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FACTORS ASSOCIATED WITH THE MICROSCOPIC ERRORS OF MALARIA IN THE ELIMINATION INTENSIFICATION ZONE IN JAYAWIJAYA REGENCY

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Abstract

Papua has an annual parasite incidence that reaches approximately 300 times the national average, so strengthening data quality, recording, reporting, and laboratory confirmation is a crucial part of the malaria elimination strategy. This study aims to determine the factors associated with the malaria microscopic error rate in the Jayawijaya Regency elimination intensification zone. This study used a quantitative analytical study with a cross-sectional design. The population was all 35 malaria microscopic officers in Jayawijaya Regency, all of whom were sampled or used as a saturation sampling method. Data were collected using questionnaires and observation sheets, then analyzed using the Chi-Square test and the Prevalence Ratio test. The study found that the variables significantly associated with the officer error rate were gender (p-value = 0.005, PR = 3.3, 95% CI (1.46-7.44)) and length of service (p-value = 0.032, PR = 2.78, 95% CI (1.0-7.8). Meanwhile, the variables age, education, training, and workload were not significantly related to the error rate.

Keywords: Error Rate, Microscopic, Malaria

Introduction

Malaria remains an unresolved global health problem, particularly in tropical and subtropical countries. Malaria elimination still faces significant challenges, despite the development of various interventions over the past two decades [(1)]. In the Indonesian context, the challenge of malaria elimination is highly heterogeneous across regions. Papua contributed to an increase in the proportion of national cases from approximately 40% to 90% during that period [(2)]. In the Indonesian context, the challenge of malaria elimination is highly heterogeneous across regions. Papua contributed to an increase in the proportion of national cases from approximately 40% to 90% during that period.

At the operational program level, malaria elimination requires more than just reducing the number of cases; it also requires a robust surveillance system and accurate diagnosis. A study by Fransisca et al. (2025) confirmed that Papua has an annual parasite incidence approximately 300 times the national average, making strengthening data quality, recording, reporting, and laboratory confirmation crucial to the elimination strategy. In the elimination phase, every positive case must be correctly identified, as the diagnosis forms the basis for clinical management, epidemiological investigations, mapping of transmission foci, and program decision-making [(3)].

One highly relevant laboratory quality indicator in this context is the malaria microscopy error rate, which is the proportion of incorrect readings that can occur in the form of false positives or false negatives. In the elimination phase, false negatives risk going undetected, leading to continued transmission without a response, while false positives can lead to misclassification of cases, unnecessary therapy, and distortion of surveillance data. Therefore, the quality of microscopy

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examinations cannot be viewed solely as a laboratory technical issue, but as a strategic factor influencing the validity of malaria elimination program indicators [1],[3].

Jayawijaya Regency is an important context for study because it is located in the Papua region, which faces the challenges of mountainous geography, uneven access to services, and demands for accelerated elimination in a setting with high operational risk. Nelwan's (2025) study emphasized that Papua remains a highly endemic region and requires a more intensive elimination strategy than other regions. In such a situation, the quality of malaria microscopy personnel is crucial, as the accuracy of blood smear readings significantly determines the accuracy of clinical and programmatic decisions at the health facility and district levels [4].

A number of previous studies have indeed provided an important basis regarding malaria in Indonesia, but their focus has not directly addressed the needs of this research [2]. Analyzing the spatial-temporal trends of malaria in Indonesia and successfully showing large disparities between Papua and other regions, but the study is macro in nature and does not assess the quality of microscopic examination at the laboratory personnel level, showed that the quality of surveillance data in Papua could be improved through strengthening recording, feedback, and process improvements, but the study did not consider the microscopic error rate as the primary outcome, and did not examine individual factors of the inspectors. [3]. Another study, more closely related to the issue of microscopy quality, was conducted by Sahli et al. (2024) in a community health center laboratory in Jayapura City. This study emphasized the importance of cross-checking in maintaining the accuracy of malaria microscopic diagnosis and demonstrated that the quality of blood smear readings still needs to be monitored through laboratory quality control mechanisms [5],[2].

Method

This study employed a quantitative analytical approach with a cross-sectional design. The population comprised all 35 malaria microscopists in Jayawijaya Regency, all of whom were sampled using a saturation sampling method. Data were collected using questionnaires and observation sheets, and then analyzed using the Chi-Square test and the Prevalence Ratio test.

