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A STUDY ON YALE OBSERVATION SCALE FOR PREDICTION OF BACTERIAL SEPSIS IN FEBRILE CHILDREN AGED 6 MONTHS TO 5 YEARS IN A TERTIARY CARE TEACHING HOSPITAL

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ABSTRACT:

Background: The most frequent reason for visiting the emergency room (ED) for paediatric patients is fever, which accounts for 20% of all visits. Fever is ranked as the second most frequent cause of paediatric hospital admissions[1,2]. Despite improvements in healthcare, infections continue to be the top reason for death in children under the age of five.

OBJECTIVES:

1. Association of Yale observation score with age of children, grade of fever, duration of fever and duration of hospital stay.
2. Association of Yale observation score with reliable markers of bacterial infection like WBC COUNT, ABSOLUTE NEUTROPHIL COUNT, CRP, PROCALCITONIN, BLOOD CULTURE.
3. Correlation of Yale observation score with CRP and PROCALCITONIN.

MATERIAL & METHODS: Study Design: Hospital based prospective cross-sectional study. **Study area:** The study was conducted in the Department of Paediatrics, APOLLO INSTITUTE OF MEDICAL SCIENCES AND RESEARCH, HYDERABAD, Telangana. **Study Period:** 1 year. **Study population:** Febrile children between the age of 6months to 5 years attending to Pediatrics department of Apollo institute of medical sciences and research, Hyderabad Telangana. **Sample size**: Study consisted a total of 350 subjects. **Sampling Technique:** Simple Random technique. **Study tools and Data collection procedure:** The study was performed as per the proforma drafted for the study on febrile children between the age of 6 months to 5 years. The history, Yale score and clinical findings was recorded in detail. The routine investigations were done and special investigations were performed wherever necessary. The post- treatment outcome was documented.

Results: In the present study, 278 (79.4%) had CRP <40mg/dl, 51 (14.6%) had CRP 40-80 mg/dl, 21 (6%) had CRP >80mg/dl. 86.3% of the children who had CRP of 40-80 had YOS more than 13 and none of the children who had CRP of >80 had a YOS of 6- 12. Indicates that proportion of children with higher CRP values (>40mg/dl) were associated with higher YOS score > 13 which was suggestive of bacterial infection with a P value 0.0001 which was significant. There is a significant corelation between Yale observation score and procalcitonin, with a p value less than 0.0001.

CONCLUSION: From our study it can be concluded that Yale observation score was one such clinical score in febrile children which is a useful predictor of bacteremia and early initiation of antibiotics in suspected cases before the arrival of investigation reports.

Keywords: Bacteremia, Febrile children, Serious bacterial infection, Yale observation scale

INTRODUCTION:

The most frequent reason for visiting the emergency room (ED) for paediatric patients is fever, which accounts for 20% of all visits. Fever is ranked as the second most frequent cause of paediatric hospital admissions[1,2]. Despite improvements in healthcare, infections continue to be the top reason for death in children under the age of five.

Fever in young children usually indicates an underlying infection and is the most common cause of concern for parents and caretakers. Most of patients with fever have self-limiting viral illness having nonspecific symptoms without focus of infection, on the other hand even some bacteremia present with absence of localizing signs. So it is difficult for a

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pediatrician to differentiate mild febrile illness from severe bacterial infection.3 So there is a high need to improve the recognition, assessment and immediate treatment of such illnesses in children.

Due to the high prevalence of viral infections and the possibility that fever in young febrile children could possibly be caused by bacteria even in the absence of localising symptoms, it is crucial to distinguish between bacterial and non-bacterial causes of fever. Early detection of bacteremia in a febrile child is crucial in lowering childhood mortality since untreated bacteremia can result in serious consequences, including death. As a result, a paediatrician relies on information gathered prior to a physical examination that could be a sign of a serious illness.

Blood culture, which is the gold standard to confirm bacteremia and can only be used as supporting evidence because it takes 48–72 hours to get a definitive result, leaves clinical assessment as the primary tool for making an early diagnosis. It is highly challenging to obtain a blood culture in resource-constrained situations, especially in rural hospitals. Additionally, a thorough physical examination requires more time, experience, and could not reveal conventional symptoms, particularly in young children.

