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Original Research Article

ROLE OF ACUTE ILLNESS OBSERVATIONAL SCALE IN COMMUNITY ACQUIRED PNEUMONIA IN CHILDREN AGED 2 TO 59 MONTHS

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ABSTRACT

Background: Community Acquired Pneumonia (CAP) is still a major burden affecting the morbidity and mortality in infants and children. There are scales available to assess the severity and outcome so that illness prognosis can be changed. This study aimed to assess the role of Acute illness observation scale (AIOS) in predicting illness severity and outcome of community acquired pneumonia.

Materials and Methods: A cross sectional study was conducted in a cohort of 360 children between 2 months to 59 months at a tertiary care centre in Kottayam. Children with suspected pneumonia, if satisfying the inclusion criteria, were included in the study after taking informed consent from parents. AIOS scoring was done on each subject on day 1 and day 5 in a reasonably quite state. Pulse oximeter reading, vital signs and respiratory parameters were documented.

Results: The study showed that AIOS correlated with the severe clinical signs, abnormal chest X ray, invasive treatment modalities and worse treatment prognosis. Also, the study has assessed the validity measure of AIOS in comparison with IMNCI diagnosis. The sensitivity measure, specificity value and accuracy value of AIOS in measuring pneumonia was 58.95%, 82.85%, 69.4% respectively. The sensitivity measure, specificity value and accuracy value of AIOS in measuring severe pneumonia was 46.4%, 98.6% and 56.38% respectively.

Conclusion: The study showed AIOS can be used as a predictor scale to assess severity in community acquired pneumonia. The increased score of AIOS correlates well with abnormal investigations, invasive treatment modalities and worst prognosis.

Keywords: Acute illness observation scale, Community Acquired Pneumonia, Integrated Management of Neonatal and Childhood Illness.

INTRODUCTION

Community acquired pneumonia (CAP) implies to an infection of the lung by a collection of micro-organisms acquired from the community, causing an inflammation of the lung tissue. The clinical presentation usually includes fever and respiratory symptoms such as cough and tachypnoea, but symptoms may not be specific in young children. Pneumonia is the leading infectious cause of death globally among children younger than 5 years, accounting for an estimated 920,000 deaths each year.[1] The groups at highest risk of long-term morbidity and mortality include infants (low birth weight or premature), those who are immunosuppressed, and those who have other underlying conditions such as malnutrition or congenital heart disease.[2]

Tackling pneumonia and reducing U5MR (Under five mortality rate) due to pneumonia do not require major advances in technology, but identifying those children at greatest risk, and targeting them with interventions of proven efficacy will enable us to close the gap.[3] Use of simple, standardized

guidelines like Integrated Management of Neonatal and Childhood Illness (IMNCI) for the identification and treatment of Community acquired pneumonia, at first-level health facilities and at referral hospitals reduces child deaths substantially.[4] However, IMNCI strategy will be more effective in managing pneumonia when supplemented by an illness-severity scoring system that can quickly quantify the severity of illness at all stages from onset to recovery. In this regard, use of Acute Illness Observation Scale (AIOS) -a generic illness severity scale- based on clinical appearance instead of complex symptomatology, helps in optimizing criteria for triage, early referral, hospitalization and initial therapeutic modalities in developing countries. AIOS is a validated clinical index with three-point scale for six ordinal variables and a total score range of 6 to 30, first introduced by McCarthy PL.[5] It is a validated clinical index of measuring risk of serious bacterial infection in children 36 months or younger presenting with febrile illnesses. AIOS concentrates on six easily observed factors that, taken together, are a sensitive, indicator of serious illness children. Incidence of serious bacterial infections is less than 2-3% if a febrile child scores 10 or less; and is more than 90% if AIOS score is 16 or above. Many studies have been done to demonstrate the utility of AIOS in detecting serious illness in febrile children; there are few studies on use of AIOS in Community acquired pneumonia especially in India. Hence the study was done to assess the role of this scale in analysing the severity and outcome of CAP.

MATERIALS AND METHODS

This was a descriptive – cross sectional study done at Institute of Child health, Govt. Medical College, Kottayam a tertiary care hospital, in children aged 2 months to 59 months. Aim of the study was to assess the role of AIOS in predicting illness severity and outcome of community acquired pneumonia.

