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Research Article

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Prevalence of Malaria and Risk Factors Among Residents in Rundu District, Kavango East Region

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Abstract

Despite efforts to eliminate local transmission, Rundu district faces fluctuating cases, necessitating a deeper understanding. Malaria persists as a significant global health challenge, especially in areas like Namibia, Kavango East Region. This study examined malaria prevalence and risk factors in Rundu District from 2017 to 2021, aiming to inform targeted interventions for sustained progress in elimination efforts. Using malaria case investigation forms from Rundu District Health Information System (2017-2021), a descriptive, analytical study was conducted. Data were extracted, cleaned, and analyzed using SPSS software. Descriptive statistics assessed malaria prevalence trends and associated factors, including demographics, seasonality, and travel impacts.

Prevalence peaked seasonally from January to April, with mixed infections (60.8%) predominating. Malaria prevalence was 7.4%, with higher susceptibility among males (50.8%) and children aged 5-14 (39.7%). Unemployment correlated with a 90.0% prevalence. Suboptimal preventive measures like home spraying and bed net usage were observed. Malaria transmission in Rundu district is complex, demanding targeted interventions for high-risk groups like males and children. Socioeconomic factors, notably unemployment, contribute to higher prevalence rates, emphasizing the need for addressing social determinants of health. Adaptable prevention and treatment strategies, coupled with improved preventive measures, are essential for reducing the malaria burden and improving public health outcomes in the region.

Keywords: Mosquito, Malaria, transmission, Prevalence, Health

Introduction and Background

Malaria, a vector-borne disease caused by Plasmodium parasites and transmitted through the bite of infected Anopheles mosquitoes, remains a significant public health concern worldwide [1]. In Southern Africa, Namibia has made remarkable progress in reducing malaria, demonstrating a strong commitment to malaria elimination through the implementation of comprehensive strategies [2]. These strategies include surveillance, rapid diagnostic tests, artemisinin-based combination therapy, indoor residual spraying, and the distribution and utilization of long-lasting insecticide-treated bed nets [3]. Namibia's goal to eliminate local malaria cases by 2022 underscores its dedication to eliminating endemic malaria transmission, contributing to the global fight against this disease. However, despite these commendable efforts, the persistence of malaria transmission, varying from year to year, remains a cause for concern, as the target is to eliminate local malaria cases to zero [2].

Research in Africa have highlighted the dynamic nature of malaria prevalence, which fluctuates yearly and seasonally [4-6]. They have also identified a range of significant risk factors contributing to malaria prevalence. These factors encompass socio-demographic

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elements such as age, gender, occupation, and place of residence, as well as healthcare accessibility [7,8]. Additionally, population mobility, which includes travel patterns that can introduce or spread malaria cases, plays a pivotal role [9]. Furthermore, shortcomings in vector control measures, characterized by low utilization rates of Long-Lasting Insecticide Treated Nets (LLINs) and Indoor Residual Spraying Programs (IRSPs), have been identified as significant contributors to malaria transmission. Environmental factors also factor into the equation [4-6,10].

Studies in Africa identified higher malaria prevalence among males, possibly due to their outdoor activities, exposure to mosquito bites, and outdoor play among male children. Additionally, Age has been associated with a higher likelihood of testing positive for malaria, while rural residence increases the odds of malaria compared to urban areas. Employment status has shown a significant impact, with employed and self-employed individuals having a lower likelihood of testing positive for malaria compared to the unemployed [11,12].

Existing literature emphasizes the importance of ongoing surveillance of malaria prevalence and identification of the risk factors in elimination settings. This approach helps evaluate the effectiveness of existing interventions, target interventions, and inform evidence-based decision-making [13]. However, there is a notable research gap in this area within Namibia particularly in the high-transmission area of Rundu district since the implementation of the National Malaria Elimination Strategic Plan (NMESP) of 2017-2022. Research on malaria prevalence and associated risk factors are not documented.

Therefore, the research assessed the prevalence of malaria and identified associated risk factors among Rundu district residents, Namibia, from 2017 to 2021. The findings contributed to a better understanding of the then-current malaria prevalence, helped in identifying risk factors in the district, and informed evidence-based strategies for malaria elimination, ultimately advancing the goal of better malaria control in Namibia, Southern Africa, and beyond.