Young infants who are very unwell and get delayed antimicrobial therapy are more likely to die. The surviving sepsis campaign advised giving empiric antibiotics to paediatric patients within an hour of the diagnosis of severe sepsis.[4]Therefore, the majority of paediatricians base their assessment of the severity of the illness in a feverish child on observation rather than a history and physical examination. Thus, the Yale Observation Scale (YOS) is created to aid medical practitioners in the early evaluation and prompt treatment of young children presenting to primary or secondary care with fever.

In this regard, the Yale Observation Scale is more effective than other laboratory tests at detecting dangerous bacterial infections early on. Additionally, McCarthy *et al*.'s 1982 invention of the bed side scale clubbed is highly straightforward, rapid, easy to administer, and economical.[5,6] Yale Observation Scale (YOS) reliability was evaluated using interobserver agreement and the kappa statistic.[5]

The Yale Observation Scale (YOS) assessment showed no interobserver variability that was statistically significant.[7] Six factors (cry quality, response to parent stimulation, state variation, colour, hydration, and response to social cues), each given a value of 1, 3, or 5, make up the disease severity scale. As a result, the overall YOS score varies from 6 for the baby who appears the healthiest to 30 for the baby who appears the sickest. Given that it excludes investigations; this score may be easily applied to every child.[8-10]

Hence the present study was undertaken at APOLLO INSTITUTE OF MEDICAL SCIENCES AND RESEARCH, HYDERABAD, Telangana to use Yale Observation Scale for prediction of bacterial sepsis in children aged 6months to 5 years.

OBJECTIVES:

1. Association of Yale observation score with age of children, grade of fever, duration of fever and duration of hospital stay.
2. Association of Yale observation score with reliable markers of bacterial infection like WBC COUNT, ABSOLUTE NEUTROPHIL COUNT, CRP, PROCALCITONIN, BLOOD CULTURE.
3. Correlation of Yale observation score with CRP and PROCALCITONIN.

MATERIAL & METHODS:

Study Design: Hospital based prospective cross-sectional study
Study area: The study was conducted in the Department of Paediatrics, APOLLO INSTITUTE OF MEDICAL SCIENCES AND RESEARCH, HYDERABAD, Telangana
Study Period: 2 years.
Study population: Febrile children between the age of 6months to 5 years attending to Pediatrics department of Apollo institute of medical sciences and research, Hyderabad Telangana
Sample size: Study consisted a total of 350 subjects
Sampling Technique: Simple Random technique
Inclusion Criteria: All children aged 6 months to 5 years who were admitted to the pediatric ward of AIMSR and had a documented fever in the hospital – defined as axillary temperature > 99.4ºF.

Exclusion criteria:

The following patients were excluded from the study even though they recorded a temperature of more than 99.4^0F.

- Patient is a known case of immunodeficiency states, arthritis, autoimmune diseases, connective tissue disorders, chronic illnesses, tumors, vasculitis, familial neutrophilia.

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 History of having received parenteral antibiotics, sedatives within 24 hrs of presentation, antipyretics within 8 hrs of presentation, CNS depressants, opioids, steroids, quinidine.
 History of being treated in other hospitals prior to our hospital visit.
 History of having received immunization within 48 hrs of presentation.
 We excluded children if they developed fever more than 24 hours after they were admitted to the hospital.

Ethical consideration: Institutional Ethical committee permission was taken prior to the commencement of the study.

Study tools and Data collection procedure:

The study was performed as per the proforma drafted for the study on febrile children between the age of 6 months to 5 years. The history, Yale score and clinical findings was recorded in detail. The routine investigations were done and special investigations were performed wherever necessary. The post- treatment outcome was documented.

TABLE 1: YALE OBSERVATION SCORE

OBSERVATION	NORMAL SCORE 1	MODERATE IMPAIRMENT SCORE 3	SEVERE IMPAIREMENT SCORE 5
Quality of cry	strong with normal cry or content and notcrying	Whimpering or sobbing	Weak or moaning or highpitched
Reaction to parent stimulation	Cries briefly thenstops or content and not crying	Cries on and off	Continuous cry or hardlyresponds
State variation	If awake stays awake or if asleep and stimulated wakes up quickly	Eyes close briefly,awakes up with prolongedstimulation	Awake or falls to sleep ordoes not wake up
Color	Pink	Pale extremitiesor acrocyanosis	Pale or cyanotic or mottledor ashen
Hydration	Skin normal, eyes normal, mucous membranes moist	Skin/ eyes normal and mouth slightlydry	Skin doughy/tented and dry mucous membranes and/or sunken eyes
Response social to overtures	Smiles or alerts	Brief smile or alerts briefly	No smile, face anxious/dull/expressionless or not alert

