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Trends in Malaria Testing and Positivity Rates by Age Group in Mimika Regency, Indonesia, 2020–2025

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Abstract

Malaria remains a major public health problem in high-endemic areas such as Mimika Regency, Indonesia. Increasing examination coverage is a key strategy for accelerating malaria elimination; however, analyzing its impact on positivity rates (PR) and case distribution by age group is essential. This study aims to analyze malaria testing trends, positivity rates, and case distribution by age group in Mimika Regency from 2020 to 2025. A descriptive observational study with an analytical approach was conducted using secondary data from the malaria program (2020–2025). Analysis included calculation of positivity rate (PR), risk ratio (RR), and distribution of case proportions by age group, with proportional comparison tested using chi-square. The number of malaria tests increased from 189,243 (2020) to 1,191,218 (2025), while the positivity rate decreased from 41.1% to 15.6%. Microscopy showed a higher PR (31.2%) than rapid diagnostic tests (9.2%) with an RR of 3.39. Case distribution was dominated by the 15–64 years age group (65%), followed by children aged 1–14 years (32%), with statistically significant differences between age groups ($p<0.05$). In conclusion, increased testing coverage contributed significantly to the decline in positivity rate. However, the high number of cases in the productive age and the number of cases in children indicate that malaria transmission is still actively ongoing both outside the home and in the household. Risk-based and age-group interventions are needed to accelerate malaria elimination.

INTRODUCTION

Malaria is still one of the significant global public health problems, especially in tropical and subtropical regions. The disease is caused by the Plasmodium parasite transmitted through the bite of the Anopheles mosquito, with the main species contributing to the disease burden being Plasmodium falciparum and Plasmodium vivax (Sitohang *et al.* 2018). Despite various interventions that have been carried out globally, malaria remains a cause of high morbidity and mortality in many developing countries, including Indonesia (Kenangalem *et al.* 2019; Dini *et al.* 2020; Sankineni *et al.* 2023; Tobing *et al.* 2024; Herdiana *et al.* 2025).

Indonesia is one of the countries with a fairly high burden of malaria, especially in the eastern region such as Papua. Mimika Regency as one of the high endemic areas shows complex malaria epidemiological characteristics, influenced by environmental factors, population mobility, economic activity, and access to health services. Diverse geographical and

socioeconomic conditions contribute to the sustainability of malaria transmission in this region (De Silva dan Marshall 2012; Kagaba Amina 2024; Villena *et al.* 2024).

In an effort to accelerate malaria elimination, the main strategy implemented is to massively increase the coverage of testing, both through health facilities and community-based approaches through the "TEMPO KAS Tuntas" innovation. This approach aims to improve the early detection of cases, including asymptomatic cases, so that they can be treated immediately and break the chain of transmission. One of the important indicators in evaluating the success of this strategy is the positivity rate (PR), which is the proportion of positive cases compared to the number of examinations.

A decrease in the positivity rate is often used as an indicator of the success of malaria control programs. Nevertheless, an increase in the number of examinations can also affect the interpretation of such indicators, especially in the context of mass screening that includes low-risk populations. Therefore, a comprehensive analysis is needed to understand the relationship between screening coverage, positivity rate, and malaria transmission dynamics (Lindblade et al., 2013; Noor et al., 2014; Weiss et al., 2019).

In addition, the distribution of cases by age group is an important aspect of malaria epidemiology. The difference in the proportion of cases between age groups can provide an overview of transmission patterns, whether it is more dominant outside the home (outdoor transmission) or within the household environment (indoor transmission). Productive age groups are often associated with exposure to the work environment, while high cases in children may indicate active local transmission.

Several studies have examined the relationship between screening coverage, positivity rates, and distribution of malaria cases by age. Cotter et al. (2013) in a study on the epidemiology of malaria elimination showed that areas with high transmission tend to have an even distribution of cases across all age groups, whereas in areas with decreased transmission, cases are often concentrated in specific groups. Stresman (2010) reported that the analysis of age distribution can be an indirect indicator of the intensity of malaria transmission in an area. Bousema et al. (2014) emphasize the importance of detecting asymptomatic cases in elimination efforts, as this group can become a reservoir of unwitting transmission. Smith et al. (2007) developed a standard for estimating malaria transmission rates and showed that the positivity rate is closely correlated with the rate of transmission in the community. In Indonesia, a study by the Ministry of Health (2022) shows that Papua is among the regions with the highest positivity rate, but an integrated study that analyzes examination trends, positivity rates, and age distribution in Mimika Regency simultaneously is still limited. Research by Alegana et al. (2020) also confirms that estimating populations at risk of malaria requires an age- and location-specific approach. Thus, this study is here to fill this gap by analyzing the trend of malaria examinations, positivity rates, and case distribution by age group in Mimika Regency for the 2020–2025 period.