Background of the Study

Malaria remains a public health problem in Africa and other countries of sub-tropical. In 2021, an estimated 247 million malaria cases and 619 000 deaths were reported in 85 endemic countries, reflecting an increase from 245 million cases in 2020 [14]. The World Health Organization (WHO) African Region carries a high share of the global malaria burden. In 2021, the region was home to 95% of malaria cases [14].

The World Health Organization emphasizes the importance of customizing interventions for malaria based on its occurrence concerning individuals, locations, and timing, particularly in elimination settings. Malaria cases cluster in specific areas, among vulnerable populations, and during specific periods, making it crucial to understand prevalence's distribution [15]. Furthermore, in Namibia, demographic factors, including age, gender, and occupation, also impact malaria cases in both rural and urban settings, further necessitating knowledge of prevalence [13]. Understanding malaria prevalence and associated risk factors is imperative for effective targeted interventions.

Namibia has experienced fluctuations in malaria prevalence from year to year, as evidenced by reported cases over recent years. In 2017, a total of 66,141 cases were reported, followed by 36,451 cases in 2018, 3,404 cases in 2019, 13,606 cases in 2020, and 11,847 cases in 2022. Notably, during January to June 2023, a total of 11,677 cases have been reported [3,16,17]. These fluctuations underscore the ongoing challenge of malaria transmission control [3]. Notably, Kavango East region, where Rundu district is located, was the second region with high malaria cases in Namibia, with a total of 5763 local cases and 15 deaths in 2020 [18]. This represents a 42% of the total country wide cases of 2020 which is concerning. Another statistics revealed that, between January and June 2023, the region reported 902 malaria cases [19].

Within the boundaries of the Kavango East region, the Rundu district itself faced its own set of challenges. In the year 2020, Rundu district reported 1146 local malaria cases and 5 deaths, representing a 20% of the total regional cases. However, there were some improvements in 2021 when the district reported 322 local cases and 2 deaths [20]. Yet, despite these efforts, the district still encountered obstacles as indicated by the 223 local cases reported from January to June 2023, falling short of the 2022 elimination target [21].

Namibia is stratified into three malaria zones, high transmission zone, low transmission zone and Malaria free zone. The Region under study (Kavango East and West region) is in high transmission zone [15]. Malaria transmission in Namibia is higher in the north-eastern regions with a seasonal peak transmission in March to May; this is influenced by rainfall, temperature, and humidity [2]. In addition, Malaria is also associated with risk factors such as sex, age, occupation, low Indoor Residual Spray (IRS) coverage and low net coverage and net use [22]. Population movement across the border to areas of high malaria transmission results in the importation of infections which easily contributes to the continued transmission of malaria, while decreased IRS and net coverage also contribute to the maintenance of transmission pockets [23].

Due to the reduced transmission, all people in malaria zones area are at risk of getting malaria; the higher risk groups include children <5 years old, pregnant women and nomadic populations [3]. Plasmodium falciparum is the dominant malaria parasite species in Namibia, which is responsible for 97% of malaria cases, and 3% is predominantly due to other species [3]. In Namibia, Anopheles Arabiensis is the primary malaria vector, whereas Anopheles gambaiae is the secondary vector [3].

To combat malaria, Namibia has implemented its National Malaria Strategic Plan of 2017-2022, with the aim of eliminating local malaria cases to zero by 2022. This plan involves comprehensive interventions, including case management, surveillance, vector control, social and behavioral change communication, and program management [2].

Despite the implementation of the above-mentioned elimination interventions, the country still experiences epidemics, local malaria transmission and case fatalities, hindering the progress towards elimination [3]. This suggested that a continuous study of the status of malaria prevalence and its associated risk factors in Rundu district was important to enable the development and implementation of evidence-based malaria elimination strategies. Therefore, this study aimed to assess the prevalence of malaria and risk factors among the residents of Rundu district from 2017 to 2021.

Problem Statement

In Kavango East Region, malaria persists despite elimination efforts. Malaria prevalence displays annual fluctuations, with cases reaching 6,487 in 2020, dropping to 1,760 in 2021, and persisted in 2022, with 902 cases in the first half of 2023, [24-26]. This pattern underscores the challenges in achieving sustained malaria elimination of zero local case, as cases fluctuate annually.