Statistical analysis:

Descriptive statistics was done for all data and were reported in terms of frequency mean values and percentages. The Chi Square test was performed to find out the correlation between the YOS and the various factors that could affect it with respect to the febrile children. Our study included percentages, mean values and p value. p value was obtained individually for YOS and GRADE OF FEVER, WBC COUNT, ANC, CRP, PROCALCITONIN, DURATION OF HOSPITAL STAY. p value less than 0.05 was considered to be statistically significant in our study. Receiver Operating Characteristics ROC curve was performed to analyze the sensitivity of the Yale observation score as an initial screening test and to find the best possible cut off with the highest possible sensitivity. All data were entered in a Microsoft excel sheet and was imported to SPSS software. All analyses were performed using SPSS software (Statistical Package for Social Sciences) version 24.

OBSERVATIONS & RESULTS:

Three hundred and fifty children were enrolled in the study group who had an axillary temperature of more than or equal to 99.4 Fahrenheit. Data from these 350 children were used for various analysis and interpretations. The percentage of children included were studied in terms of distribution of age, sex, temperature recorded, duration of fever, grade of fever and duration of hospital stay. The YOS score divided into various ranges were compared with laboratory parameters like WBC count, ANC, CRP, PROCALCITONIN.

TABLE 2: DISTRIBUTION OF YALE OBSERVATION SCORE IN THE STUDY

YOS	FREQUENCY	PERCENTAGE
6 - 12	256	73.1%
13 - 18	58	16.6%

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19 - 24	25	7.1%
25 - 30	11	3.1%
TOTAL	350	100

Among the children who presented with fever and met the inclusion criteria, majority had a Yale Observation Scale score between 6-12 - 256 (73.1%), 58 (16.6%) of children had a score between 13-18, 25 (7.1%) had a score between 19-18, the rest of the 11 (3.1%) patients had a score between 25-30.

Among the 350 participants, 157 (44.9%) patients were females and 193 (55.1%) were males. The gender did not affect the YOS significantly. The various ranges of YOS score was almost the same between males and females in the study population (p=0.247).

The study participants 108 (30.9%) belonged to the age group of 6M -1year, 123 (35.1%) to 1-3 years, 119 (34 %) to 3 to 5 years. Majority of the children are under 3 years of age.

TABLE 3: ASSOCIATION OF AGE WITH YOS

AGE IN YEARS	YALE SCORE		Total	Chi square test,df	P value
	<12	>12			
6m - 3 years	161, 69.70	70, 30.30%	231	4.1068	0.04
> 3 years	95, 79.83%	24, 20.17%	119		
Total	256	94	350		

The children aged greater than 36 months did not show much increase in YOS score greater than 12. It was hence interpreted that younger the age of the child the higher the association of age with the YOS score (p <0.04).

TABLE 4: ASSOCIATION OF TEMPERATURE WITH YOS

Temperature (F)		Yale Observation Score				Total	P value
		6-12	13-18	19-24	25-30		
Low grade 99.4-101	Count	67	4	3	0	74	0.0001
	% within Temperature	90.5	5.4	4.1	0	100	
Moderate 101-103	Count	101	23	7	3	134	
	% within Temperature	75.4	17.2	5.2	2.2	100	
HIGH >= 104	Count	88	31	15	8	142	
	% within Temperature	62	21.8	10.6	5.6	100	

In the study conducted 74 (21.1%) had temperature between 99.4 to 101F, 134 (38.3%) had temperature between 101-103F, 142 (40%) had temperature >103F. The children with temperature less than 101F did not have a YOS score greater than 25. As the temperature recorded was of higher grade, 75.4% of the children had YOS of 6-12. Above table indicates that proportion of children with moderate to higher temperature (> 101F) were associated with higher YOS score > 13 with a P value 0.0001 which was significant.

