PATTERN OF *PLASMODIUM* INFECTION AND EFFICACY OF STAINED BLOOD FILM AND RAPID DIAGNOSTIC TEST (RDTS) AMONG PATIENT ATTENDING GENEAL HOSPITAL OFFA

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ABSTRACT

Background: Malaria, a significant global health challenge, particularly in regions like Nigeria, necessitates effective diagnosis to combat its widespread impact.

Aim: The aim of this study conducted at General Hospital Offa was to comprehend the patterns of *Plasmodium* infection and evaluate the efficacy of diagnostic tools, such as stained blood films and Rapid Diagnostic Test Kits (RDTs).

Methodology: With a cross-sectional design, 100 participants aged 5-30 years, exhibiting malaria symptoms, underwent clinical evaluations, demographic data collection, and blood sample analyses.

Results: Findings revealed a 65% prevalence of *Plasmodium* infection, predominantly *Plasmodium falciparum*. Higher infection rates were observed in the 11-20 years age group. Diagnostic tool assessment revealed variable sensitivities and specificities: Thick Blood Film (TBF) had 70% sensitivity and 85% specificity, Thin Blood Film (tBF) showed 60% sensitivity and 80% specificity, CareStart HRP2 Kit displayed 65% sensitivity and 50% specificity, and SD Bioline Kit demonstrated 55% sensitivity and 65% specificity.

Conclusion: This research provides crucial insights into local malaria infection patterns and diagnostic tool performance, guiding evidence-based healthcare decisions. The study has the potential to shape policies, assist practitioners in selecting effective diagnostic methods, and contribute to the global anti-malaria effort. Overall, this initiative signifies a positive shift in local healthcare practices, addressing knowledge gaps and promoting adaptable malaria control strategies in similar regions.

Keywords: *Plasmodium* infection, Stained blood film, Diagnostic kit test , General Hospital Offa

INTRODUCTION

Malaria, caused by the *Plasmodium* parasite and transmitted through mosquito bites, remains a formidable global health challenge, particularly in tropical and subtropical regions. The impact of malaria on public health is especially pronounced in countries like Nigeria Awosolu *et al.* (2021), where the disease is endemic, leading to a substantial burden on healthcare systems. The morbidity and mortality rates associated with malaria are disproportionately high among vulnerable populations, underscoring the urgency of comprehensive research to comprehend the patterns of *Plasmodium* infection and evaluate the efficacy of diagnostic methods. General Hospital Offa, situated in Nigeria, plays a crucial role in the local healthcare infrastructure and is actively engaged in the fight against malaria within the Offa community. (Adedoja *et al.,* 2015). Despite the efforts exerted by healthcare professionals, the efficacy of diagnostic tools employed for detecting *Plasmodium* infections, such as stained blood films and Rapid Diagnostic Test Kits (RDTS), warrants a comprehensive evaluation.

The accuracy and timeliness of malaria diagnosis are paramount for ensuring appropriate treatment, mitigating the risk of complications, and forestalling the emergence of drug-resistant strains (Oboh *et al.,* 2018).

The primary objective of this research is to delve into the prevalent patterns of *Plasmodium* infection among patients seeking medical attention at General Hospital Offa. Additionally, the study aimed to conduct a comparative analysis of the efficacy of two widely utilized diagnostic methods—stained blood film and RDTS. The overarching goal is to meticulously assess the diagnostic accuracy and reliability of these methods, ultimately offering valuable insights that can inform evidence-based decision-making within the local healthcare setting (Kotepui *et al.,*2020). The significance of this study is multifaceted, encompassing the potential to revolutionize diagnostic practices, optimize treatment strategies, and contribute substantively to the reduction of malaria-related morbidity and mortality in the Offa community. Given the evolving global health landscape, an in-depth understanding of the performance of different diagnostic tools is increasingly pivotal for the development and implementation of targeted interventions (Yakubu *et al* .,2019).

As malaria continues to exact a toll on communities in Nigeria and beyond, addressing the challenges associated with diagnosis and treatment becomes imperative. The research conducted at General Hospital Offa is poised to make a meaningful contribution to the body of knowledge surrounding malaria by providing a nuanced understanding of local infection patterns and critically evaluating the diagnostic tools commonly employed (Openbracketviedo *et al.,*2023).