Research in Africa has highlighted that malaria prevalence and transmission is influenced by socio-demographic factors, population mobility, healthcare accessibility, low utilization of Long-Lasting Insecticide nets and Indoor Residual Spraying globally [27]. Despite literature emphasizing the importance of ongoing surveillance and the identification of risk factors, a substantial research gap exists within Namibia, specifically in the high-transmission area of the Rundu district. Since the initiation of the National Malaria Elimination Strategic Plan of 2017-2022, research on malaria prevalence and associated risk factors remain undocumented. Given these circumstances, there was an urgent need for a study to assess malaria prevalence and its associated risk factors in Namibia, specifically the Rundu district. Such research was crucial for gaining insights into the underlying risk factors of these fluctuations, identifying persistent transmission areas, at risk person, and guide targeted interventions to achieve the longstanding goal of zero local malaria cases.

Purpose of the Study

The aim of the study was to assess malaria prevalence and associated risk factors among residence of Rundu district, Kavango East Region, Namibia.

Objectives of the Study

a) To establish the prevalence of malaria among Rundu district residents, Kavango East Region, from 2017- 2021.

b) To identify the risk factors associated with malaria prevalence in a confirmed malaria case, Rundu district Kavango East Region, from 2017-2021.

c) To analyze the malaria prevalence and associated risk factors in Rundu district, Kavango East Region, from 2017-2021.

Significance of the Study

The study aimed to provide scientific evidence of current knowledge on malaria prevalence and risk factors associated with malaria during elimination phase. The findings of the study can be generalized and results such as the risk factors associated with malaria in Rundu district can be used to minimize and control the fluctuations of cases in the regions. Additionally, the study may enable the health sector to develop and implement scientifically based interventions, targeting key risk factors associated with malaria prevalence in different communities, especially high transmission zones such as Rundu district. This will then catalyze the achievement of the longstanding goal of zero local malaria cases.

Research Methodology

Study Design

This study was a retrospective descriptive, analytical study. The study was conducted to determine the 5 years' period (2017-2021) malaria prevalence and identify the risk factors associated with a confirmed case of malaria in Rundu district, Kavango East Region. Case investigation forms of malaria cases confirmed with rapid diagnostic test or microscopy and recorded on the Rundu District Health Information System from 2017 to 2021 were used.

Study Site

Namibia is stratified into three malaria zones, high transmission zone (>1 case per 1000 population), low transmission zone (0-1 case per 1000 population) and Malaria free zone (0 cases). The area under study, Rundu district in Kavango East region is in high transmission zone [28]. Malaria transmission is seasonal with peaks between December and April and is highly dependent on rainfall patterns [29]. The region borders Angola, a country with significantly higher transmission gradients [29]. Rundu district is the largest district in the region, with a population of 105766 people [30]. The district has one district hospital, one health center and 11 clinics. Rundu has a hot-semi-arid climate and records high rainfall of 568mm per year [31-35].

Study Population

The study population were the inhabitants of Rundu district during the study period of 2017 to 2021.

The study comprised of all malaria case investigation forms that were captured into the Rundu district health information surveillance system between 2017 and 2021. The study excluded all malaria case investigation forms that were not entered into the DHIS 2 surveillance system between 2017 and 2021.

a) Malaria diagnosed outside of the specified time frame (before 2017 or after 2021).

b) Malaria cases which were diagnosed outside the geographical boundaries of the Rundu district.

Sample Size and Sampling Procedure

All malaria case investigation forms recorded in Rundu district DHIS2 surveillance System, which met the inclusion criteria were included in the study. A request was made to the hospital management for all malaria case investigation forms to be made available for study purposes.

Data Collection Method and Procedure

After obtaining ethical clearance, the researcher commenced the data collection process in February 2024. During this phase, data from reported case investigation forms that had been entered into the District Health Information System of Rundu district, Kavango East region, from 2017 to 2021, were extracted. All the variables on the data extraction tools were retrieved from the DHIS2 System, saved, and downloaded into Microsoft Excel.

