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Role of Yale's Observational Score in Predicting Bacteraemia among Febrile Children Aged 3–36 Months: A Hospital-Based Prospective Cross-Sectional Study

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ABSTRACT

Background: Early identification of bacteraemia in febrile children remains a clinical challenge because young children often present with non-specific signs and symptoms. The Yale's Observational Score (YOS) is a simple clinical tool that may assist in identifying children at increased risk of serious bacterial infection. This study was undertaken to evaluate the role of YOS in predicting bacteraemia among febrile children aged 3–36 months. **Methods**: A hospital-based prospective cross-sectional study was conducted among 210 febrile children aged 3–36 months admitted to the Department of Paediatrics at Owaisi hospital and research centre, Hyderabad. All children underwent clinical assessment using the Yale's Observational Score followed by blood culture and relevant laboratory investigations. Statistical analysis was performed using SPSS version 25. Receiver Operating Characteristic (ROC) curve analysis was used to determine the diagnostic performance of YOS in predicting bacteraemia. **Results**: Among the 210 children, 29 (13.8%) had culture-confirmed bacteraemia. The mean YOS was significantly higher in children with bacteraemia compared to those without bacteraemia (15.45 ± 3.78 vs. 9.99 ± 2.36; $t = 10.51$, $p < 0.0001$). ROC curve analysis demonstrated good diagnostic performance of YOS with an area under the curve (AUC) of 0.86 (95% CI: 0.771–0.950, $p < 0.0001$), indicating good discriminatory ability for predicting bacteraemia. **Conclusion**: The Yale's Observational Score demonstrated good accuracy in predicting bacteraemia among febrile children aged 3–36 months. Being simple, rapid, inexpensive, and non-invasive, YOS can serve as a valuable bedside screening tool to identify children at higher risk of bacteraemia, particularly in resource-limited settings. It should be used as an adjunct to clinical assessment and laboratory investigations rather than as a replacement for blood culture.

Keywords: *Yale's Observational Score, bacteraemia, fever, children, ROC curve, blood culture.*

INTRODUCTION

Fever is the most common reason for a sick child visit.[1] Febrile episodes in young children are mostly due infection with bacteria or virus. Differentiating between the two is crucial for the effective management of the patient. In young children, the incidence of viral infections is high; however, fever may also be due to occult bacteraemia. [2]

2 to 3 % of children between the age of 3 to 36 months who present with a fever of 39 degrees Celsius or more with no clear source of fever and are non – toxic at presentation have occult bacteraemia.[3]As the infant matures beyond three

months of age, the bacterial pathogens that usually cause bacteraemia, sepsis and meningitis are Streptococcus pneumoniae, H. influenzae type B (if the child is unimmunized or only partially immunized) and Neisseria meningitidis. [1]

Focal infections (ex.: meningitis) and/or persistent bacteraemia is seen in 25% of patients with untreated occult pneumococcal bacteraemia. Occult bacteraemia due to Neisseria meningitides is rare, but when present will lead to morbidity (meningitis in 40% of cases) and mortality (4%).[3]

Untreated bacteraemia can cause other serious complications such as abscesses, endocarditis, sepsis, shock, organ failure, death. [2] Hence, young febrile children who are at a risk of occult bacteraemia should be carefully evaluated and should be followed up closely. [3] Early diagnosis and treatment of bacteraemia in a febrile child is crucial in reducing childhood morbidity and mortality. In a resource restrained setting, testing the blood for culture and sensitivity is difficult. Waiting for culture report to start the antibiotic treatment will lead to unjustifiable delay in instituting treatment in children who have fever due to bacterial infection. [2]

One way to avoid the complications of bacteraemia is to start empirical antibiotic treatment, however this policy has resulted in the emergence of resistant strains of bacteria. This is a Catch 22 situation. Hence rationalisation of antimicrobial therapy is necessary. [2]

Any child who is at a risk for occult bacteraemia can be screened by blood culture and treated with empirical antibiotics. The disadvantage to this approach includes the cost of such screening tests, temporary inconvenience caused to the patients, development of resistance to antibiotics, side effects of antibiotics. So, the pros and cons of this approach needs to evaluated.[4]

Due to the absence of localising signs and non-specific presentation it is difficult to detect serious bacterial infections in young children. As classical signs of infection cannot be elicited in young children even on detailed physical examination, this will lead to missing more cases of occult bacteraemia. [4,5]

Prediction rules are promoted as a means to improve recognition of serious infections. These rules help in identifying the children with bacteraemia so that the physician can judge the need for blood cultures and antibiotics in a more objective manner. Yale's Observational Scale (YOS) is an observational scale consisting of 6 observational items. This scale was originally characterised and clubbed by McCarthy et al in 1982. It was validated in young febrile children (<24 months, n = 165) to detect a serious illness. [2,6,7]

It is simple, quick and easy to apply and cost effective as it is purely observational and does not contain investigational items.