Some previous studies have shown that regions with high transmission tend to have a more even distribution of cases across all age groups, whereas in regions with decreased transmission, cases are often concentrated in specific groups. Therefore, the analysis of age distribution can be an indirect indicator of the intensity of malaria transmission in an area. Mimika Regency in recent years has shown a significant increase in the coverage of malaria screening, accompanied by a change in the pattern of the positivity rate. However, studies that

integrate analysis of the number of tests, positivity rates, and case distribution by age group are still limited. This information is critical to evaluating the effectiveness of the program and determining more targeted intervention strategies.

Based on this background, this study aims to analyze the trend of malaria examinations, positivity rates, and case distribution by age group in Mimika Regency for the 2020–2025 period. The results of this study are expected to contribute to strengthening policies and strategies to accelerate malaria elimination, especially in high-endemic areas.

RESEARCH METHODS

Study Design

This study used an analytical descriptive observational design with a cross-sectional approach based on program data.

Data Source

The data used is secondary data from the Mimika Regency malaria program report for the period January 2020-December 2025, including:

1. Number of malaria screenings
2. Number of positive cases
3. Types of examination (microscope and RDT)
4. Distribution of cases by age group

Research Variables

1. Variable dependen:
a. Malaria status (positive/negative)
2. Independent variable:
a. Types of inspections
b. Age group
3. Variable Turunan:
a. Positivity Rate (PR)
b. Risk Ratio (RR)

Operational Definition

1. Positivity Rate (PR): the proportion of positive cases compared to the number of tests (%)
2. Risk Ratio (RR): comparison of the risk of malaria incidence between groups
3. Age group: categorized into 0–11 months, 1–4 years, 5–9 years, 10–14 years, 15–64 years, and >64 years

Data Analysis

1. Descriptive analysis:
    a. Frequency and proportion distribution
    b. Inspection and PR trends
2. Inferential analysis:
    a. Chi-square test to see the difference in proportions between age groups
    b. Risk Ratio (RR) calculation to compare risks between groups
3. Epidemiological interpretation:
    a. Analysis of transmission patterns based on age distribution
    b. Identification of high-risk groups

Analysis Tools

The analysis was carried out quantitatively using basic epidemiological approaches and statistical interpretation of public health programs.

RESULTS AND DISCUSSION

1. Increased Screening and Decreased Positivity Rate

The results showed a significant increase in the number of malaria examinations by more than six times during the period 2020–2025, which was followed by a decrease in the positivity rate by 62%. These findings indicate that the massive testing strategy plays an important role in increasing case detection, including asymptomatic cases.

The decrease in PR reflects:

a. Increasing coverage of population screening
b. Decrease in transmission intensity
c. Surveillance system improvements

However, PRs that are still above 10% indicate that this region has not yet reached the elimination phase, where generally PR is <5%.