Statistical Analysis

Data were retrieved electronically from DHIS2 and saved on excel spreadsheets for cleaning, verification, and coding. The data were then imported into SPSS version 27, (statistical package for social science) software for further analysis. SPSS was used to analyze the frequencies, proportions, and associations to explain the study participants and to show the malaria prevalence in the study area. Logit regression was run to assess association between socio-demographic (age, gender, location, occupation, and malaria prevalence). Odds ratio with the corresponding 95% Confidence Interval (CI) were used to determine the strength of association between dependent (malaria prevalence) and independent variables (age, gender, occupation, utilization of a mosquito net and spraying the house). Associations were considered as significant only if the P value was less than 0.05.

The variables extracted included time of illness (malaria cases per year from 2017-2021, malaria cases per month from January -December), health facility, age, gender, village, current occupation, and case classification (local or non-local case), history of travelling, malaria treatment given to the positive cases, houses sprayed with IRS within 6 months, availability of bed nets, sleeping under bed nets for the last 3 nights. Summary descriptive analysis of the data with frequencies, averages, rates, proportions, and percentages will be done. Tables, charts, and graphs will be used to present the data.

In determining the proportion of confirmed malaria cases for all ages from 2017 to 2021, malaria morbidity was grouped into under five years, five to 14 years old, 15 to 24 and 25 years old and above. Estimation of the relative frequencies or proportions for each age category was done by expressing the number of malaria cases for each age-group divided by the total confirmed cases.

The frequencies, proportions, and percentage of male and females who had malaria were calculated. The cases were also categorized according to occupation. This analysis was conducted to draw conclusions on the most affected age group and whether gender and occupation played a role in the risk of getting malaria. Malaria cases were also classified according to place, health facility and local or non-local origin. This was done to show the hot spot areas, clinics/health centers, and whether the cases are local or non-local. Data were also analyzed to show trends of malaria from 2017 to 2021. Risk factors will also be determined using information of utilization of Indoor Residual Spraying, Insecticide treated nets, and history of traveling.

Ethical Considerations

The study commenced after approvals and permissions were granted from all the relevant institutions, which included University of Namibia, Ministry of Health, and Social Services at national and regional level. The researcher ensured that the identities of the patients were protected. The researcher did not include the respondents' names and identification numbers. To achieve confidentiality, the collected data were stored in a personal computer that was not shared and with a password that was not known by any other persons. The researcher made sure that the district and people in the community benefited from the results of the research. The researcher shared the findings and recommendations of the research with the district.

Results

Demographic and Socio-Economic Information

A presentation of participants' gender, age and employment status is displayed in this section. This is to show how malaria infections are distributed based on these variables. Gender data revealed the most infected, age data revealed the most vulnerable age group while employment status data revealed the relationship between socio-economic status and malaria infection.

Malaria Infection in Relation to Gender

According to the record review from 2017 to 2021 in Rundu district, at least 1.7% more males were positively infected by malaria than females. Out of a total 14 805 positive patients 7528 were males and 7266 were females and 11 were unspecified (Figure 1).

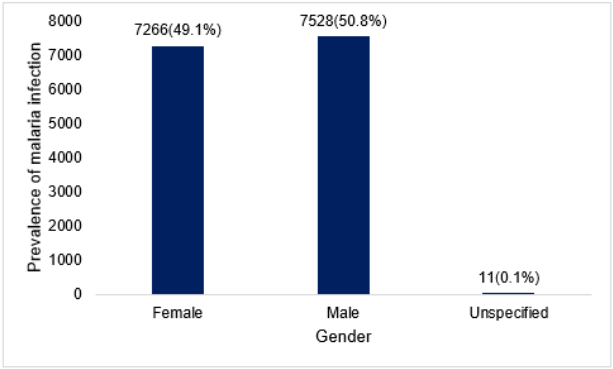

Figure 1: Prevalence of malaria infection in per gender.

The infections rates among males were 50.8% and females were 49.1%, 0.1% were unspecified as shown in Figure 1 above.

Malaria Infections in Relation to Age Groups

The age range was 0 to 99 years. As shown in Figure 2 above, the age-specific prevalence rate of malaria infections was 1923 (13%) for the age group less than five (<5) years old, 5880 (39.7%) for the age group between 5 - 14 years old, 3211 (21.7%) for the age group between 15-24 years old and 3791 (25.6%) for the age group 25 and above (Figure 2).

