastic use of chest x- ray in small children. A possible reason for this finding in present study might be that in children tachypnea may be present because of the fever at presentation which has been taken as the inclusion criteria. Also tachypnea can be a presentation of other respiratory tract infections like acute bronchiolitis and wheeze associated lower respiratory tract infections (WALRI) Regarding AIOS scoring 27(67.5%) children had score of less than or equal to 10 indicating mild respiratory distress as a main feature of ARI followed by 7(17.5%) children with score of greater than or equal to 16. This study is in contrary to the study where all13 in which majority of children 68% had scored more than or equal to 16, probable reason being most of the children in our study presented with mild respiratory distress as they present early in the hospital because of easy accessibility [35].

4. CONCLUSIONS

In both the developing and developed worlds, acute respiratory infection (ARI) is a major source of morbidity. It is the most common reason parents take their children to see the physician and for attending

an emergency department with a medical problem. ARI is the acute onset of at least one of the following four respiratory symptoms, cough or sore throat or shortness of breath or coryza and a clinician's judgement that illness is due to infection. In low and middle-income nations, the incidence and prevalence of ARIs are much higher than in high-income countries. According to the World Health Organization (WHO), ARI- related deaths in children under the age of five years (excluding deaths due to measles, pertussis, and newborn deaths) accounted for around 2.1 million every year, or nearly 20% of all pediatric deaths. ARI kills over 10.8 million children each year. According to estimates, ARI killed 1.9 million children, 70% of whom lived in Africa and Southeast Asia. The incidence of ARI stands first in Southeast Asia causing more than 80% of all the incidences along with Sub-Saharan African countries. ARI is responsible to cause death of about 28,000 children in Nepal each year. AIOS do not correlate with abnormal X ray findings in ARI, thus on the basis of only AIOS whom to send for X-ray or not cannot be determined. AIOS correlates well with IMNCI classification of ARI in illness severity assesment AIOS can be used as a tool to triage ARI and start treatment in healthcare setting and early referral of children with community acquired pneumonia in the fields by peripheral health care workers. Since AIOS do not correlates well with abnormal X ray findings in ARI, on the basis of AIOS only, whom to send for X-ray or not cannot be determined, thus emphasizing the importance of detail clinical examination so as to predict the abnormality in the chest X-ray or the possibility of radiological pneumonia. Further along with IMNCI, AIOS also remains as the sensitive tool in illness severity classification in pneumonia, can be used as a tool to triage and early institution of treatment in healthcare setting or early referral of children with community acquired pneumonia in the ruler area by peripheral health care workers. Further incorporation of pulse asymmetry in AIOS may predict abnormal CXR as shown in many other studies. However a larger metacentric study with more number of patients is required so as to confirm the findings.

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