Among the children studied, the maximum number of children had a fever of duration between <3 days. But it was clearly evident that majority of the children who had fever less than 3 days had a YOS score of 6-12. Proportion of children with YOS > 12 had prolonged duration of fever and significant association was found between YOS and duration of fever with a p value of 0.0001 which was significant.

Of 350 children who presented with fever, cough was the most common presenting complaint followed by rhinitis. Vomiting was present in 111(31.7%), pain abdomen in 84(24%), seizures were present in 29(8.3%), urinary complaints in 6(1.7%) and throat pain in 3 (0.9%) patients.

Among 350 patients, pallor is present in 124(35.4%), hepatomegaly is in 143(40.9%), splenomegaly in 44(12.6%), crepts and wheeze were present in 35(10%) and 26(7.4%) respectively.

TABLE 5: LABORATORY FINDINGS IN THE STUDY

PARAMETER		FREQUENCY	PERCENTAGE
Hemoglobin	Anemia	148	42.3
Platelets	Thrombocytosis	39	11.1

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	Thrombocytopenia	55	15.7
TLC	Leucocytosis	172	49.1
	Leucocytopenia	71	20.3
CRP	< 40	278	79.4
	> 40	72	20.6
Procalcitonin	<2	280	80
	>2	70	20
CUE	Abnormal	23	6.6
Typhidot IgM	Positive	7	2
Dengue	Positive	31	8.9
Malaria	Positive	4	1.1
Mantoux	Positive	2	0.6
Blood culture	Positive	58	16.6
Urine culture	Positive	17	4.9

Among 350 children 148 had anemia, Thrombocytopenia was present in 55 children, 39 had increased platelet count. Leucocytopenia was present in 71 children, 172 had leucocytosis. 278 children had CRP <40, 72 had CRP >40mg/dl. 280 had procalcitonin <2ng/dl, 70 children had procalcitonin >2 ng/dl. Dengue was positive in 31 children. Malarial antigen was present in 4 children. Typhidot IgM was positive in 7 children. 2 children had Mantoux positive. Blood culture and sensitivity was positive in 58 children and urine culture and sensitivity was positive in 17 children.

TABLE 6: ASSOCIATION OF WBC WITH YALE OBSERVATION SCORE

WBC count		Yale Observation Score				Total	Chi square test;df	P value
		6-12	13-18	19-24	25-30			
<5000	Count	57	8	4	2	71	10.920;6	0.091
	% within WBC count	80.3	11.3	5.6	2.8	100		
5000 - 11000	Count	122	37	10	3	172		
	% within WBC Count	70.9	21.5	5.8	1.7	100		
>11000	Count	77	13	11	6	107		
	% within WBC count	72	12.1	10.3	5.6	100		
Total	Count	256	58	25	11	350		
	% within WBC count	73.1	16.6	7.1	3.1	100		

Among the 350 cases studied 49(49.1%) had a WBC count between 5000 -11000, 107 (30.6%) had WBC count > 11000 and 71 (20.3 %) had a count < 5000.Of 71 children who had WBC count of <5000, 57(80.3%) had YOS of 6-12. And among 172 children who had a WBC count between 5000-11000, 122 children had YOS score of 6-12. Out of 107 children who had WBC count of 107, 77 children had YOS score of 6-12. From the above table, it was evident that either with leucopenia or leucocytosis there is no increase in YOS and there is no association between WBC count and YOS.

TABLE 7: ASSOCIATION OF ANC WITH YALE OBSERVATION SCORE

ANC count		Yale Observation Score				Total	Chi square test;df	P value
		6-12	13-18	19-24	25-30			
<2000	Count	56	4	3	1	64		
	% within ANC	87.5	6.3	4.7	1.6	100		

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	count							
2000 - 6000	Count	129	33	10	2	174	19.745;6	0.003
	% within ANC Count	74.1	19	5.7	1.1	100		
>6000	Count	71	21	12	8	112		
	% within ANC count	63.4	18.8	10.7	7.1	100		
Total	Count	256	58	25	11	350		
	% within WBC count	73.1	16.6	7.1	3.1	100		

Among the 350 cases studied 174 (49.7 %) had an ANC count between 2000 - 6000, 112 (32%) had WBC count > 6000 and 64 (16.3 %) had a count < 2000. All of the 350 patients included in the study had an absolute neutrophil count done. Among the 64 children who had a count of less than 2000 87.5% showed a YOS score between 6-12. With a p value of 0.003 there was a significant correlation between YOS and ANC. 36.6% of the children who had ANC > 6000 had YOS > 12