Results

1. Univariate analysis

Table 1. Independent variable distribution

No	Variable	Frequency (n)	Percentage (%)
1	**Age**		
	Old Adult	16	45.7
	Young Adults	19	54.3
2	**Gender**		
	Male	14	40
	Female	21	60
3	**Education**		
	High	16	45.7
	Low	19	54.3
4	**Length of Work**		
	New	12	34.2
	A long time	23	65.7
5	**Training**		
	have had training	28	80
	None	7	20

6	Workload		
	Light Workload	22	62.9
	Heavy Workload	13	7.1
7	Error Rate	19	
	Good	16	54.3
	Bad		45.7
	Total	35	100,0

Based on the table above, it is known that most of the respondents are in the young adult group, as many as 19 respondents (54.3%), dominated by women, as many as 21 respondents (60.0%). Based on education level, the majority of respondents have higher education, namely 19 respondents (54.3%), and the majority of respondents have long work experience, namely 23 respondents (65.7%). Based on training history, the majority have attended training as many as 28 respondents (80.0%), light workload is more, namely 22 respondents (62.9%). Meanwhile, based on the error rate, most respondents are in the good category, namely 19 respondents (54.3%).

2. Bivariate Analysis

Table 1. Risk Attribute, Chi-Square Analysis, and Prevalence Ratio

No	Variable	Error Rate				P value	PR	Lower-Upper
		Good		Bad				
		N	%	n	%			
1	**Age**							
	Old Adult	8	50	8	50	0.89	1.19	0.58-2.44
	Young Adult	11	57.9	8	42.1			
2	Gender							
	Female	3	21.4	11	78.6	0.005	3.3	1.46-7.44
	Male	16	76.2	5	23.8			
3	Education							
	High	13	68.4	6	31.6	0.137	1.98	0.92-4.24
	Low	6	37.5	10	62.5			
4	length of work							
	Long time	16	69.6	7	30.4	0.031	2.78	1.0-7.8
	New	3	25	9	75			
5	**Training**							
	have had training	18	64.3	10	35.7	0.032	4.5	0.7- 7.8
	None	1	14.3	6	85.7			
6	Workload							
	Light Workload	15	68.2	7	31.8	0.073	2.2	0.9-5.2
	Heavy Workload	4	30.8	9	69.2			

Based on the table above, it is known that the variables that have a significant relationship with the officer's error rate are gender with a p value = 0.005, PR = 3.3, CI 95% (1.46-7.44), and length of service with a p value = 0.032, PR = 2.78, CI 95% (1.0-7.8). Meanwhile, the variables of age, education, training, and workload are not significant in the results of the microscopic officer error rate.

Discussion

The results of the study showed a significant relationship between gender and the error rate of microscopists (p = 0.005). This indicates that women are approximately three times more likely to experience a positive error than men. This finding suggests that gender is associated with differences in the quality of microscopic examination results. In this study, women appeared to have a higher proportion of positive results (76.2%), which may reflect consistency and accuracy in reading slides. Several previous studies have also shown a tendency for men to work faster but less thoroughly, while women tend to be more careful, resulting in lower error rates. In laboratory work that relies heavily on precision, these differences in work methods can impact examination results. Furthermore, other studies have shown that women may have lower error rates after accounting for occupational and work environment factors [(6)].

However, this difference does not always reflect absolute work quality, because it is also influenced by workload, amount of work, and how the work is assessed [(7)]. Within the framework of service quality, gender is more appropriately viewed as an individual characteristic, not a primary factor directly determining the quality of examination results. Therefore, the results of this study need to be understood within the context of working conditions and staff management in the laboratory. Research Results: The results showed no significant relationship between education level and the error rate of microscopists. This finding suggests that formal education does not always determine the level of accuracy in work. In practice, the ability to understand procedures, accuracy when reading slides, and technical skills play a greater role in influencing errors. This aligns with a 2023 study by Verzosa-Quinto & Mabansag, which found that reading and analytical skills were more influential in determining errors than education level [(8)].

