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Our experience with malaria patients presenting to a hospital in Mali

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Abstract
Introduction: Malaria, a parasitic disease transmitted by Anopheles mosquitoes, continues to impact global public health profoundly. In 2023, the World Health Organization reported an estimated 263 million malaria cases worldwide, accompanied by approximately 597,000 deaths. This article elucidates our experiences with malaria, encompassing clinical observations, intervention strategies, and outcomes.
Method: The study included 140 participants who had applied to the hospital and were suspected of having malaria. The patients were first given a rapid test, and then the diagnosis was confirmed with thick drop and peripheral smear tests. The participants' average red blood cell, white blood cell, and platelet values were compared according to their gender. The possible correlation was investigated between the participants' red blood cells, white blood cells, platelets, and age variables.
Results: The oldest participant is 88 years old, and the youngest is two years old. Red blood cells and platelet values showed statistically significant differences between genders, while white blood cells did not. It was determined that there was a significant negative correlation between platelet values and red blood cells and a significant positive correlation between white blood cells.
Conclusion: In conclusion, our experiences with malaria underscore the complexity.

Keywords: Malaria, red blood cell, white blood cell, platelet, public health, Mali

1. Introduction

Malaria, a parasitic disease transmitted by Anopheles mosquitoes, continues to profoundly impact global public health, particularly within tropical and subtropical regions [1]. Despite concerted international efforts to mitigate its prevalence, malaria remains a formidable adversary, exacting a substantial toll in terms of morbidity and mortality [2]. The World Health Organization (WHO) reported an estimated 263 million malaria cases worldwide in 2023, accompanied by approximately 597,000 deaths. Notably, the WHO African Region bore a disproportionate burden, accounting for 94% of cases (246 million) and 95% of deaths (569,000), with children under five constituting about 76% of these fatalities [3].

Multifaceted factors, including climatic conditions, socioeconomic determinants, and the emergence of resistance to antimalarial drugs and insecticides, influence malaria persistence [4, 5]. Climate change, in particular, has expanded the habitable range of malaria vectors, exacerbating transmission dynamics [6]. Conflicts and population displacement also disrupt healthcare infrastructure, impeding effective disease management and control. These challenges are compounded by inequalities in access to healthcare, disproportionately affecting vulnerable populations such as children and pregnant women [7].

Financial constraints further impede progress in malaria control. In 2023, global funding for malaria control efforts was approximately $4 billion, significantly below the estimated $8.3 billion required to achieve comprehensive control measures. This funding gap hampers the deployment of effective interventions, including the distribution of insecticide-treated nets, indoor residual spraying, and access to diagnostic testing and treatment [8].

Despite these obstacles, malaria prevention and treatment advancements offer a semblance of optimism. The development and deployment of malaria vaccines, such as the RTS, S/AS01 (Mosquirix) [9], and the R21/Matrix-M [10], have demonstrated efficacy in reducing the incidence of malaria among children in high-burden areas. For instance, Nigeria, which bears the world's heaviest malaria burden, commenced the provision of the R21/Matrix-M vaccine to

young children in 2024, aiming to reduce severe malaria cases and deaths significantly [11].

Furthermore, innovative vector control strategies, including the introduction of genetically modified mosquitoes designed to reduce vector populations or impede their capacity to transmit the parasite, are under evaluation [12]. For example, trials involving transgenic mosquitoes are underway to assess their potential in curbing malaria transmission in Kenya [13]. While these approaches hold promise, they necessitate rigorous scientific evaluation to ascertain their efficacy and safety, alongside considerations of ecological impacts and public acceptance [14].

The global health community continues to advocate for integrated strategies that encompass prompt diagnosis, effective treatment, and robust surveillance systems. Emphasis is placed on strengthening healthcare infrastructures, particularly in endemic regions, to ensure equitable access to preventive measures and medical care. Educational initiatives to increase public awareness about malaria transmission and prevention are also pivotal in fostering community engagement and compliance with control measures [13].

In light of the persistent challenges and emerging opportunities in malaria control, this article elucidates our experiences with malaria, encompassing clinical observations, intervention strategies, and outcomes. This discourse aims to contribute to the collective understanding of malaria dynamics and inform future endeavors to mitigate the burden of this enduring disease.