TABLE 8: ASSOCIATION OF CRP WIYH YOS SCORE

CRP (mg/dl)		Yale Observation Score				Total	Chi square test;df	P value
		6-12	13-18	19-24	25-30			
<40	Count	249	19	8	2	278	238.676;6	0.000
	% of CRP	89.6	6.8	2.9	0.7	100		
40-80	Count	7	33	8	3	51		
	% of CRP	13.7	64.7	15.7	5.9	100		
>80	Count	0	6	9	6	21		
	% of CRP	0	28.6	42.9	28.6	100		
Total	Count	256	58	25	11	350		
	% of CRP	73.1	16.6	7.1	3.1	100		

Among the 350 cases studied, 278 (79.4 %) had a CRP <40mg/dl, 51 (14.6%) had CRP 40-80 mg/dl, 21 (6%) had CRP >80mg/dl. 86.3% of the children who had CRP of 40-80 had YOS more than 13 and none of the children who had CRP of >80 had a YOS of 6- 12. Indicates that proportion of children with higher CRP values (>40mg/dl) were associated with higher YOS score > 13 which is suggestive of bacterial infection with a P value 0.0001 which was significant.

TABLE 9: ASSOCIATION OF PROCALCITONIN WITH YOS

PROCALCITONIN (ng/ml)		Yale Observation Score				Total	Chi square test;df	P value
		6-12	13-18	19-24	25-30			
<2	Count	247	28	3	2	280	189.016; 6	0.0001
	% of procalcitonin	88.2	10	1.1	.7	100		
2-10	Count	6	29	20	7	62		
	% of procalcitonin	9.7	46.8	32.3	11.3	100		
>10	Count	3	1	2	2	8		
	% of procalcitonin	37.5	12.5	25	25	100		

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Total	Count	256	58	25	11	350		
	% of procalcitonin	73.1	16.6	7.1	3.1	100		

Among the 350 cases, studied, 280 (80 %) had a procalcitonin <2 ng/ml, 62 (17.7%) had procalcitonin 2 to 10 ng/ml, 8 (2.3 %) had procalcitonin >10 ng/ml. 61.4% of the children who had procalcitonin of 2-10 had YOS more than 12 and 50% of the children who had procalcitonin of >10 had YOS more than 19. Indicates that proportion of children with higher procalcitonin values which was suggestive of bacterial sepsis are associated with higher YOS with a P value 0.0001 which was significant.

Among 350 patients, 292 children had negative blood culture, 222(76.03%) had a Yale observation score less than 12, 70(23.97%) had Yale observation score more than 12. 58 children had positive blood culture, 34 (58.62%) had YOS less than 12, 24(41.38%) had YOS >12. The proportion of children with positive blood culture and YOS >12. With a p value of 0.0062 there was a significant association between blood culture and YOS.

In the present study, 96% of the children had a hospital stay of 1-3 days and a Yale observational score between 6-12, 4% of the children had hospital stay of 1-3 days with Yale observation score of more than 13.

