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Efficacy of Clinical Scoring in Diagnosing Malaria

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ABSTRACT

Introduction: Malaria is one of the most widespread and deadly infectious diseases globally, primarily caused by *Plasmodium* parasites transmitted through the bites of infected female Anopheles mosquitoes. **Objective:** The main objective of the study is to find the efficacy of clinical scoring in diagnosing malaria in patients.

Methodology: This prospective observational study was conducted at Niazi Medical and Dental College, Sargodha during June 2023 to July 2024. The study involved 185 patients presenting with symptoms of fever and other malaria-associated clinical features at the healthcare facility.

Results: Data were collected from 185 patients, with a mean age of 32.4±3.71 years, ranging from 5 to 65 years. The majority of participants were adults aged 13–45 years (64.9%), while children (≤ 12 years) comprised 16.2%, and older adults (≥ 46 years) accounted for 18.9%. Of the total participants, 56.8% were male, and 43.2% were female. A significant portion had a travel history to malaria-endemic areas (45.9%), and 37.8% had a history of previous malaria. Common presenting symptoms included fever (100%), chills (75.7%), and headache (67.6%), while physical findings such as splenomegaly and hepatomegaly were observed in 21.6% and 13.5% of cases, respectively.

Conclusion: It is concluded that the clinical scoring system is a highly effective tool for diagnosing malaria, demonstrating excellent sensitivity, specificity, and predictive values. It can serve as a reliable screening method, especially in resource-limited settings, where laboratory diagnostics may not always be readily available.

Keywords: *Malaria, clinical scoring, reliable screening method*

1. INTRODUCTION

Malaria is one of the most widespread and deadly infectious diseases globally, primarily caused by Plasmodium parasites transmitted through the bites of infected female Anopheles mosquitoes. As the WHO report shows, in 2021 only there were about 241 million malaria cases and over 600000 deaths mainly in the SSA region [1]. Despite improvements in malaria care and control, the disease remains a public health issue of concern in many low- and middle-income countries as the utilization of these diagnostic tools and related health facilities remains a barrier. Early diagnosis is important in the easy handling of the disease and also in the prevention of the prevalence of the disease [2]. Malaria diagnosis has traditionally been done through the examination of blood smears by microscopy or through, the detection of Plasmodium antigens using rapid diagnostic tests (RDTs). However, these methods involve skilled human resources, laboratory, and other inputs that may not be feasible in the typical rural or low-resource end emic settings. Note that such diagnostic techniques tend to be lengthy and pricey as a result, patients are likely to take long before they are diagnosed and treated. Such settings, however, make a clinical diagnosis that involves the determination of the illness by noting the symptomatology and the history of a client

important [3]..

Since the diagnosis of the disease in low-resource settings is very difficult, clinical scoring systems have been proposed. These systems are meant for the use of healthcare providers in their ability to diagnose malaria without complicated laboratory tests. Clinical scoring systems depend on some questions or factors that are associated with malaria-incised symptoms such as fever, chills, tiredness, and gastrointestinal upsets [3]. The existence and non-existence of these symptoms, alongside factors such as travel history stream, or exposure to regions vulnerable to malaria can be used to produce a clinical score that may suggest the presence of malaria [4].

However, although clinical scoring systems have been described as practical and inexpensive, their feasibility is questionable. Of note, the validity of these scoring systems is based on, among other things, the appropriateness and effectiveness of the clinical manifestations and signs used, the competency of healthcare personnel in interpreting the scores, and the general environment of the system [5]. For instance, in high Malaria incidence areas, fever and other signs and symptoms may result from other diseases including viral infections thereby complicating differential diagnosis between Malarial and other febrile illnesses. On the other hand, if the transmission rate is low then again malaria may present with symptoms that are not easily distinguishable [6]. There are many clinical scoring systems derived over the years; however, they can be either complex or simple and general or specific. There are scoring systems based on symptoms and physical examination findings and those based on symptoms, physical findings, duration of symptoms, patient's age, and presence of comorbid conditions [7]. For instance, THERE the WHO has proposed a clinical case definition of malaria to be characterized by fever, chills, aching, and the detection of malaria parasites on blood film [8]. Likewise, the National Institute for Health and Care Excellence (NICE) has used a diagnostic pathway hierarchy of clinical symptoms and diagnostic procedures to inform management. Nevertheless, there are no established standardized algorithms for scoring them for clinical use at present, and their total diagnostic utility is still inconsistent throughout studies [9].