Objectives:

1. Assessment of febrile child aged 3 to 36 months.
2. To assess the role of Yale's observational scale in scoring febrile kids.

MATERIALS AND METHODS

Type of study: A hospital based cross-sectional prospective study
Place of study: Department of Paediatrics, Owaisi Hospital and Research Centre, Hyderabad
Sample size: 210
Duration of study: From 01/06/2024 to 31/05/2026

Inclusion criteria:

- Children between the age of 3 months to 36 months with documented fever in the hospital – taken as axillary temperature more than 37.4 degree Celsius.

Exclusion criteria:

- Children less than 3 months of age
- Children more than 36 months of age
- Children who developed fever 12 hours after admission to the hospital
- Children known to have an immunodeficiency state.
- Children with preexisting central nervous system impairment (Yale's scale cannot be assessed properly in cases of decreased consciousness / altered sensorium)

Ethics committee approval: Study was approved by institutional ethics committee.

Informed consent: The purpose of the study and details of protocol were discussed with the parents and an informed written consent was obtained.

Method of collection of data:
Relevant history of the patients was taken from the mother/ caretaker. Axillary temperature of all enrolled patients was taken before administration of antipyretics with a clinical mercury thermometer. The thermometer was cleaned with cool water. It was shaken so that the mercury inside goes below 36 degrees centigrade. The axilla was wiped with cotton to make it free from moisture. The bulb of the thermometer was placed in the hollow of the axilla with the stem pointing towards the patient's chest. The arm is then brought across the chest so that the bulb is in constant touch with the skin surface. The thermometer is allowed to remain in place for three minutes. It is then removed and the temperature reading was taken. Assessment using the Yale's Observational Scale (YOS) was performed with the child seated on the parent's lap or examination table in an undisturbed state. Observation-based parameters (state, colour, and quality of cry) were scored first, followed by parameters requiring interaction. Two independent treating physicians, blinded to each other's scores, assessed the children. This was followed by a detailed clinical examination focusing on the affected system.

Venous blood samples were collected under strict aseptic precautions. The venipuncture site was disinfected with chlorhexidine gluconate followed by povidone-iodine, allowing adequate drying time before sample collection. Blood was immediately inoculated into BACTEC blood culture bottles (1.5 mL for children ≤1 year and 6–10 mL for children >1 year) and sent for culture along with other investigations. Total and differential leukocyte counts were performed using an automated hematology analyzer on EDTA samples. C-reactive protein (CRP) was estimated using the latex slide agglutination test, and erythrocyte sedimentation rate (ESR) was measured by the Wintrobe method.

For urine culture, a midstream clean-catch urine sample was collected in a sterile, wide-mouthed, screw-capped container after thorough cleansing of the external genitalia with soap and water. Antiseptics were not used. The initial portion of urine was discarded to minimize contamination by urethral commensals, and the midstream sample was collected. Whenever possible, the first morning urine specimen was preferred to improve bacterial yield before being sent immediately for culture.

Statistical analysis plan:
All study data were entered into Microsoft Excel and analyzed using SPSS (Statistical Package for the Social Sciences) version 25.0. Descriptive statistics were expressed as frequencies, percentages, mean, and standard deviation. Comparisons between groups were performed using the Chi-square test or Student's *t*-test, as appropriate. A p-value ≤ 0.05 was considered statistically significant.

Receiver Operating Characteristic (ROC) curve analysis was performed to determine the optimal cut-off value of the Yale's Observational Score (YOS). The false-positive rate (1−specificity) was plotted on the X-axis and the true-positive rate (sensitivity) on the Y-axis. The cut-off value with the highest combined sensitivity and specificity was considered the optimal YOS threshold.