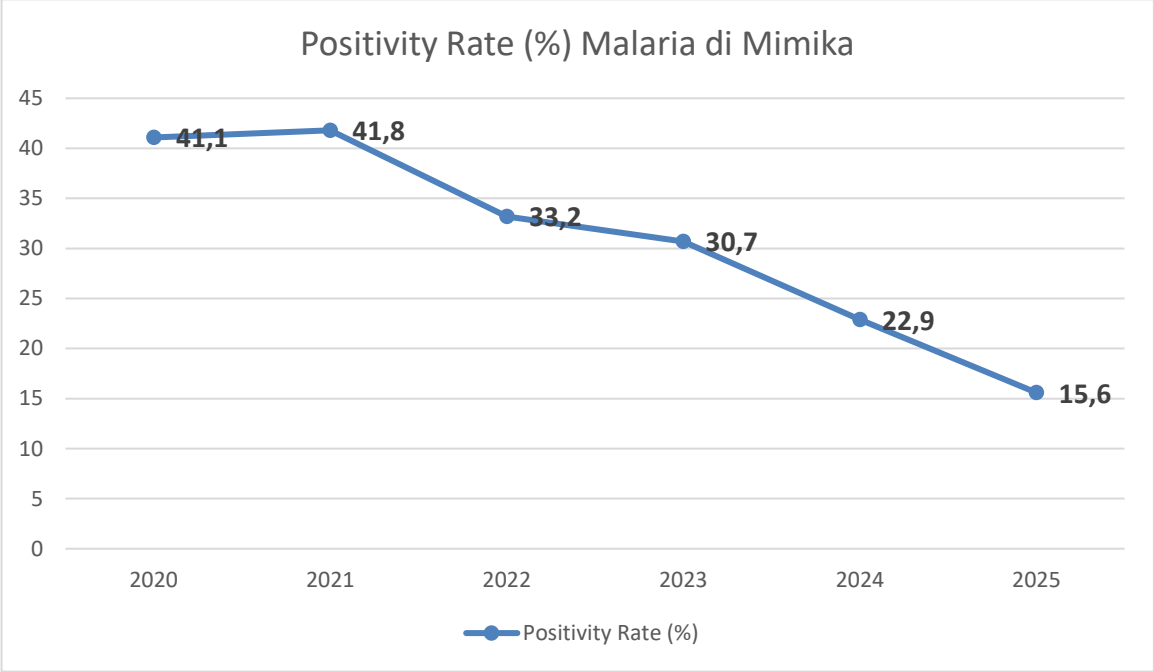

Figure 1. Trend of Declining Malaria Positivity Rate in Mimika Regency, 2020-2025
(Data Source: Tempo Cash Tuntas Innovation Report-Mimika Health Office, 2025)

In figure 1. shows a decrease in the Malaria Positivity Rate in Mimika Regency since 2020-2025 since it means reducing the burden of malaria transmission in the population.

2. Differences in Types of Examinations and Diagnostic Implications

Examination using a microscope showed a much higher PR than RDT (31.2% vs 9.2%; RR=3.39). This is likely due to diagnostic selection bias, where microscopes are more often used in patients with more pronounced or severe clinical symptoms.

In contrast, RDT is used in mass screening so that it includes populations with a lower probability of disease. These findings underscore the importance of:

a. Combination of diagnostic methods
b. Strengthening the quality of microscopic diagnosis
c. Community-based screening strategy

3. Distribution of Cases by Age Group

The distribution of cases is predominantly in the 15–64 age group (65%), indicating that malaria in this region is closely related to productive activities, such as outdoor exposure.

However, the proportion of cases in children (32%) indicates that local transmission in the household environment is still occurring. This condition leads to a mixed transmission pattern, namely:

a. Outdoor transmission at productive age
b. Indoor/household transmission in children

These findings are in line with the characteristics of high endemic areas, where environmental factors, population mobility, and vector density play a major role.

Table 1. Distribution of Malaria Cases by Age Group

Age Group	Percentage (%)
0 – 11 Months	2
1 – 4 Years	10
5 – 9 Years	12
10 – 14 Years	10
15 – 64 Years	65
>64 years old	1

(Data Source: Tempo Cash Tuntas Innovation Report-Mimika Health Office, 2025)

Data in Table 1. It shows the highest burden of malaria (65%) in the age group of 15-64 years but 32% of malaria cases are found in children < 5 years old, which indicates that there has been transmission or outdoor exposure, while in children <5 years old, potential exposure occurs in households (indoor exposure).

4. Epidemiological and Program Implications

These results have several important implications:

a. Intervention Targets
    1) Productive age: individual protection (repellent, mosquito net, job education)
    2) Children: household protection (mosquito nets, IRS)
b. Elimination Strategy
    1) Peningkatan active case detection
    2) Focus handling (hotspot) with high PR
    3) Strengthening region-based surveillance
c. Parasite Control

The predominance of Plasmodium falciparum and Plasmodium vivax indicates the need to:

1) Appropriate and complete treatment
2) Prevention of relapse in P. vivax

5. Study Limitations

a. Using the program's secondary data (potential recording bias)
b. No individual analysis available (e.g. specific risk factors)
c. No multivariate test

6. Implications of Advanced Research

Further research is needed:

a. Spatial analysis (malaria hotspots)
b. Study cohort factor risk
c. Evaluation of the effectiveness of specific interventions

CONCLUSION

The increase in malaria screening coverage in Mimika Regency during the 2020–2025 period has been proven to contribute significantly to the decrease in the positivity rate, which shows improvements in case detection and strengthening of the surveillance system. However, the relatively high positivity rate indicates that malaria transmission is not yet fully controlled and the region is still in the endemic phase towards elimination. The distribution of cases dominated by the productive age group (15–64 years) shows that malaria transmission occurs mostly due to outdoor activities, while the high proportion of cases in children indicates transmission in the household environment. This pattern illustrates the presence of mixed transmission (outdoor and indoor) which is a challenge in malaria control efforts. Thus, accelerating malaria elimination in Mimika Regency requires a more targeted intervention strategy based on risk groups and transmission characteristics, including strengthening active detection, protection of individuals of productive age, and household-based interventions to protect children, in order to break the chain of transmission more effectively.

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