2. Materials and Methods

2.1 Study Population

The study included those who applied to the hospital and were suspected of malaria. Preliminary diagnostic criteria for suspected malaria were high fever, shivering, sweating, and fatigue. 15 records from repeated patient applications were excluded from the study. The total number of participants was 140. 68 of the participants were female, and 72 were male.

2.2 Study Design and Participants

Our study was conducted between October 2017 and July 2023 on patients who applied to a secondary hospital in Bamako, Mali, with suspected malaria. The hospital serves the capital city of Bamako and surrounding settlements in Mali. The patients were first given a rapid test, and then the diagnosis was confirmed with thick drop and peripheral smear tests. The participants' average red blood cell (RBC), white blood cell (WBC), and platelet values were compared according to their gender. The possible correlation was investigated between the participants' RBC, WBC, platelet, and age variables.

2.3 Exclusion Criteria

- Participants who refuse to participate in the study,
- Repeated patient applications,
- Those with missing data.

2.4 Examined Variables

- Age
- Gender
- RBC
- WBC
- Platelet.

2.5 Ethics

Ethical permissions were obtained from the secondary healthcare facility. Participants were not forced to participate in the research, and informed consent was obtained from them.

2.6 Statistical Analysis

Statistical analysis was performed using SPSS version 26. The suitability of the data for the variables was assessed using the Kolmogorov-Smirnov test for normal distribution. Demographic data were presented as numbers, percentages, means, and standard deviations. Relationships among variables were investigated using Mann-Whitney U tests. Possible correlations between variables were examined with the Spearman correlation test. A p-value of less than 0.05 was considered the threshold for statistical significance.

3. Results

Table 1 shows the demographic data of the participants. The oldest participant is 88 years old, and the youngest is two years old.

Table1: Demographic data of the participants.

Gender	**Female (%)**	**Male (%)**
	68 (48,5)	72 (51,5)
	Mean ± SD	
Age	38,94 ± 17,18	
RBC	4,79 ± 0,64	
WBC	8,53 ± 3,85	
Plt	256,56 ± 115,21	

The participants' average RBC, WBC, and platelet values were compared according to their gender. Accordingly, RBC and platelet values showed statistically significant differences between genders, while WBC did not (Table 2).

Table 2: RBC, WBC and platelet values of the participants were compared according to their gender (Mann Whitney U Test).

	Gender	**Mean ± SD**	**P**
RBC	Female	4,49 ± 0,49	<0,01
	Male	5,07 ± 0,63	
WBC	Female	8,16 ± 3,78	0,1
	Male	8,88 ± 3,90	
Plt	Female	269,37 ± 102,86	0,04
	Male	244,47 ± 125,29	

The possible correlation was investigated between the participants' RBC, WBC, platelet, and age variables. It was determined that there was a significant negative correlation between platelet values and RBC and a significant positive correlation between WBC (Table 3).

Table 3: Correlation between the RBC, WBC, platelet and age variables.

			Age	RBC	WBC	Plt.
Spearman's rho	Age	Cor. Coef.	1,0	,01	,07	-,11
		Sig. (2-tailed)	.	,90	,39	,18
		N	140	140	140	140
	RBC	Cor. Coef.	,01	1,00	-,10	-,24**
		Sig. (2-tailed)	,90	.	,21	,00
		N	140	140	140	140
	WBC	Cor. Coef.	,07	-,10	1,0	,22**
		Sig. (2-tailed)	,39	,21	.	,00
		N	140	140	140	140
	Plt	Cor. Coef.	-,11	-,24**	,22**	1,0
		Sig. (2-tailed)	,18	,00	,00	.
		N	140	140	140	140

**Correlation is significant at the 0.01 level (2-tailed).

4. Discussion

The analysis of our experiences with malaria provides a comprehensive insight into the multifaceted challenges and progress encountered in preventing, diagnosing, and managing this significant infectious disease. Malaria, caused by Plasmodium parasites and transmitted by the Anopheles mosquito, remains a formidable public health concern in endemic regions despite substantial advancements in global control measures. This discussion synthesizes the findings of our study, elucidates the implications for clinical practice, and highlights areas for future research [15].