RESULTS

Table 1: Age wise distribution of cases in study group

Age (Months)	**No of cases**	Percentage
3 – 12	85	40.5
13 – 24	66	31.4
25 – 36	59	28.1
Total	**210**	**100**

The above table shows age wise distribution of cases in the study group. Majority of the cases i.e. 85 (40.5%) were in the age group of 3 to 12 months, followed by 66 (31.4%) of cases in age group of 13 to 24 months and 59 (28.1%) in the age group of 25 to 36 months.

Table 2: Gender wise distribution of cases in study group

Gender	**No of cases**	Percentage
Male	120	57.1
Female	90	42.9
Total	**210**	**100**

The above table shows gender wise distribution of cases in the study group. Majority of the cases i.e. 120 (57.1%) were male and 90 (42.9%) of the cases were female. The male: female ratio is 1.3 :1.

Table 3: Distribution of cases in study group according to YOS

YOS score	**No of cases**	Percentage
6 – 10	136	64.8
11 – 15	48	22.8

>15	26	12.4
Total	**210**	**100**

The above table shows YOS score wise distribution of cases in the study group. Majority of the cases i.e. 136 (64.8%) had YOS score of 6 to 10, followed by 48 (22.8%) cases with a score of 11 to 15 and remaining 26 (12.4%) cases had a score of >15.

Table 4: Distribution of cases in study group according to bacteraemia

Blood culture	**No of cases**	Percentage
Positive	29	13.8
Negative	181	86.2
Total	**210**	**100**

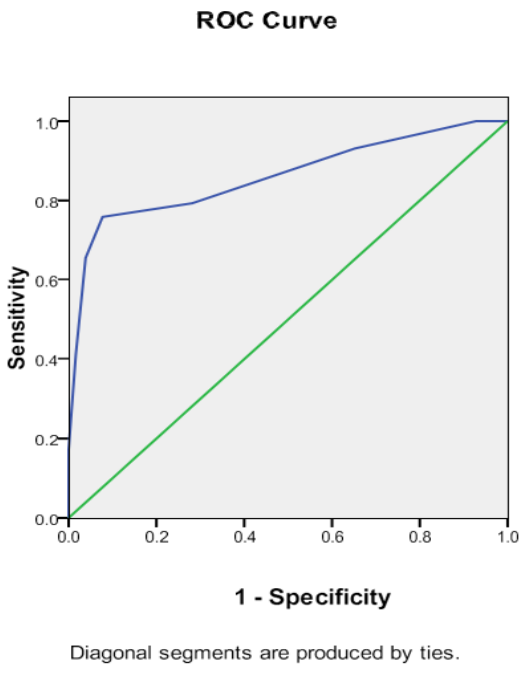
The above table shows bacteremia wise distribution of cases in the study group. Majority of the cases i.e. 181 (86.2%) had negative blood culture and remaining 29 (13.8%) cases had positive blood culture.

Table 5: Comparison between Yale observation scale and bacteremias in study group

Parameter	**Bacteremia**				**t Value**	P Value
	Present (29cases; 13.8%)		**Absent (181cases; 86.2%)**			
	Mean	SD	Mean	SD		
YOS score	15.45	3.776	9.99	2.362	10.51	<0.0001

The above table shows comparison between YOS and bacteremia in the study group. Among 29 cases with bacteremia mean YOS score was 15.45 (S.D. ±3.77), and among 181 cases with negative blood culture mean YOS score was 9.99 (S.D. ±2.36). Mean difference analyzed quantitatively using T test. T value worked out to be 10.51 which was statistically highly significant (p<0.0001).

Figure 1: ROC curve for using YOS as a test to predict bacteraemia



The Receiver Operating Characteristic (ROC) curve was used to evaluate the diagnostic performance of the Yale's Observational Score (YOS) in predicting bacteraemia. The area under the ROC curve (AUC) was 0.86 (95% CI: 0.771–0.950), indicating good discriminatory ability of the YOS to distinguish between children with and without bacteraemia. The result was statistically significant ($p < 0.0001$), suggesting that the predictive performance of the YOS was significantly better than chance. The relatively narrow confidence interval further supports the reliability of the test as a useful screening tool for predicting bacteraemia in febrile children.

Table 6: Area under the curve

Area	**Std. Error**	**Significance**	**95% CI**
0.86	0.046	<0.0001	0.771 – 0.950

DISCUSSION

Fever is one of the most common complaints of the pediatric population presenting to the outpatient or emergency department. Also, it is the single most important complaint which causes anxiety to the caregivers. Persistent fever, even after admission into the inpatient department is a cause of worry to the parents. Although fever can be treated with antipyretics, serious bacterial infections and bacteremia warrant the use of antibiotics in a timely manner. Yale's observational Scale reduces the subjectivity from the clinical evaluation of a patient and helps in effectively ruling out bacteremia.