In health services, differences in education do not always have an impact if all officers have a relatively similar understanding of the work [(9)]. This means that as long as officers have a sufficient knowledge base and work within a standardized system, differences in educational level become less noticeable in influencing work outcomes. Nevertheless, education remains important as a foundation for developing competencies. However, its influence will be more optimal if supported by other factors such as work experience, training, and a supportive work environment. [(10,11,12)].

The results showed that the length of service was significantly associated with the error rate of microscopists (p = 0.031). Respondents with longer tenure had a good error rate of 2.46 (95% CI: 1.23–4.96), indicating that officers with longer tenure were at greater risk of experiencing a good error rate than more experienced officers. This finding suggests that work experience plays a role in improving examination accuracy. Officers with longer tenure tend to be more accustomed to recognizing parasite moPRhology, distinguishing artifacts, and consistently following work procedures. Conversely, officers with new tenure are still in the adjustment phase, so the risk of errors remains higher. This aligns with the notion that work experience can improve task understanding, although limitations in experience can be overcome through structured training [(13,14)].

Within the framework of service quality, length of service can be understood as part of the human resource characteristics that support the quality of the inspection process. However, work experience does not stand alone. Other factors such as workload, environmental conditions, and fatigue levels can also influence officer performance. Furthermore, the experience gained must be relevant to the type of work performed to truly impact skill improvement. [(15)]. The results showed that microscopic training was significantly associated with the error rate of microscopic technicians (p = 0.032). An PR value of 4.5 (95% CI: 0.7–7.8) indicates that technicians who have received training have a good chance of experiencing an error rate of 4.5. However, because the lower and upper values encompass one, the result is not significant.

These findings suggest that training plays a crucial role in improving examination accuracy. Through training, technicians can strengthen their ability to recognize parasites, distinguish artifacts, and perform examination procedures more consistently. In situations where practical opportunities are scarce, training is crucial for maintaining skills. These results align with previous research that suggests training can improve technical skills and job readiness, especially in personnel with limited experience. [16,17,13]. Within the framework of service quality, training is a crucial part of efforts to improve human resource quality, which will impact work processes and audit results.

However, training is not the only factor influencing performance. Work experience, supervision, and daily work habits also play a role in shaping staff skills. Furthermore, the effectiveness of training depends heavily on the quality of its implementation and its relevance to job requirements. The results showed that workload was not significantly associated with the error rate of microscopic officers (p = 0.073). A PR value of 2.2 (95% CI: 0.9–5.2) indicated a tendency for a good error rate in the group with a light workload, but this relationship was not statistically significant.

This situation indicates that the workload still has the potential to impact examination accuracy. A high workload can reduce concentration and the time available for careful slide reading. Conversely, a lighter workload allows officers to work more focused. This aligns with research showing that excessive workloads can increase the risk of errors and reduce the quality of performance [18,19]. However, the insignificant results of this study indicate that the effect of workload is not independent. Officers may have been able to adapt to the demands of the job, especially if supported by work experience and established work habits. Under these circumstances, variations in workload do not necessarily directly impact examination results.

Furthermore, the measurement of workload in this study was general, distinguishing only light and heavy. This category does not fully reflect actual working conditions, such as fatigue, work pressure, or distractions during work. These factors may actually have a greater influence on error occurrence [20]. Thus, workload tends to influence error rates, but this has not been statistically proven in this study. Therefore, workload management still needs to be considered through a balanced division of tasks and a good work system to maintain audit quality [21].

Conclusion

1. Age was not significantly associated with the error rate of microscopic officers (p-value = 0.89, PR = 1.1, 95% CI (0.58-2.44).
2. Gender was significantly associated with the error rate of microscopic officers (p-value = 0.005, PR = 3.3, 95% CI (1.46-7.44).
3. Education was not significantly associated with the error rate of microscopic officers (p-value = 0.137, PR = 1.98, 95% CI (1.0-7.8).
4. Length of service was significantly associated with the error rate of microscopic officers with a P value of 0.031, PR = 2.78, 95% CI (1-7.8).
5. Training was significantly associated with the error rate of microscopic officers, with a P value of 0.032, PR = 4.5, 95% CI (0.7-7.8).
6. Workload was not significantly associated with the error rate of microscopic officers with a P value of 0.073, PR = 2.2, 95% CI (0.9-5.2).

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