FIGURE 1: ROC CURVE WITH CRP A MARKER OF BACTERIAL SEPSIS

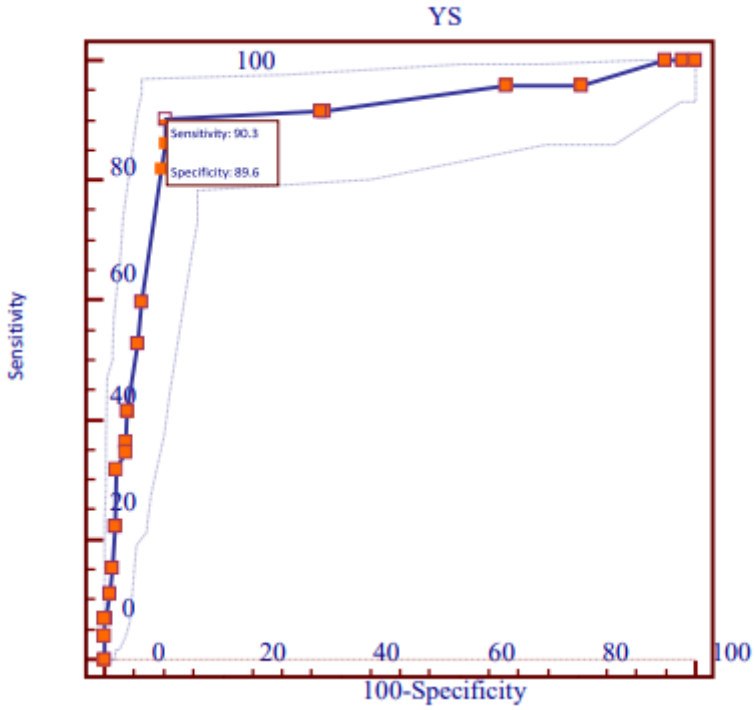

TABLE 10: CORRELATION OF YOS WITH CRP

Area under the ROC curve (AUC)	0.894684
Standard Error[a]	0.0246
95% Confidence interval[b]	0.857686 to 0.924810
z statistic	16.018
Significance level P (Area=0.5)	<0.0001

Receiver operating characteristic curve (ROC) corresponded to a YOS score of 12 as cut-off with sensitivity of 90.3%, specificity (89.6%), ppv (51.43%), npv (90%), LR+ positive likelihood ratio) 8.65 and LR-(negative likelihood ratio) 0.11 for YOS with CRP, diagnostic accuracy being 63%. It can be inferred from above data that cut-off value of 12 performed excellently in its sensitivity and npv for serious illness. But higher cut-off values were needed to achieve appreciable specificity and ppv (> 90% for YOS ≥14).

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FIGURE 2: ROC WITH PROCALCITONIN AS A MARKER OF BACTERIAL SEPSIS

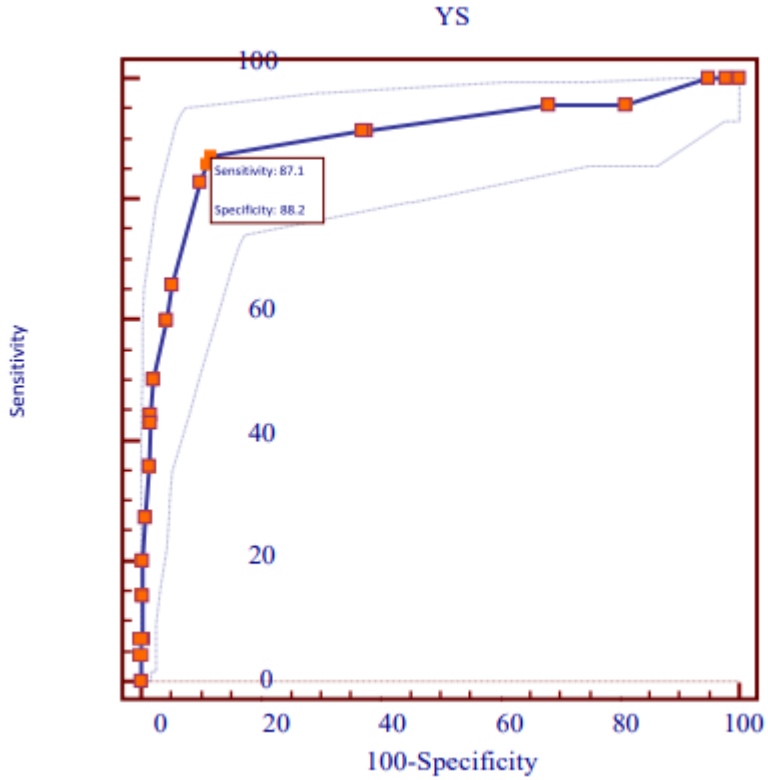

TABLE 11: YALE SCORE WITH PROCALCITONIN

Area under the ROC curve (AUC)	0.900995
Standard Error[a]	0.0251
95% Confidence interval[b]	0.864796 to 0.930201
z statistic	15.968
Significance level P (Area=0.5)	<0.0001

Receiver operating characteristic curve (ROC) corresponded to a YOS score of 12 as cut-off with sensitivity of 87.1%, specificity (88.2%), ppv (51.43%), npv (90%), LR+(positive likelihood ratio) 7.39 and LR- (negative likelihood ratio) 0.15 for YOS with procalcitonin, with diagnostic accuracy being 63%. Similarly, with respect to outcome; the sensitivity, specificity, ppv, npv, LR + and LR - were 100%, 32.97%, 12.86%, 100 %, 1.49 and 0.00 respectively; the diagnostic accuracy being 39%. It can be inferred from above data that cut-off value of 12 performed excellently in its sensitivity and npv for serious illness. But higher cut-off values were needed to achieve appreciable specificity and ppv (> 90% for YOS ≥14).