The outcomes of this research have the potential to influence policy decisions, guide healthcare practitioners in selecting the most effective diagnostic methods, and contribute to the ongoing efforts to combat malaria. Furthermore, the findings may have broader implications for other regions grappling with similar healthcare challenges, aiding in the development of adaptable and context-specific strategies for malaria control Oviedo *et al.,* (2023).

This comprehensive research initiative represents a concerted effort to bridge existing knowledge gaps related to the patterns of *Plasmodium* infection and the efficacy of diagnostic tools in General Hospital Offa (Adedoja *et al.,* 2015),. By doing so, it aspires to be a catalyst for positive change in local healthcare practices, with the ultimate goal of advancing the global fight against malaria.

MATERIALS AND METHODS
Study Area
The research was conducted at General Hospital Offa, Nigeria. General Hospital Offa is situated in the Offa Local Government Area of Nigeria. This primary healthcare facility serves the Offa community, providing a representative sample of patients presenting malaria-related symptoms for the study.

Study Design
The study adopts a cross-sectional design to investigate *Plasmodium* infection patterns and compare the efficacy of stained blood film and Rapid Diagnostic Test Kits (RDTS) at General Hospital Offa. This design allows for a momentary examination of prevalence and diagnostic accuracy, offering insights into the dynamics of malaria in the specified timeframe.

Participant Recruitment
Hundred (100: aged 5 – 30 years; Female – 50 and Male - 50) Patients exhibiting symptoms indicative of malaria at General Hospital Offa were recruited informed consent was secured from each participant after a thorough explanation of the study's purpose and procedures.

Data Collection
Clinical Evaluation
Participants undergone a comprehensive clinical examination to assess malaria symptoms.

Demographic information, including age, gender, and medical history, were documented.

Blood Sample Collection
Venous blood samples were collected for stained blood film and RDTS.

Laboratory Analysis
Microscopic identification of *Plasmodium* in thin ad thick blood film was carried out as described by (Cheesbrough, 2006) while serological examination was carried out using CareStart HRP2 and SD Bioline Kits according to the manufacturers'' instruction.

CareStart HRP2
The CareStart™Malaria HRP2/pLDH (Pf/pan) Combo Test is a three-band RDT that detects HRP2 and pan-pLDH antigens CareStart™RDT has been evaluated previously in field settings using PCR-corrected microscopy as reference, showing better sensitivity for microscopy (WHO, 2023).

DATA ANALYSIS
The results was subjected to statistical analysis using SPSS 21.0 to determine proportion, prevalence rate, mean, sensitivity and specificity.

ETHICAL CONSIDERATIONS
The proposal of this work was reviewed and approved by the Ethical and Research committee of the General Hospital, Offa, Nigeria before the commencement of this work. Informed consent was also obtained from each of the patients.

RESULTS
Hundred subjects were recruited and investigated. Out of the 100, 65% (65) were positive with the distribution according to spices as: 42% (42) *Plasmodium falciparum,* 21%. (21) *Plasmodium malariae,* % (1) *Plasmodium ovale* and 1% (1) *Plasmodium vivax* (Table 1). Distribution of *Plasmodium based* on age showed 62.5% (10/16) 5 – 10 years; 65.5% (19/29) 11 – 20 years and 64.3% (18/28) 21 – 30 years (Table 2). Efficacy of Stained Blood Film and Rapid Diagnostic Kit Test (RDTS) showed that Thick Blood Film (TBF): 70%, Sensitivity and 85%, Specificity. Thin Blood Film (tBF): 60% Sensitivity and 80%, Specificity; CareStart HRP2 Kit: 65%, Sensitivity and 50%, Specificity while SD Bioline Kit: Showed a Sensitivity of 55%, and Specificity of 65% (Table 3).

Table 1: Distribution of *Plasmodium* falciparum, *Plasmodium* malariae, *Plasmodium ovale* and *Plasmodium vivax* in the subjects

	Total	*Plasmodium* falciparum	*Plasmodium* malariae	*Plasmodium* ovale	*Plasmodium* vivax
Number of subjects tested	**100**	100	100	100	100
Plasmodium infected patients	**65% (65)**	42% (42)	21% (21)	1% (1)	1% (1)

Table 2: Prevalence of *Plasmodium* infection based on age

S/N	Age Group	Number Examined	Number Infected	% Prevalence
1	5 – 10	16	10	62.5%
2	11 – 20	29	19	65.5%
3	21 – 30	28	18	64.3%

Table 3: Efficacy of Stained Blood Film and Rapid Diagnostic Kit Test (RDTS)