In the study by Murali B. H, Lingaraju Mulage, [6] the prevalence of tachypnoea 51-60/ minute in CAP with AIOS>16 was 26.7%. Considering this, sample size was calculated with the equation

$n = Z^2_{1-\alpha/2} * p * (1 - p) / d^2$

$N = 1.96^2 * 0.267 * (1 - 0.267) / 0.05^2$

$N = 301$

The addition of a response rate of 80% makes the sample size to be 360. Children between 2 months to 59 months coming to hospital with suspected pneumonia were consecutively taken to be included in the study

Inclusion Criteria

Children between 2 months –59 months presenting with Fever less than 3 days with history of cough or difficult breathing with Fast breathing (2 Months – 12 months >50/mt,12 Months –5 years >40/mt) +/- any of the following: chest indrawing, stridor in calm child, grunting, lethargy, convulsion and Inability to feed

Exclusion Criteria

Children with duration of illness more than 2 weeks, respiratory distress with prominent wheezing, congenital heart disease or ventilator associated pneumonia were excluded from the study

Children between 2 months to 59 months coming to hospital with suspected pneumonia, if satisfying the inclusion criteria were enrolled into the study group, after obtaining informed consent from the parents of the subjects. AIOS scoring was done on each subject on day 1 and day 5 in a reasonably quite state. IMNCI classification was done at the time of admission. Pulse oximeter reading of each patient was recorded. Respiratory parameters and vital signs as in data collection form were documented. Chest Xray, complete blood count and blood culture were done within 24hours of admission. Treatment, investigations and the disease course as per data collection form were documented. The child is followed up until discharge or death. Clinical parameters, investigatory findings, mode of treatment, presence of complications, duration of hospital stay, final outcome (death/discharge) were being entered in data sheet and are statistically compared with AIOS scoring taken at the time of admission.

Statistical Analysis

Data was entered in MS excel sheet and analysed using SPSS software version16. Categorical variables like age, gender, weight for age, danger signs, respiratory clinical features, treatment modalities and clinical course are represented in frequencies and percentages. Chi-squared test was used to find the association among variables. When a Categorical Variable is associated with another categorical variable, the variables are represented in both by tables and bar diagrams. Fisher's exact test is used when more than 20% of the cell values have expected cell value less than 5. The validity measure of AIOS in assessing the severity and outcome of CAP was assessed by its comparison with IMNCI and measures of sensitivity, specificity and accuracy was calculated. The critical value of P indicating the probability of significant difference was taken as <0.05 for comparison.

Table 1: AIOS score: composition and score description

Observation item	Score = 1(Normal)	Score=3 (Moderate impairment)	Score=5 (Severe impairment)
Quality of Cry	Strong cry with normal tone or contented and not crying	Whimpering or sobbing	Weak cry/ moaning, or high-pitched cry
Reaction to Stimulation to parent	Cries briefly and stops, or is content and not crying	Cries on and off	Cries continuously or responds hardly

State Variation	When awake, stays awake, or if stimulated while sleeping, awakens quickly	Closes eyes for short period when awake, or awakens when stimulated for long time	Fast asleep or not arousable
Colour	Pink	Pale extremities /acrocyanosis	Pale/ cyanotic/, mottled /ashen
Hydration	Normal skin and eyes and moist mucous membranes	Normal skin and eyes, mouth slightly dry	Poor recoiling of skin, mucous membranes dry and/or eyes sunken
Response to social overtures	Smiles or alert	Smiles for a brief period or alerts briefly	No smile, anxious face, no expressions, or not alert

RESULTS

Among the 360 children between 2 months to 59 months included in the study, 203 (56.4%) belonged to the age group of 2-12 months, 109(30.3%) subjects belonged to 13-36 months and 48(13.3%) belonged to more than 36 months. The study showed that most of subjects were males 193(53.6%) and 167(46.4%) were females. When the weight for age distribution among the subjects was considered, 171(47.5%) belonged to a weight for age between -2 and -3 SD and 67 (18.6 %) had weight for age below -2 SD, thus the study showed that subjects with underweight (<-2SD) were 238 (66.11%) among the study population as in figure 1.

