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Original Research Article

YALE OBSERVATION SCALE AS PREDICTOR OF SERIOUS BACTERIAL INFECTIONS IN CHILDREN 1 MONTH TO 36 MONTHS

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Abstract

Background: Febrile illnesses in children aged 1 to 36 months pose significant diagnostic challenges due to the difficulty in distinguishing serious bacterial infections (SBIs) from viral illnesses. The Yale Observation Scale (YOS) offers a rapid, non-invasive scoring tool to predict bacteremia and guide early clinical decision-making. **Materials and Methods:** This prospective, descriptive study was conducted at a tertiary care center over 1.5 years. A total of 76 febrile children aged 1 to 36 months were assessed using YOS. Clinical and laboratory parameters, including blood culture, CRP, WBC, and ANC, were recorded. Statistical analyses were performed to evaluate the diagnostic performance of YOS and its correlation with other variables. **Result:** The YOS demonstrated a sensitivity of 82.14%, specificity of 97.96%, positive predictive value of 95.83%, negative predictive value of 90.57%, and diagnostic accuracy of 92.21% in predicting bacteremia. YOS scores were significantly correlated with temperature ($p = 0.01$), while no significant correlations were observed with CRP, WBC, or ANC. Among participants with YOS scores of 6–14, 31.4% had positive blood cultures, compared to 50% for scores of 23–30. **Conclusion:** The Yale Observation Scale is an effective screening tool for early identification of SBIs in febrile children, with high diagnostic accuracy and significant correlation with elevated temperature. While YOS alone is insufficient for definitive diagnosis, its integration with clinical judgment and laboratory testing enhances its utility in resource-limited settings.

INTRODUCTION

Febrile illnesses in young children represent one of the most common reasons for pediatric consultations worldwide. Distinguishing between bacterial and non-bacterial febrile illnesses is critical due to the potentially severe consequences of untreated bacterial infections, including bacteremia, meningitis, and sepsis. However, the non-specific nature of febrile symptoms in young children complicates clinical decision-making, often resulting in unnecessary investigations or delayed treatment.[1] The Yale Observation Scale (YOS) was developed to provide a structured, non-invasive tool for assessing illness severity and predicting serious bacterial infections (SBIs) in febrile children. This scale incorporates six observational parameters, including quality of cry, alertness, hydration status, and interaction with caregivers, which are combined into a composite score.[2]

Previous studies have shown mixed results regarding the utility of YOS. While some investigations have demonstrated its effectiveness in predicting SBIs, others suggest it has limited sensitivity and specificity when used independently, emphasizing the need for complementary diagnostic tools.[3,4]
This study aims to evaluate the diagnostic accuracy of the Yale Observation Scale in predicting serious bacterial infections in febrile children aged 1 to 36 months. By validating its utility in a hospital-based setting, we seek to provide insights into its clinical applicability for early diagnosis and management of SBIs, potentially reducing diagnostic delays and improving patient outcomes.

MATERIALS AND METHODS

This prospective, descriptive study was conducted over 1.5 years at the Department of Pediatrics, Dr. D.Y. Patil Medical College, Hospital, and Research Centre, Nerul, Navi Mumbai. The primary objective

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was to evaluate the diagnostic accuracy of the Yale Observation Scale (YOS) in predicting serious bacterial infections (SBIs) in febrile children aged 1 to 36 months. The study included all eligible children admitted during the study period, with a minimum sample size of 50 participants. A total of 76 children were enrolled based on the inclusion criteria of febrile illness (axillary temperature ≥38°C) and parental consent. Exclusion criteria included children with known immunodeficiency disorders, autoimmune diseases, chronic illnesses, tumors, vasculitis, or familial neutrophilia, as well as those who had received parenteral antibiotics, CNS depressants, opioids, steroids, quinidine, or immunizations within 48 hours prior to presentation. Ethical approval was obtained from the institutional ethics committee, and informed consent was secured from parents or legal guardians of all participants. The clinical assessment included a detailed history, general and systemic examination, and recording of axillary temperature at admission. Each child was assessed using the YOS, which evaluates six parameters: quality of cry, reaction to parents, state variation, color, hydration status, and response to social overtures. Scores for each parameter were combined to calculate a total YOS, ranging from 6 to 30, with higher scores indicating a greater likelihood of SBI.