DISCUSSION:

The study included 350 patients aged 6 months to 5 years, admitted in the AIMSR, who had axillary temperature of > 99.4 F and who satisfied the inclusion and the exclusion criteria. Though, culture is the gold standard, ANC, WBC count, CRP, PROCALCITONIN give a reliable evidence of bacterial infection. Hence ANC, WBC counts, CRP, PROCALCITONIN were taken as markers of bacteremia and its association with YOS is studied. There are previous studies conducted for prediction of bacterial sepsis with YOS and association with blood culture, WBC, ANC and CRP. In the present study procalcitonin which is more sensitive marker for bacterial sepsis is added.

In the present study, 55.1% were males, 44.9% were females and no significant association was found between gender and YOS. This is similar to study conducted by sudhakar *et al*[11] in which 56% were males, 44% were females. This is in contrast to studies done by kansakar P *et al*[12] in which 59% were males and 41% were females and Bang *et al*[13] in which 60% were males and 40% were females. In the present study, 30.9% were between 6months to 1 year, 35.1% between 1 to 3 years, 34% were between 4 to 5 years and a significant association was found between Yale observation score and age of the child with a p value of 0.04. This observation was similar with other studies Sudhakar p *et al*[11] in

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which 42.4% were between 3 months to 1 year, 57.5% were between 1 to 3 years, Akash bang *et al*[13] in which 56.62% were between 3 months to 1 year and 43.38% were between 1 to 3 years.

Studies	Temperature	P value
Karuna *et al*	Not significant (mean -101F)	0.07
Sudhakar *et al*	Significant	0.0001
Mangala *et al*	Not significant (mean - 101.7F)	1.000
Present study	Significant	0.0001

In the present study 74 children had temperature between 99.4-101F, 90.5% had YOS between 6 - 12, 5.4% between 13-18, 4.1% between 19-24 and none of the children had YOS between 25-30. In the study conducted by Sudhakar *et al*[11] 90 children had temperature between 100.4-101F, 81% had YOS between 6 - 12, 18.9% between 13-18, none of the children had YOS between 19-30.

In the present study, proportion of children with moderate to higher temperature (> 101F) are associated with higher YOS score > 13 with a significant P value. It is similar to the result of study conducted by Sudhakar P *et al*[11], and Bhavneet Bharti *et al*.[14] which states that rise of temperature showed significant correlation to critical illness parameters. But these results are in contrast to the results shown by Thapar k *et al*[15.]

Layla A. Al-Gwaiz *et al*[16] ANC and toxic granulation appear to be more sensitive than band count in predicting bacterial infections. Bonsu *et al*.[17] found that use of the WBC cut-off of 15 x 109 /l would have yielded a sensitivity of only 45% and specificity of 78%. Even the use of a lower cut-off of 5 x 109 /l would not detect 21% patients with bacteremia. Galletto-Lacour *et al*.[18] WBC cut-off of 15 x 109 /l had a sensitivity of 68% and specificity of 77%.

In the present study, 71 children who had WBC count of <5000, 57(80.3%) had YOS of 6-12. And among 172 children who had a WBC count between 5000- 11000, 70.9% children had YOS score of 6-12. Out of 107 children who had WBC count of >11000, 73.1% children had YOS score of 6-12. It is evident that either with leucopenia or leucocytosis there is no increase in YOS and there is no association between WBC count and YOS. This is in contrast to study conducted by sudhakar *et al*,[11] where a significant association was found between YOS and total WBC count.

Sabah *et al*.[19] suggested that toxic signs in neutrophils were highly sensitive. Jafri and Cass[20] also demonstrated a high correlation between vacuolated neutrophils and culture-positive infections. Adams *et al*.[21] disagreed, demonstrating in their study that vacuolation of neutrophils was not sensitive for sepsis. Gombos *et al*.[22] supported the findings of Adams *et al*.[21], finding minimal vacuolation and toxic granulation's in specimens from patients who had bacteremia.