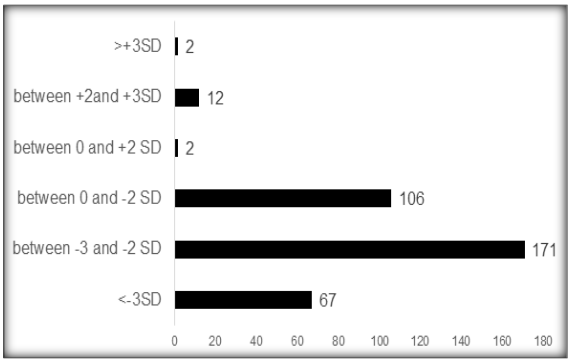

Figure 1: Weight for age distribution among the subjects

Regarding danger signs, 226(62.8%) had nil danger signs, 60 (16.7%) had lethargy, 39 (10.8%) showed inability to drink, 26(7.2%) had grunting, 5(1.4%) had convulsions and 4(1.1%) showed stridor. Most of the subjects 177(49.2%) had respiratory rate between 50-60 per minute, 121(33.6%) had between 40-50 per minute and 62(17.2%) had more than 60 per minute. Among the respiratory findings, the study showed that 216 (6%), 256(71.1%), 168(46.7%), and 33(9.2%) had abnormal temperature, presence of intercostal retraction, subcostal retraction, and abnormal breath sounds respectively. 60 subjects (16.7%) had a SpO2 value <85%, 99(27.5%) had SpO2 between 86 and 92% and 201(55.8%) had SpO2 more than 92%. The classification based on IMNCI among the population showed 224(62.2 %) had pneumonia and 136children (37.8 %) had severe pneumonia.

The blood investigations among the population showed 44(12.2%), 222(61.7%) and 24(6.7%) had abnormal capillary refill time, presence of leucocytosis and organism detected in blood culture respectively. 253(70.3%) subjects had abnormal X-ray in comparison with that of 107(29.7%), who had normal X-ray. Treatment modalities used among population showed that 48(13.3%), 14(3.9%), 173(48.1%), 19(5.3%), 311(86.4%) and 98(27.2%) had used ionotropic support, nebulization, oxygen, ventilation intravenous antibiotics and intravenous fluids respectively.

In the study persistent distress on day 5 was present among 125(34.7%) of the subjects. Most of the subjects 178(49.4%) had a hospital stay of 5-14 days. In the study 64(17.8%) had complications. The complications were as follows, 52(14.4%) had septic shock, 7(1.9%) had empyema and 26(7.2%) hade presence of effusion.

Table 2 shows the AIOS distribution among the subjects. The study showed that 291(80.2%) subjects were having abnormal AIOS among the subjects. [Table 2]

In the individual item analysis, Quality to cry, Response to parent stimulation, State variation, Colour, Hydration and Response to social overtures respectively had abnormal score as given in Table 3. [Table 3]

The study showed significant difference between age groups in terms of AIOS categories. In the age group >36 months 29(60.4%) had AIOS more than 15. For the 2-12 months and 13-36 months age group, 84(41.4%) and 51(46.8%) had score between 10-15 respectively. The relationship between AIOS categories and demographic variables is given in Table 4. [Table 4]

The Table 5 shows the association of respiratory rate, temperature, intercostal retraction, subcostal retraction, breath sounds with AIOS categories The study showed there is a significant difference in subjects with intercostal retraction. 117(45.7%) of subjects with intercostal retraction had a AIOS score of more than 15. [Table 5]

Table 6 shows the association of SPO2 and Chest Xray with AIOS categories. The study showed there is a significant difference in subjects with SPO2 <85%. 39(65%) of subjects with SPO2 <85% had a AIOS score of more than 15. Also 144(56.9%) of subjects with abnormal chest Xray had an AIOS score of more than 15. [Table 6]

Table 7 shows the association of capillary refill time, presence of leucocytosis and blood culture positivity with AIOS categories. The study showed there is a significant difference in subjects with capillary refill time > 2 seconds. 43 (97.7%) of subjects with capillary refill time > 2 seconds had a AIOS score of more than 15. Also 23(95.8%) of

subjects with organism detected in blood culture had an AIOS score of more than 15. The result is statistically significant. [Table 7]