In addition to clinical scoring, laboratory investigations were performed, including blood culture (the gold standard for bacteremia detection), complete blood count (CBC), absolute neutrophil count (ANC), and C-reactive protein (CRP) levels. A venous blood sample of 5 mL was collected aseptically for these investigations, which were conducted using standardized protocols. The results of the laboratory tests were used to confirm the presence of bacteremia and correlated with YOS scores for diagnostic evaluation.

The data collected were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 25. Descriptive statistics, such as means, standard deviations, and percentages, were used to summarize the data. The Kolmogorov-Smirnov test was applied to assess the normality of the data. Comparative analyses included ANOVA for quantitative data, chi-square tests for categorical variables, and Pearson correlation tests to examine associations between YOS scores and laboratory parameters. The diagnostic performance of YOS was evaluated by calculating its sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy.

To ensure the reliability of YOS scoring, two trained pediatric residents independently assessed each child. Inter-observer discrepancies were resolved through consensus. The study's primary outcome was the diagnostic accuracy of YOS in predicting bacteremia, while secondary outcomes included correlations between YOS scores and fever duration, temperature, and laboratory parameters (CRP, WBC, ANC). This study provided a robust assessment of YOS as a rapid, non-invasive tool for early identification of SBIs in febrile children, facilitating timely intervention and appropriate management.

RESULTS

A total of 76 children aged 1 to 36 months were included in this study. The age distribution was nearly uniform, with 32.9% of participants in the <12 months group, 34.2% in the 12–24 months group, and 32.9% in the 24–36 months group. The study population consisted of 63.2% males (n = 48) and 36.8% females (n = 28). The duration of fever at the time of presentation varied, with most participants (71.1%) experiencing fever for 1–5 days, 26.3% for 5–10 days, and only 2.6% for more than 10 days. In terms of temperature, the majority of children (76.3%) presented with a temperature range of 100–103°C, while 19.7% had a temperature of 99–100°C, and 3.9% exhibited a temperature of 104–105°C.

The Yale Observation Scale (YOS) was analyzed in relation to the duration of fever. Among participants with a fever lasting 1–5 days, 68.6% had YOS scores of 6–14, while only 5.2% scored 15–22, and 2.6% scored 23–30. Similarly, for children with a fever duration of 5–10 days, 68.6% scored 6–14, and no participants had scores in the higher ranges of 15–22 or 23–30. Among children with fever lasting more than 10 days, only 2.7% scored 6–14, with no scores in the higher ranges. The relationship between YOS scores and fever duration was found to be statistically non-significant ($p = 0.239$).

Temperature demonstrated a significant correlation with YOS scores ($p = 0.01$). In the temperature range of 99–100°C, 21.4% of participants had YOS scores of 6–14, and none scored in the higher ranges of 15–22 or 23–30. For temperatures between 100–103°C, 74.3% of participants scored 6–14, while 5.2% and 2.6% scored in the 15–22 and 23–30 ranges, respectively. At the highest temperature range of 103–105°C, 4.3% of participants scored 6–14, with no cases scoring higher. These results indicate that higher temperatures were significantly associated with higher YOS scores.

The correlation between YOS scores and blood culture results revealed that 31.4% of participants with YOS scores of 6–14 had positive blood cultures, while none of the participants with scores of 15–22 tested positive. Among those with scores of 23–30, 1.3% had positive blood cultures. Negative blood culture results were observed in 68.6% of participants with scores of 6–14, 5.2% with scores of 15–22, and 1.3% with scores of 23–30. However, the association between YOS scores and blood culture positivity was not statistically significant ($p = 0.34$).

YOS scores were also analyzed in relation to laboratory parameters such as CRP, WBC, and ANC. The mean CRP levels were 38.48 ± 50.65 for YOS scores of 6–14, 85.49 ± 60.87 for scores of 15–22, and 60.17 ± 79.59 for scores of 23–30, with no statistically significant correlation observed ($p =$

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0.18). Similarly, mean WBC counts for the three YOS categories were 13.08 ± 6.31, 14.26 ± 4.71, and 8.42 ± 2.72, respectively, also showing no significant correlation (p = 0.53). ANC levels followed a similar trend, with means of 6.01 ± 3.50 for scores of 6–14, 8.22 ± 4.15 for scores of 15–22, and 2.90 ± 1.69 for scores of 23–30, with no significant correlation (p = 0.21).