Epidemiological Trends and Challenges

Our observations align with global epidemiological patterns, demonstrating that malaria disproportionately affects resource-limited settings, particularly in sub-Saharan Africa [16]. The persistence of high incidence rates in these regions underscores the complex interplay of socioeconomic, environmental, and healthcare-related factors that sustain malaria transmission [17]. Precisely, poverty, inadequate access to healthcare, and insufficient public health infrastructure exacerbate the burden of disease. The findings from our study emphasize the need for tailored, community-specific interventions to address these disparities effectively [17].

Additionally, climatic variations and environmental changes, such as deforestation and urbanization, have altered the distribution of mosquito breeding sites, complicating vector control efforts. In our study region, changes in rainfall patterns and temperature fluctuations significantly influenced malaria incidence, indicating the necessity of incorporating climate adaptation strategies into malaria control programs [18].

Diagnostic and Therapeutic Advances

The study highlights considerable progress in diagnostic technologies, particularly the widespread adoption of rapid diagnostic tests (RDTs). These tools have enhanced diagnostic accuracy and accessibility, particularly in remote areas. However, challenges remain, including false-negative results and the limited sensitivity of RDTs in detecting low-level parasitemia [19]. Although considered the gold standard, microscopic examination remains resource-intensive and requires skilled personnel, limiting its applicability in low-resource settings [20].

Therapeutically, artemisinin-based combination therapies (ACTs) have transformed malaria management, significantly reducing mortality and morbidity [21]. Clinical experiences underscore the efficacy of ACTs, though the emergence of artemisinin resistance, particularly in the Greater Mekong Sub region, poses a critical threat to these gains. The study advocates for intensified surveillance of drug resistance patterns and developing novel antimalarial compounds to preempt therapeutic failures [22].

Vector Control Strategies

Our findings reaffirm the efficacy of vector control strategies, particularly insecticide-treated nets (ITNs) and indoor residual spraying (IRS), in reducing malaria transmission. However, operational challenges, including limited coverage, inconsistent usage, and insecticide resistance, threaten the sustainability of these interventions. Our study identified gaps in community adherence to ITN use, often attributed to discomfort, cultural beliefs, and misconceptions about malaria transmission. Educational campaigns tailored to local contexts are imperative to enhance compliance and maximize the impact of vector control measures [23].

Moreover, developing novel vector control tools, such as genetically modified mosquitoes and innovative insecticides, represents a promising frontier in malaria elimination. However, integrating these technologies into existing programs necessitates robust regulatory frameworks, ethical considerations, and community engagement to ensure acceptance and effectiveness [12].

Public Health Interventions and Community Engagement

Effective malaria control involves implementing integrated public health interventions and active community involvement. Our experiences underscore the pivotal role of health education in fostering community awareness about malaria prevention and treatment. As trusted local resources, community health workers have proven instrumental in bridging the gap between healthcare providers and at-risk populations [24].

The study also highlights the importance of strengthening healthcare systems to ensure timely access to diagnostic and therapeutic services. Investments in healthcare infrastructure, workforce training, and supply chain management are critical to sustaining malaria control efforts. Furthermore, partnerships with non-governmental organizations and international agencies have augmented local capacity to combat malaria, demonstrating the value of collaborative approaches in addressing global health challenges [25].

Limitations and Future Directions

While our study provides valuable insights, several limitations warrant consideration. First, the retrospective nature of some data collection methods may have introduced recall bias, potentially affecting the accuracy of reported outcomes.

Additionally, the study's geographic focus limits the generalizability of findings to other malaria-endemic regions with distinct epidemiological and healthcare contexts.

Future research should prioritize longitudinal studies to elucidate the long-term impacts of malaria control interventions and the socioeconomic factors influencing disease dynamics. Integrating advanced data analytics and geospatial mapping could enhance the precision of malaria surveillance and inform targeted interventions. Furthermore, exploring innovative therapeutic and diagnostic approaches, such as point-of-care molecular diagnostics and monoclonal antibody therapies, holds promise for addressing current limitations in malaria management.

5. Conclusion

In conclusion, our experiences with malaria underscore the complexity of controlling this disease amidst evolving epidemiological and operational challenges. While significant progress has been made in reducing the malaria burden through advancements in diagnostics, therapeutics, and vector control, persistent barriers necessitate continued investment in research, healthcare infrastructure, and community-based interventions. By leveraging multi-sectoral collaborations and fostering innovation, we can accelerate progress toward the global goal of malaria elimination, ultimately improving health outcomes for populations most at risk.

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