Table 8 depicts the association of use of ionotropic support, intravenous fluids nebulization, ventilation, oxygen, and intravenous antibiotics with AIOS categories. P value shows the result is statistically significant. [Table 8]

Table 9 shows the association of Persistent distress on day5, Hospital stay, Complications, presence of Septic shock, Presence of empyema and Effusion with AIOS categories. [Table 9]

Table 10 shows the association of IMNCI assessment and AIOS categories. The study showed that both groups was comparable in assessing the severity.116(80%) of subjects with severe pneumonia had AIOS score more than 15. [Table 10]

The sensitivity measure, specificity value and accuracy value of AIOS in measuring pneumonia and severe pneumonia are depicted in Table 11. [Table 11]

Table 2: AIOS distribution among the population

	Frequency	%
<10	69	19.2
10-15	146	40.6
>15	145	40.2

Table 3: Individual item analysis in AIOS among population

	Normal score (=1)		Abnormal score (=3 or 5)	
	Frequency	%	Frequency	%
Quality to cry	85	23.6	275	76.4
Response to parent stimulation	121	33.6	239	66.4
State variation	124	34.4	236	65.6
Colour	306	85	54	15
Hydration	299	83.1	61	16.9
Response to social overtures	43	11.9	317	88.1

Table 4: AIOS categories and demographic variables

Variables		AIOS categories			Test value	p value
		<10	10-15	>15		
Age	2-12 months	44(63.8%)	84(57.5%)	75(51.7%)	11.89	0.02*
	13-36 months	17(24.6%)	51(34.9%)	41(28.3%)		
	>36 months	8(11.6%)	11(7.5%)	29(20%)		
Gender	Male	39(20.2%)	78(40.4%)	76(39.4%)	0.32	0.59
	Female	30(18%)	68(40.7%)	69(41.3%)		
Weight for age	Abnormal	46(19.4%)	96(40.3%)	96(40.3%)	0.02	0.97
	Normal	23(18.8%)	50(41%)	49(40.2%)		

Table 5: AIOS categories with clinical features

Variables		AIOS categories			Test value	p value
		<10	10-15	>15		
Respiratory rate	40-50 /minute	35(28.9%)	44(36.4%)	42(34.7%)	13.73	0.11
	50-60 / minute	22(12.4%)	74(41.8%)	81(45.8%)		
	>60/ minute	12(19.4%)	28(45.2%)	22(35.4%)		
Temperature	Normal	34(23.6%)	58(40.3%)	52(36.1%)	3.51	0.07
	Abnormal	35(16.2%)	88(40.7%)	93(43.1%)		
Intercostal retraction	Absent	37(35.6%)	39(37.5%)	28(26.9%)	27.36	<0.001*
	Present	32(12.5%)	107(41.8%)	**117(45.7%)**		
Subcostal retraction	Absent	46(24%)	68(35.4%)	78(40.6%)	7.62	0.23
	Present	23(13.7%)	78(46.4%)	67(39.9%)		
Breath sounds	Normal	65(19.9%)	134(41%)	128(39.1%)	2.24	0.14
	Abnormal	4(12.1%)	12(36.4%)	17(51.5%)		

Table 6: AIOS categories with SPO2 and Chest Xray

Variables		AIOS categories			Test value	p value
		<10	10-15	>15		
SPO2	>92%	55(27.4%)	76(37.8%)	70(34.8%)	33.04	<0.001
	86-92%	13(13.1%)	50(50.5%)	36(36.4%)		
	<85%	1(1.7%)	20(33.3%)	39(65%)		
Chest X ray	Normal	62(57.9%)	44(41.1%)	1(0.9%)	177.97	<0.001
	Abnormal	7(2.8%)	102(40.3%)	144(56.9%)		