Table 1: Baseline Characteristics of the Study Participants.

		Frequency	Percent
Age	<12	25	32.9
	12-24	26	34.2
	24-36	25	32.9
	Total	76	100.0
Sex	Female	28	36.8
	Male	48	63.2
	Total	76	100.0
Duration of fever (day) wise	1-5	54	71.1
	5-10	20	26.3
	>10	2	2.6
	Total	76	100.0
Temperature	99-100	15	19.7
	100-103	58	76.3
	104-105	3	3.9
	Total	76	100.0

Table 2: Comparison of YOS Scores with various parameters

Variable	YOS 6-14	YOS 15-22	YOS 23-30	P-value
Duration of Fever (days)				
1-5	68.6% (48)	5.2% (4)	2.6% (2)	0.239
5-10	68.6% (20)	0.0% (0)	0.0% (0)	
>10	2.7% (2)	0.0% (0)	0.0% (0)	
Temperature (°C)				
99-100°C	21.4% (15)	0.0% (0)	0.0% (0)	0.01 (S)
100-103°C:	74.3% (52)	5.2% (4)	2.6% (2)	
103-105°C	4.3% (3)	0.0% (0)	0.0% (0)	
Blood Culture				
Positive Cases	31.4% (22)	0.0% (0)	1.3% (1)	0.34 (NS)
Negative Cases	68.6% (48)	5.2% (4)	1.3% (1)	
CRP (Mean ± SD)	38.48 ± 50.65	85.49 ± 60.87	60.17 ± 79.59	0.18 (NS)
WBC (Mean ± SD)	13.08 ± 6.31	14.26 ± 4.71	8.42 ± 2.72	0.53 (NS)
ANC (Mean ± SD)	6.01 ± 3.50	8.22 ± 4.15	2.90 ± 1.69	0.21 (NS)

Table 3: Diagnostic Accuracy of the Yale Observation Scale for Predicting Bacteremia

	Value	95% CI
Sensitivity	82.14%	63.11%to 93.94%
Specificity	97.96%	89.15%to 99.95%
Positive Predictive Value	95.83%	76.64%to 99.38%
Negative Predictive Value	90.57%	81.25%to 95.51%
Accuracy	92.21%	83.81%to 97.09%

Table 4: Correlation Between YOS Scores and Study Variables

		Duration of fever	Temperature	WBC	ANC	CRP
YOS SCORE	Pearson Correlation	-0.137	0.289*	-.071	0.002	0.104
	P value	0.239	0.01 (S)	0.542	0.985	0.372

The diagnostic performance of YOS for predicting bacteremia demonstrated strong results. The scale had a sensitivity of 82.14% and specificity of 97.96%, with a positive predictive value (PPV) of 95.83% and a negative predictive value (NPV) of 90.57%. The overall diagnostic accuracy of YOS was 92.21%. These findings underscore the utility of YOS as a reliable tool for the early identification of serious bacterial infections in febrile children.

Pearson correlation analysis between YOS scores and clinical or laboratory parameters revealed statistically significant positive correlations only with temperature (r = 0.289, p = 0.01). No significant correlations were observed between YOS scores and other variables, including duration of fever, CRP, WBC, or ANC.

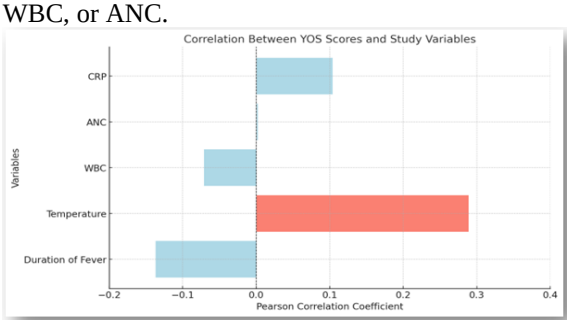

Figure 1: Correlation Between YOS Scores and Study Variables.