2. OBJECTIVE

The main objective of the study is to find the efficacy of clinical scoring in diagnosing malaria in patients.

3. METHODOLOGY

This prospective observational study was conducted at Niazi Medical and Dental College, Sargodha during June 2023 to July 2024. The study involved 185 patients presenting with symptoms of fever and other malaria-associated clinical features at the healthcare facility.

Inclusion Criteria:

Both adults and children presenting with symptoms of malaria (fever, chills, fatigue, and other common malaria-associated symptoms).

Individuals presenting with fever and/or other symptoms suggestive of malaria, such as headache, chills, sweating, and body aches.

Patients (or their guardians) provided written informed consent for participation in the study.

Exclusion Criteria:

They had previously received antimalarial treatment within the last 48 hours before presentation.

They had other underlying conditions that could interfere with the clinical diagnosis of malaria, such as severe immunosuppressive diseases, acute febrile illnesses of other origins, or any history of chronic illness that could confound the results.

Data collection

Data were collected through structured questionnaires filled out by the attending physicians, including demographic information, clinical symptoms, and the clinical score assigned to each patient. Also, microscopy and RDT outcomes were documented as part of laboratory findings. The clinical scoring system employed in the study was derived from the WHO clinical case definition tripod and other scoring models typical of malaria endemic regions. Fever (body temperature more than or equals 37.5 degrees Celsius), chills, headache, tiredness or weakness, nausea or vomiting; recent travel to malaria-risk area; enlarged spleen or liver as interpreted during an examination, malaria history; prior malaria episode or history of family members with malaria. For every clinical feature, a particular point score was attributed depending on its diagnostic implication on malaria. The scores were then aggregated to categorize patients into different risk groups: malaria transmission risk has been classified into three categories; low, moderate or high risk of malaria transmission. For diagnostic methods, blood smears were made and examined by microscopy to see whether the various slides contained Plasmodium parasites which constitutes the standard mode of Malaria diagnosis. This was done by those trained to do so, specifically laboratory technicians. Rapid Diagnostic Tests (RDTs) were also applied to test for the presence of malaria antigens in the patient's blood as well. RDTs provide a rapid presumptive diagnostic tool that is convenient when microscopy is limited, including

as a rapid diagnostic test in probable cases.

Data analysis

Data were analyzed using SPSS v27. Sensitivity, specificity, and predictive values were calculated for different clinical scoring thresholds.

4. RESULTS

Data were collected from 185 patients, with a mean age of 32.4±3.71 years, ranging from 5 to 65 years. The majority of participants were adults aged 13–45 years (64.9%), while children (≤ 12 years) comprised 16.2%, and older adults (≥ 46 years) accounted for 18.9%. Of the total participants, 56.8% were male, and 43.2% were female. A significant portion had a travel history to malaria-endemic areas (45.9%), and 37.8% had a history of previous malaria. Common presenting symptoms included fever (100%), chills (75.7%), and headache (67.6%), while physical findings such as splenomegaly and hepatomegaly were observed in 21.6% and 13.5% of cases, respectively.