	Sensitivity	Specificity
Thick Blood Film (TBF):	70%,	85%,
Thin Blood Film (tBF):	60%	80%,
CareStart HRP2 Kit:	65%,	50%,
SD Bioline Kit:	55%,	65%,

DISCUSSION

The findings of the research conducted in General Hospital Offa, Nigeria, provide a comprehensive understanding of the prevailing patterns of *Plasmodium* infection among patients in the region. The study also critically evaluates the efficacy of two commonly utilized diagnostic methods – stained blood films and Rapid Diagnostic Test Kits (RDTS). Malaria continues to be a significant public health concern in Nigeria, and comprehending the local infection patterns is paramount for the development and implementation of effective control and management strategies.

The prevalence of *Plasmodium* infection observed in this study is alarming, with 65% of the recruited subjects testing positive compared with the previous reports that the prevalence of malaria in Nigeria remains a significant public health concern (Salwa *et al*., 2016). Studies in 2016 have shown high prevalence rates in various regions of Nigeria, with Kano State reporting 60.6% of participants positive for *P. falciparum* (Salwa *et al*., 2016).

Additionally, the Nigeria Malaria Indicator Survey in 2021 indicated a decrease in malaria prevalence from 42% in 2010 to 22% in 2021, showing progress in combating the disease (WHO, 2022).

This underscores the persistent burden of malaria in the Offa community. The distribution of *Plasmodium* species highlights *Plasmodium* falciparum as the predominant species, aligning with the global trend where this species is responsible for the majority of malaria cases. The age-wise distribution emphasizes the vulnerability of younger age groups, stressing the need for targeted interventions and preventive measures in pediatric populations. *Plasmodium falciparum* is the dominant species, comprising 42% of the cases, followed by *Plasmodium malariae*, *Plasmodium ovale*, and *Plasmodium vivax*. Understanding the distribution of *Plasmodium* species is critical for tailoring appropriate treatment strategies and interventions. The high prevalence of P. falciparum emphasizes its role as a major contributor to malaria cases in the studied population.

High prevalence of *Plasmodium* infection especially *falciparum* has also been reported in a periurban community in Kwara State by Babamale *et al.,* Sendor *et al.,* (2023). *Plasmodium malariae* and *Plasmodium ovale* have also been reported in a highly malaria-endemic country have also ee reported by Sendor *et al.,* Rachel *et al.,* (2023). These reports are consistent with the findings of this work as indicated above

The age-based analysis indicates varying prevalence rates across different age groups, with the highest prevalence observed in the 11-20 years age group (65.5%). This information suggests potential age-related factors influencing malaria exposure and susceptibility (Griffin *et al* ., 2014, Adedoja *et al* ., 2015, Kotepui *et al.,* 2020). . Identifying age groups with higher malaria prevalence can inform targeted interventions, such as vaccination campaigns or enhanced surveillance in specific demographics (Griffin *et al* ., 2014, Adedoja *et al* ., 2015, Kotepui *et al.,* 2020).

The study evaluated the efficacy of different diagnostic methods, revealing varying sensitivities and specificities. Thick Blood Film (TBF) demonstrated the highest sensitivity (70%) and specificity (85%), while the CareStart HRP2 Kit exhibited lower specificity (50%). The variations in diagnostic efficacy highlight the importance of selecting appropriate diagnostic tools based on the specific needs of the population and healthcare setting. High sensitivity is crucial for accurate detection, while high specificity is essential to minimize false positives (Kenji *et al.,* (2019).

The findings suggest that using the TBF method may offer a reliable diagnostic approach due to its high sensitivity and specificity. However, the choice of diagnostic method may depend on factors such as resource availability and local epidemiological patterns. Implementing effective diagnostic strategies is essential for timely and accurate malaria management. The study provides practical insights for healthcare practitioners and policymakers in selecting appropriate diagnostic tools based on their performance characteristics (Berzosa *et al.,* (2018).

A comparative analysis of diagnostic methods reveals nuanced insights into the performance of stained blood films and RDTS. Stained blood films, encompassing both thick and thin films, demonstrated reasonable sensitivity and specificity, with thick blood films exhibiting higher specificity. RDTS, specifically the CareStart HRP2 Kit and SD Bioline Kit, showed variable sensitivity and specificity values. The CareStart HRP2 Kit demonstrated higher sensitivity but lower specificity compared to the SD Bioline Kit. These findings suggest that while RDTS may offer quicker results, stained blood films, particularly thick blood films, maintain a higher level of specificity Berzosa *et al.,* (2018).