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DISCUSSION

The findings of this study highlight the utility of the Yale Observation Scale (YOS) as a reliable, non-invasive clinical tool for predicting serious bacterial infections (SBIs) in febrile children aged 1 to 36 months. YOS demonstrated strong diagnostic performance, with a sensitivity of 82.14%, specificity of 97.96%, and overall diagnostic accuracy of 92.21%. These results are consistent with previous research and provide further validation for YOS in identifying children at risk of bacteremia.

Several studies have evaluated the predictive accuracy of YOS in detecting SBIs. In a study by (Kansakar P 2015), YOS was applied to febrile children aged 1–36 months, yielding a sensitivity of 45.45% and specificity of 88.05% for scores >10 4. While the sensitivity reported in our study is significantly higher, the specificity is comparable, emphasizing YOS's ability to rule out SBIs effectively when combined with clinical judgment and laboratory markers.

In contrast, a study by Sudhakar and Ajitha (2019) found YOS to have an optimal cut-off score of 14.5 for predicting bacteremia, achieving a sensitivity of 97% and specificity of 79.6%.[5] This aligns closely with our findings of significant correlations between YOS scores and higher temperature levels, as fever severity is a critical component in the YOS assessment.

In a broader population study, (Nigrovic LE 2017) reported that YOS had limited reliability in identifying SBIs in infants ≤60 days of age, with sensitivity as low as 11.6% for certain conditions.[3] This discrepancy may be attributed to age-related differences in clinical presentations and the challenge of distinguishing bacterial from viral illnesses in neonates.

The significant correlation between YOS and temperature ($p = 0.01$) is consistent with other studies that have identified fever severity as a robust predictor of SBIs. For example, Bang and Chaturvedi (2009) highlighted the predictive utility of YOS in children with fever, showing high inter-observer reliability and a strong correlation between higher YOS scores and bacteremia (Bang & Chaturvedi, 2009).

Further more, Walia et al. (2016) demonstrated that YOS scores ≥20 had a sensitivity of 100% for predicting bacteremia, albeit with some false positives. This aligns with our observation that higher YOS scores (23–30) showed a higher positivity rate for blood culture compared to lower scores.[7]

While YOS is a valuable screening tool, it does have limitations. Studies such as those by Teach and Fleisher (1995) and McCarthy et al. (1982) indicate that YOS scores alone are insufficient for identifying all serious illnesses and should be used in conjunction with laboratory tests and clinical judgment1,6. Our findings corroborate this view, as YOS scores did not correlate significantly with laboratory markers such as CRP, WBC, or ANC ($p > 0.05$).

The diagnostic accuracy and ease of use make YOS particularly beneficial in resource-limited settings where advanced laboratory facilities may not be available. As seen in previous studies, YOS can guide early decision-making, such as prioritizing blood cultures or initiating antibiotics for children with higher scores.

Our study reaffirms the utility of YOS as a simple, reliable, and effective tool for identifying febrile children at risk of serious bacterial infections. While it is not a standalone diagnostic tool, combining YOS with laboratory investigations and clinical expertise enhances its predictive value, enabling timely intervention and improved outcomes. Future multicentric studies with larger cohorts and diverse populations are recommended to further validate its utility and establish standardized cut-off scores for various clinical settings.

CONCLUSION

The Yale Observation Scale (YOS) is a valuable clinical tool for the early identification of serious bacterial infections (SBIs) in febrile children aged 1 to 36 months. Our study demonstrated that YOS is highly sensitive (82.14%), specific (97.96%), and diagnostically accurate (92.21%) in predicting bacteremia. A significant correlation between higher YOS scores and elevated temperature reinforces the scale's utility as a bedside screening method in pediatric practice.

While YOS alone may not comprehensively detect all SBIs, it provides an efficient, non-invasive, and cost-effective approach to stratify risk and prioritize further diagnostic evaluations, such as blood culture or inflammatory markers. It is particularly useful in resource-limited settings, where laboratory testing may be unavailable or delayed.

The findings highlight the need to use YOS in combination with clinical judgment and adjunct laboratory investigations to enhance its predictive power. Future research should focus on standardizing cut-off scores, assessing its utility in diverse populations, and integrating it with newer diagnostic models, such as machine learning algorithms, for even greater accuracy. By adopting YOS as part of routine practice, healthcare providers can improve early diagnosis, initiate timely interventions, and reduce complications associated with SBIs in febrile children.

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