The present study was carried out to validate the use of Yales observational scale in identifying serious infections in children aged between 3 months to 36 months with assessment of febrile child with age 3 to 36 months, scoring for febrile kids according to Yales observational scale and correlating the bacterial cultures with score and a finding accuracy and reliability of YOS scale in predicting bacteremia.

Total 210 cases were selected in the study based on inclusion and exclusion criteria.

Age wise distribution showed that majority of the cases i.e. 85(40.5%) were in the age group of 3 to 12 months, followed by 66 (31.4%) cases in age group of 13 to 24 months and remaining 59 (28.1%) cases were in the age group of 25 to 36 months. (Table no 1) Daniel J. Isaacman, Justine Shults, Toni K. Gross, Paris H. Davis, Marvin Harper (2000) developed an improved model for the prediction of bacteremia in young febrile children.633 cases were enrolled in the study group, of which 46 cases had bacteremia. The mean age among the study group was 15.8 months. [98-8]

Gender wise distribution showed majority of the cases were males i.e. 120 (57.1%) as compared to females – 90 (42.9%). Male to female ratio is 1.3 :1. (Table no 2) Similar finding was seen in a study conducted by Prerana Kansakar, Prakash Sundar Shrestha, Merina Shrestha (2014) who assessed the efficacy of the Yale Observation Scale (YOS) to detect serious bacterial infection in febrile children aged 1-36 months. Results showed that majority of the cases were male i.e. 59% this will match with our study. [91-9]

Distribution of cases in the study group based on YOS showed that 136 (64.8%) cases had a YOS score between 6 to 10, 48 (22.8%) cases had a score between 11 to 15, and 26 (12.4%) cases had a score of > 15. (Table no 3). Similar finding was seen in a study conducted by Prerana Kansakar, Prakash Sundar Shrestha, Merina Shrestha (2014) who assessed the efficacy of the Yale Observation Scale (YOS) to detect serious bacterial infection in febrile children aged 1-36 months. Results showed that most the cases (77%) had a YOS score <10, 14% of the cases had a YOS score between 11 to 15 and 9% of the cases had a score >15. [91-9]

In our study, 29 cases (13.8%) had bacteremia and 181 cases (86.2%) did not. (Table no 4) Similar finding was seen in a study conducted by Shagun Walia et al (2016) in which they assessed predictability of bacteremia, clinical course during hospital stay and final outcome in febrile children in the age group of 3-36 months admitted in tertiary health centres by application of Yale observation scale (YOS). Results showed that among 100 cases included in the study out of which 18% of the cases had bacteremia. [92-10]

Presence of bacteremia showed significant rise in YOS score in the study group. Mean YOS score among cases with bacteremia (29 cases -13.8%) was 15.45 and among the cases without bacteremia (181 cases -86.2%) the mean YOS score was 9.99. (Table no 5). Mean difference was analyzed quantitatively using T test. T value worked out to be 10.51 which was statistically highly significant ($p<0.0001$). Similar finding was seen in study conducted by Shagun Walia et al (2016) in which they assessed predictability of bacteremia, clinical course during hospital stay and final outcome in febrile children in the age group of 3-36 months admitted in tertiary health centres by application of Yale observation scale (YOS). Results showed that among 100 cases included in the study out of which 18% cases were bacteremia and all 18 bacteremia children had YOS ≥20. Of the 74 subjects in whom the YOS was less than 20, bacteremia was seen in 0% of the cases. [92-10]

CONCLUSION

The present study demonstrates that the Yale's Observational Score is an effective clinical screening tool for predicting bacteraemia in febrile children aged 3–36 months. Children with bacteraemia had significantly higher YOS scores than those without bacteraemia, and the score showed good diagnostic accuracy (AUC = 0.86) with excellent statistical significance. The YOS is simple, quick, inexpensive, and can be performed at the bedside without specialized equipment. It may help clinicians identify children at increased risk of bacteraemia, prioritize investigations, and initiate timely management, particularly in resource-constrained settings. However, blood culture remains the gold standard for diagnosis, and YOS should be used to complement, rather than replace, definitive microbiological investigations.

Conflict of interest: None

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