Table 7: AIOS categories and Blood investigations

Variables		AIOS categories			Test value	p value
		<10	10-15	>15		
Capillary refill time	Normal	69(21.8%)	145(45.9%)	102(32.3%)	68.78	<0.001*
	Abnormal >2s	0	1(2.3%)	**43(97.7%)**		
Leucocytosis	Absent	30(21.7%)	61(44.2%)	47(34.1%)	3.66	0.07
	Present	39(17.6%)	85(38.3%)	98(44.1%)		
Blood culture	Sterile	69(20.5%)	145(43.2%)	122(36.3%)	33.03	<0.001*
	Organism detected	0	1(4.2%)	**23(95.8%)**		

Table 8: AIOS categories with treatment modalities

Variables		AIOS categories			Test value	p value
		<10	10-15	>15		
Ionotropic support	Not used	69(22.1%)	145(46.5%)	98(31.4%)	76.51	<0.001*
	Used	0	1(2.1%)	**47(97.9%)**		
Intravenous fluids	Not used	67(25.6%)	122(46.6%)	73(27.9%)	66.01	<0.001**
	Used	2(2%0	24(24.5%)	**72(73.5%)**		
Nebulisation	Not used	69(19.9%)	146(42.2%)	131(37.9%)	21.59	<0.001*
	Used	0	0	**14(100%)**		
Ventilation	Not used	68(19.9%)	145(42.5%)	128(37.5%)	20.24	<0.001*
	Used	1(5.3%)	1(5.3%)	**17(89.5%)**		
Oxygen support	Not used	55(29.4%)	77(41.2%)	55(29.4%)	32.75	<0.001*
	Used	14(8.1%)	69(39.9%)	**90(52%)**		
Intravenous antibiotics	Not used	29(59.2%)	17(34.7%)	3(6.1%)	64.29	<0.001*
	Used	40(12.9%)	129(41.5%)	**142(45.7%)**		

Table 9: Course of illness and complications with AIOS categories

Variables		AIOS categories			Test value	p value
		<10	10-15	>15		
Persistent distress on day5	Absent	65(27.7%)	105(44.7%)	65(27.7%)	55.06	<0.001*
	Present	4(3.2%)	41(32.8%)	**80(64%)**		
Hospital stay	< 5 days	65(52.8%)	50(40.7%)	8(6.5%)	219.63	<0.001*
	5-14 days	2(1.1%)	95(53.4%)	81(45.5%)		
	>14 days	2(3.4%)	1(1.7%)	**56(94.9%)**		
Complications	Absent	67(22.6%)	143(483%)	86(29.1%)	87.22	<0.001*
	Present	2(3.1%)	3(4.7%)	**59(92.2%)**		
Septic shock	Absent	67(21.8%)	144(46.8%)	97(31.5%)	68.49	<0.001*
	Present	2(3.8%)	2(3.8%)	**48(92.3%)**		
Presence of empyema	Absent	69(19.5%)	146(41.4%)	138(39.1%)	10.59f	0.002*
	Present	0	0	**7(100%)**		
Effusion	Absent	69(20.7%)	145(43.4%)	120(35.9%)	36.41	<0.001*
	Present	0	1(3.8%)	**25(96.2%)**		

Table 10: Comparison of AIOS categories with IMNCI assessment

Variables	AIOS categories			Test value	p value
	<10	10-15	>15		
Pneumonia	68(98.5%)	127(86.9%)	29(20%)	290.65	<0.001
Severe pneumonia	1(1.4%)	19(13.01%)	116(80%)		

Table 11: The validity measure of AIOS in comparison with IMNCI

IMNCI assessment	AIOS categories		
	Sensitivity	Specificity	Accuracy
Pneumonia	58.95%	82.85%	69.4%
Severe pneumonia	46.4%	98.6%	56.38%

DISCUSSION

The study was done with an aim to assess the role of AIOS in predicting illness severity and outcome of community acquired pneumonia. The study assessed 360 children in the age group of 2-59 months

In the study most of the subjects 203(56.4%) belonged to the age group of 2-12 months. AIOS scores were significantly higher in this age group. In a study done by Awasthi et al at Lucknow Infants (2–11 months) had nearly five to ten times higher occurrence of CAP than those in 12–59 months age group.[7] In Child Health Epidemiology Reference Group study three times higher occurrence of severe pneumonia was seen in children aged 2–11 months.[8] The reason for infants being more prone can be due to the maternal factors, the gestational age issues during delivery (term or preterm), breastfeeding and weaning practices.