Although malaria infections were reported in all age groups, the most vulnerable age group within the district was that of individuals between the age of 5 - 14 years old with the highest score of 39.7%.

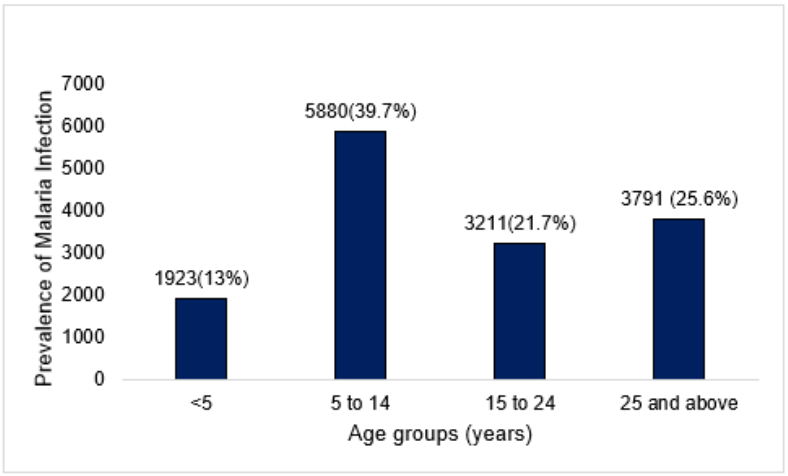

Figure 2: Prevalence of Malaria infection per age group.

Malaria Infections in Relation to Employment Status

As depicted in Figure 3, employment status prevalence rate of malaria for employed individuals was 1335 (9.0%), were as a 1% was recorded for individuals who did not disclose their employment status (Figure 3).

Majority of those who were reported to be positive with malaria infections within the district of Rundu were unemployed people with a 90% rate, representing 13324 individuals.

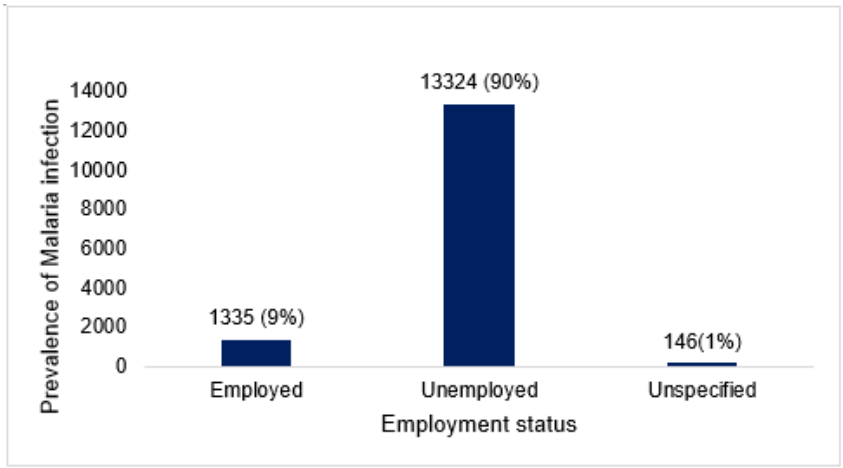

Figure 3: Malaria infections per employment status.

Malaria Prevalence in Rundu district

The result shows the number of confirmed malaria cases were 14 805 (refer to Figure 1) out of 198 807 suspected cases, proving an overall prevalence rate of 7.4 % over the five -year period. Based on data depicted in Figure 4, In 2017, the prevalence rate of malaria was 54 per 1000 population (Figure 4).