The observed variations in sensitivity and specificity among the diagnostic methods underscore the importance of selecting appropriate tools based on the context and purpose of diagnosis. Stained blood films, despite being a conventional method, continue to be reliable, especially in settings where laboratory infrastructure may be limited. Conversely, RDTS can provide rapid results, aiding prompt decision-making in resource-constrained environments. However, the trade-off between sensitivity and specificity should be carefully considered in the selection of diagnostic tools Mwenda *et al.,* (2018)

While the study provides valuable insights, limitations such as the sample size and geographic scope should be considered. Future research could expand the study to more diverse populations and settings for generalizability. Acknowledging the study's limitations underscores the need for ongoing research to refine and validate findings. Continuous monitoring and adaptation of diagnostic strategies are crucial to address evolving malaria dynamics (Adedoja *et al.,* 2015, Oboh *et al.,* 2018).

It is essential to acknowledge the limitations of the study, including the relatively small sample size and the focus on a single healthcare facility. Future research endeavors could encompass larger, multi-center studies to enhance the generalizability of the findings. Additionally, continuous monitoring of diagnostic tool performance and local *Plasmodium* strains is crucial for adapting control measures to evolving epidemiological trends (Griffin *et al* ., 2014, Kotepui *et al.,* 2020, Berzosa *et al.,* 2018) .

This research significantly contributes valuable insights into the patterns of *Plasmodium* infection in General Hospital Offa and the efficacy of diagnostic tools employed. The results underscore the need for a nuanced approach in selecting diagnostic methods based on their performance characteristics and the local healthcare context (Berzosa *et al.,* 2018). These findings can guide healthcare practitioners, inform policy decisions, and contribute to the ongoing global efforts to combat malaria, not only in Offa but also in similar healthcare settings worldwide (Kenji *et al.,* 2019).

CONCLUSION

In this study conducted at General Hospital Offa, Nigeria, a comprehensive investigation into malaria prevalence and diagnostic efficacy was undertaken. With a sample size of 100 subjects, the research unveiled a concerning reality, with 65% testing positive for malaria. Plasmodium falciparum emerged as the predominant species, affecting 42% of the population, particularly impacting younger age groups. Furthermore, the distribution of Plasmodium infections across different age brackets highlighted the vulnerability of children and young adults, with prevalence rates remaining consistently high. This underscores the urgent need for targeted interventions and preventive measures tailored to these demographic groups. The evaluation of diagnostic methods, including stained blood films and Rapid Diagnostic Test Kits (RDTS), revealed varying levels of sensitivity and specificity. While Thick Blood Film (TBF) demonstrated higher sensitivity compared to Thin Blood Film (tBF), RDTS kits exhibited differing performance characteristics. These findings emphasize the importance of selecting appropriate diagnostic tools based on their accuracy and reliability in different clinical settings. Beyond its local implications, this research contributes valuable insights to the global fight against malaria. By informing policymakers and guiding healthcare practitioners in diagnostic tool selection, the study aims to enhance malaria control strategies worldwide. The outcomes of this research have the potential to influence healthcare policies not only in Offa but also serve as a reference for similar healthcare challenges globally. In the face of ongoing infectious diseases, such as malaria, the study underscores the critical importance of accurate diagnostics and optimized treatment. Through evidence-based healthcare practices and collaborative efforts, General Hospital Offa's initiative seeks to catalyze positive change, advancing malaria control efforts both locally and globally. Ultimately, the research endeavors to contribute significantly to the ongoing fight against malaria, fostering a healthier future for communities in Nigeria and beyond.

RECOMMENDATIONS

1. Diagnostic Training: Enhance healthcare professionals' training on stained blood films and Rapid Diagnostic Test Kits (RDTS) interpretation.
2. Quality Control: Implement regular quality control measures to ensure accuracy in stained blood film and RDTS results.
3. Combination Approach: Adopt a dual-method strategy by combining stained blood films and RDTS to enhance diagnostic accuracy.
4. Community Education: Launch community-wide programs for malaria awareness, emphasizing early diagnosis and treatment.
5. Continued Research: Encourage ongoing research at General Hospital Offa to monitor *Plasmodium* infection patterns and diagnostic method efficacy.

These measures can significantly improve malaria diagnosis, treatment, and healthcare practices in and beyond the Offa community.

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