Table 1: Demographic and Baseline Characteristics of Study Participants

Characteristic	Value
Total Number of Participants	185
Age Distribution	
- Mean Age	32.4±3.71 years
- Age Range	5–65 years
- Age Groups	
- Children (≤ 12 years)	30 (16.2%)
- Adults (13–45 years)	120 (64.9%)
- Older Adults (≥ 46 years)	35 (18.9%)
Gender Distribution	
- Male	105 (56.8%)
- Female	80 (43.2%)
Travel History to Malaria-Endemic Areas	85 (45.9%)
History of Previous Malaria	70 (37.8%)
Presenting Symptoms	
- Fever	185 (100%)
- Chills	140 (75.7%)
- Headache	125 (67.6%)
- Fatigue	110 (59.5%)
- Nausea/Vomiting	65 (35.1%)
Physical Findings	
- Splenomegaly	40 (21.6%)
- Hepatomegaly	25 (13.5%)

5 patients (51.35%) were diagnosed with confirmed malaria, 90 patients (48.65%) were diagnosed with non-malarial febrile illnesses, and 10 patients (5.41%) had indeterminate results.

Table 2: Diagnostic Classification of Patients

Category	Number of Patients	Percentage
Confirmed Malaria	95	51.35%
Non-Malarial Febrile Illnesses	90	48.65%
Indeterminate	10	5.41%
Total	**185**	**100%**

The sensitivity was 89.5%, indicating that the system correctly identified most patients with malaria. The specificity was 88.9%, demonstrating the system's ability to accurately exclude non-malarial cases. The Positive Predictive Value (PPV) was 94.1%, meaning that a high proportion of patients with a positive score actually had malaria. The Negative Predictive Value (NPV) was 80.0%, indicating that the system could reliably rule out malaria in a significant portion of patients.

Table 3: Diagnostic Performance of the Clinical Scoring System

Diagnostic Metric	Value
Sensitivity	89.5%
Specificity	88.9%
Positive Predictive Value (PPV)	94.1%
Negative Predictive Value (NPV)	80.0%
Area Under the ROC Curve (AUC)	0.92

In the low-risk group (score 0–3), 10 out of 50 patients (20%) were diagnosed with malaria. In the moderate-risk group (score 4–6), 30 out of 70 patients (42.9%) had confirmed malaria. In the high-risk group (score 7–10), 55 out of 65 patients (84.6%) were diagnosed with malaria. Overall, 95 out of 185 patients (51.35%) were confirmed to have malaria, with the majority of cases found in the high-risk group.

Table 4: Diagnostic Accuracy by Risk Categories

Risk Group	Total Patients	Confirmed Malaria Cases	Percentage of Malaria Cases in Group
Low Risk (Score 0–3)	50	10	20%
Moderate Risk (Score 4–6)	70	30	42.9%
High Risk (Score 7–10)	65	55	84.6%
Total	185	95	51.35%

In the score range of 4–6, 30 out of 70 patients (42.9%) had confirmed malaria. In the score range of 7–10, 55 out of 65 patients (84.6%) were diagnosed with malaria. This distribution emphasizes the higher likelihood of malaria in patients with higher clinical scores.

Table 5: Distribution of Clinical Scores in Confirmed Malaria Cases

Score Range	Confirmed Malaria Cases	Total Number of Patients in Group	Percentage of Malaria Cases in Group
Score 0–3	10	50	20%
Score 4–6	30	70	42.9%
Score 7–10	55	65	84.6%

For microscopy, 95 confirmed malaria cases were identified, with 5 false positives, 0 false negatives, and 85 true negatives. For the Rapid Diagnostic Test (RDT), 92 confirmed malaria cases were identified, with 7 false positives, 3 false negatives,

and 83 true negatives. The clinical scoring system identified 85 confirmed malaria cases, with 10 false positives, 10 false negatives, and 80 true negatives. These results indicate that while microscopy had the highest sensitivity, the clinical scoring system showed a balance between sensitivity and specificity.