In the study conducted by Pulliam *et al*.[23] CRP was found to be a much more useful biomarker than WBC count for this group of patients, with sensitivity of 79% and specificity of 91% at cut off > 40mg/l as compared to karuna Thapar *et al*[15] study, where CRP<5mg/l was taken as cut-off as only 12 patients had CRP levels > 40mg/l. Thus, CRP showed negative statistical results for prediction of critical illness at cut off of 5mg/l. In the present study CRP >40 mg/dl was taken as a cut off of bacterial sepsis and at YOS score of more than or equal to 13 there was a significant association between YOS and CRP with a significant p value. The mean YOS score of the overall study population was 12. The YOS scores were broadly ranging between 6 to 30 in the study with 256 patients having YOS ≤ 12, proportion of children with higher CRP values (>40mg/dl) were associated with higher YOS score >12 which was suggestive of bacterial infection with a P value 0.0001 which was significant.

In the present study, Receiver operating characteristic curve (ROC) was done with CRP and procalcitonin. Corresponded to a YOS score of 12 as cut-off with sensitivity of 90.3%, specificity (89.6%), ppv (51.43%), npv (90%), LR+ positive likelihood ratio) 8.65 and LR-(negative likelihood ratio) 0.11 for YOS with CRP, diagnostic accuracy being 63%. It can be inferred from above data that cut-off value of 12 performed excellently in its sensitivity and npv for serious illness. But higher cut-off values were needed to achieve appreciable specificity and ppv (> 90% for YOS ≥14).

Receiver operating characteristic curve (ROC) corresponded to a YOS score of 12 as cut-off with sensitivity of 87.1%, specificity (88.2%), ppv (51.11%), npv (87.1%), LR+(positive likelihood ratio) 7.39 and LR- (negative likelihood ratio) 0.15 for YOS with procalcitonin, with diagnostic accuracy being 50%. It can be inferred from above data that cut-off value of 12 performed excellently in its sensitivity and npv for serious illness. But higher cut-off values were needed to achieve appreciable specificity and ppv (> 90% for YOS ≥14).

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COMPARISON OF UTILITY OF YOS WITH OTHER STUDIES

Authors (year)	Sampl e size(N)	Study population	Outcome assessed	Sens (%)	Spec (%)	PPV (%)	NP V (%)
McCarthy et al[2] (1982)	165	OPD+Emergency room, <24months, >38.3^{0}C	Serious illness (15.8%) n=26	77	88	56	97.3
Baker MD al[19] et (1990)	126	Emergency room, 29-56d, >38.2^{0}C	Bacterial disease (9.5%)	33	73	11	91
Baker RC et al[18] (1989)	154	OPD+Emergency room,3-24mnths, >39.4^{0}C	Bacteremia (occult+with focus) n=19 (12.9%)	68	77	30	
Teach et al[17] (1995)	6611	OPD, 90d-36mnths, >39^{0}C	Occult Bacteremia n=192 (2.9%)	5.2	96.7	4.5	97.1

In the study conducted by Jamuna R *et al*[24] attempted to define clinical predictors of occult bacteraemia in an age group of 3-36 months attending pediatric outpatient department, the observational scoring and vital investigations together provided the ideal resources for confirming diagnosis, measuring severity of illness and deciding treatment.

These observations make the YOS a sensitive tool in predicting bacteremia and hence considered as useful initial screening scale to predict the risk of bacteremia in a febrile child. This was in accordance to the findings of Bang *et al.*[13] Their findings revealed that the best cut off value for YOS score was >10 for prediction of bacteremia. In another study by Walia *et al*[25], the cut off value of YOS score was taken at ≥20 and noticed the 100% sensitivity and NPV with lower specificity of 90%. In the present study study the cut off of YOS is 12.

CONCLUSION:

From our study it can be concluded that Yale observation score was one such clinical score in febrile children which is a useful predictor of bacteremia and early initiation of antibiotics in suspected cases before the arrival of investigation reports. The Yale Observation Scale (YOS) is a quick and accurate screening test for bacteremia prediction. Therefore, it should be done on young febrile children (ages 3-36 months) at the time of admission. It can also be used to predict patient outcomes and classify patients for triage.

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