In the study, subjects with underweight (<-2SD) were 238(66.11%) among the population. The increased occurrence of infectious disease particularly pneumonia among those who are underweight is evident from other studies too.[9,10.11]

In the study most common among danger signs, was lethargy, followed by inability to drink, ,convulsions

and stridor respectively. Study done in Bangalore showed that lethargy was common danger sign 32.1% while convulsion 4.6% and grunting 2.8% was least common.[6]

In our study abnormal X ray was found in 253(70.3%) subjects. Study by Murali B et al 63.3% showed abnormal X rays.[6] Fancourt et al,[12] and Awasthi et al,[13] showed 54% and 34.53% respectively. These variations in case of proportion of abnormality in Chest X ray can be due to disparities in study samples, study areas, place of residence, infecting organism, immune response of patient and prior duration and presence of disease.

The study showed 47(97.9%) of subjects who used ionotropic support, 14(100%) of subjects who used nebulization and 72(73.5%) of subjects who used intravenous fluids had an AIOS score of more than 15. In the study 17(89.5%) of subjects who used ventilation, 90(52%) of subjects who used oxygen support and 142(45.7%) of subjects who used intravenous antibiotics had an AIOS score of more than 15.[14] The study showed 80(64%) of subjects who had persistent distress on day 5, 56(94.9%) of subjects who had hospital stay for more than 14 days and 59(92.2%) of subjects who had complication had an AIOS score of more than 15. In the study 48(92.3%) of subjects who had septic shock, 7(100%) of subjects who had empyema and 25(96.2%) of subjects who had effusion had an AIOS score of more than 15. This showed that AIOS score correlated with the severe clinical signs, abnormal chest X ray, invasive treatment modalities and worse treatment prognosis. Anoop and Sangeetha in 2020 showed that children scoring abnormally on Acute Illness Observation Scale (>10) had significantly higher occurrence of severe tachypnoea, marked chest retraction, grunting, cyanosis, lethargy and inability to drink. Severe hypoxemia linked with cyanosis (SpO2<85) was seen in those with high value Acute Illness Observation Scale.[15] Mulage and Murali et al in 2014 did a study which showed AIOS associates well with clinical signs, abnormal X ray findings, initial SPO2 reading, forecasting the therapeutic decision taken by the physician and clinical results.[6] Reddy et al in 2018 did a study which showed AIOS score>10 had high sensitivity in predicting abnormal chest Xray and pulse oximetry readings.[16] AIOS >15 is significantly linked with poor clinical course, complications, extended hospital stay and pneumonia which culture positive.[17]

The study have assessed the validity measure of AIOS in comparison with IMNCI diagnosis. The sensitivity measure, specificity value and accuracy value of AIOS in measuring pneumonia was 58.95%, 82.85% and 69.4% respectively. The sensitivity measure, specificity value and accuracy value of AIOS in measuring severe pneumonia was 46.4%, 98.6 % and 56.38% respectively. Anoop and Sangeetha in 2020 did a study where associating with IMNCI, sensitivity value of AIOS in identifying illness severity in fast breathing pneumonia was 95% and specificity value was 55%, whereas in severe pneumonia its sensitivity value was 48% and specificity value was 98%.[15] Mulage and Murali et al in 2014 showed that in comparison with IMNCI, sensitivity value of AIOS in identifying illness severity in pneumonia group was 35.56% and specificity value was 90.63%, whereas in very severe pneumonia its sensitivity value was 79.17% and specificity value was 90.59%.[6]

CONCLUSION

The study showed that AIOS correlated with the severe clinical signs, abnormal chest X ray, invasive treatment modalities and worse treatment prognosis. Also the study have assessed the validity measure of AIOS in comparison with IMNCI diagnosis. The study showed good correlation between AIOS scoring and IMNCI classification of pneumonia. AIOS score has good specificity in pneumonia and very high in severe pneumonia. AIOS can be used as a useful tool to decide on therapeutic modalities and predict the severity and complications of pneumonia in children in hospital care setting.

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