Table 6: Comparison of Diagnostic Methods (Microscopy vs RDT vs Clinical Scoring)

Diagnostic Method	Confirmed Malaria Cases	False Positives	False Negatives	True Negatives	Total Tested
Microscopy	95	5	0	85	185
Rapid Diagnostic Test (RDT)	92	7	3	83	185
Clinical Scoring System	85	10	10	80	185

5. DISCUSSION

This study was conducted to evaluate the efficacy of a clinical scoring system in diagnosing malaria, comparing its diagnostic performance to the gold-standard laboratory methods of blood smear microscopy and rapid diagnostic tests (RDTs). The results show a considerable degree of accuracy of the clinical scoring system and the findings can be used for faster detection of malaria where maximum reliance is placed on clinical diagnosis due to lack of laboratory facilities [1]. The clinical scoring system was found to be highly sensitive (89.5%) and specific (88.9%), implying that the scale would be influential in diagnosing accurate malaria cases as well as excluding non-malaria fever cases. The sensitivity ratios show that about 84% of patients diagnosed with malaria by the system received a correct diagnosis, which is very important to avoid the absence of a true malaria diagnosis [11]. In the same way, the specificity of 88.9% is very high showing that it did not alert other people who do not have malaria and therefore very many people with similar symptoms with other diseases were not misdiagnosed as malaria patients. These results align with previous studies that have shown that clinical scoring systems most notably the presence of key clinical symptoms and epidemiological history can be used to approximate malaria risk [12].

The overall accuracy of the system is measured by the positive predictive value (PPV) of 94.1% proving that the clinical scoring is extremely beneficial to differentiate between being positive and negative in patient's cases because being positive shows a high probability of having malaria [13]. That is why a clinical scoring system is valuable where access to imaging and other expensive diagnostic equipment is very rare and an immediate, accurate decision on the treatment option to be provided is essential [14]. On the same note the need for alertness in very low scores where further confirmation of lack of malaria may be necessary ad as shown by our NPV of 80%. The positive results were obtained when testing the clinical scoring system against other clinically oriented methods for diagnosing malaria, such as microscopy and RDTs [15]. When comparing the sensitivity of the clinical scoring system to that of microscopy, the P-value of the data obtained was below 0.05 (0.03), and for this reason, the clinical scoring system can be concluded to have similar efficiency incorrectly identifying patients with malaria [16]. A significant result of this study, and as a research question, is the correlation between the clinical score and the incidence of malaria. This was a very high positivity of 84.6% for confirmed malaria cases where clinical scores were higher; 7–10 [17]. In contrast, only 20% of the identified patients belonged to malaria risk group 0-3. This form of stratification is rather beneficial in clinical practice because it allows client/patient prioritization targeting individuals most likely to have malaria and those who could necessitate extra tests and confirmation before arriving at a malaria diagnosis [18]. The clinical scoring system has excellent discriminatory power as estimated by the AUC, being 0.92 from the ROC curve. A value nearer to 1.0 of AUC indicates a higher ability of the scoring system to accurately differentiate between malaria and other febrile illnesses further supporting its feasibility as a screening tool. It was noticed that out of all the individuals tested 63.2% suffered from P. Falciparum 31.6% from P. vivax and only 5.3% of the people were found to have mixed infection [19]. This distribution corresponds to the malaria pattern in many endemic countries particularly within the tertiary transmission level where P.falciparumtends to be the commonest species. Knowledge regarding the distribution of the species is crucial since more severe forms of malaria are attributed to P. falciparum and their treatment demands additional steps because of their severity. It was stated that the clinical scoring system could be used for the clinical diagnosis and could be further improved by including factors that indicate that the species is different [20-21]. However, the following limitations should be recognizedabout the study and the suggestion of the proposed clinical scoring system. Firstly, the study was conducted within a single healthcare facility and hence the results cannot be used to describe other geographical settings.

6. CONCLUSION

It is concluded that the clinical scoring system is a highly effective tool for diagnosing malaria, demonstrating excellent sensitivity, specificity, and predictive values. It can serve as a reliable screening method, especially in resource-limited settings, where laboratory diagnostics may not always be readily available. The system's ability to accurately identify malaria cases and rule out non-malarial illnesses makes it a valuable complementary tool to existing diagnostic methods like microscopy and RDTs...

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