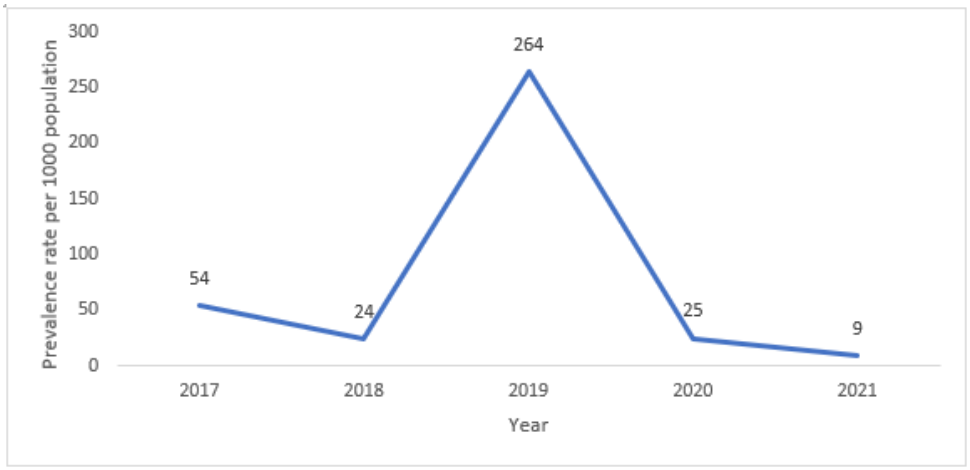

Figure 4: Annual malaria prevalence per 1000 population.

By 2018, there was a decrease in the prevalence rate to 24 per 1000 population. However, in 2019, the prevalence rate sharply rose to 264 per 1000 population, the trend reversed in 2020, with the prevalence rate dropping to 25 per 1000 population. This declining trend continued into 2021, as the prevalence rate further decreased to 9 per 1000 population, indicating a continued decline in malaria cases over recent years in Rundu district.

Annual Trends of Malaria Infection Prevalence

Out of 198807 suspected cases which were tested in Rundu district from 2017 to 2021, 14805 (7.4%) were confirmed as malaria positive with the Rapid Diagnostic Test (RDT). The investigation revealed that there were fluctuating trends of malaria during the five years' period in review (Figure 5).

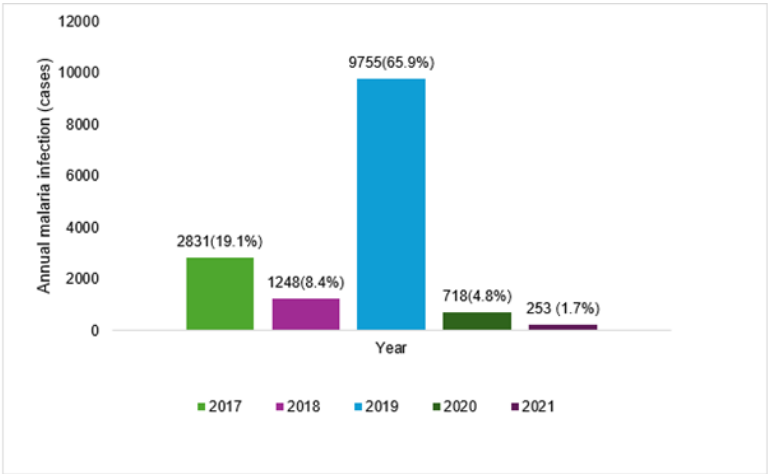

Figure 5: Malaria infections annual trends per year.

According to Figure 5, a minimum of 253 (1.7%) confirmed malaria positive cases were reported in 2021 and the maximum was 9755 in 2019 representing a 65.9% of confirmed malaria positive cases reported in Rundu district. Furthermore, the data indicated that malaria prevalence rate decreased from 19.1% in 2017 to 8.4% in 2018, but the infection increased to 65.9% in 2019 and decreased again to 4.8% in 2020 and further decrease of 1.7% in 2021.

Seasonal Variation of Malaria Infection

As depicted in Figure 6, a fluctuation in malaria cases per month per year were observed. Interestingly, a trend of cases peaking up every first five (5) months each year was also observed. Year on year, the trend for 2017 is similar to that of 2018, 2020 and 2021 making 2019 a unique year based on overall data trend (Figure 6).

Surprisingly, in 2019 only, the district experienced two peaks, at the beginning of the year between January and April and mid-year between July and September. It was also observed that the number of cases exceeded a 1000 mark for the first time, this was between December 2018 and February 2019, with January yielding the highest number of cases for the period under investigation. However, the district has successfully kept the cases below 1000 from May 2019 to December, 2021. Overall, the minimum numbers of malaria cases recorded were during the months of November to December each year.

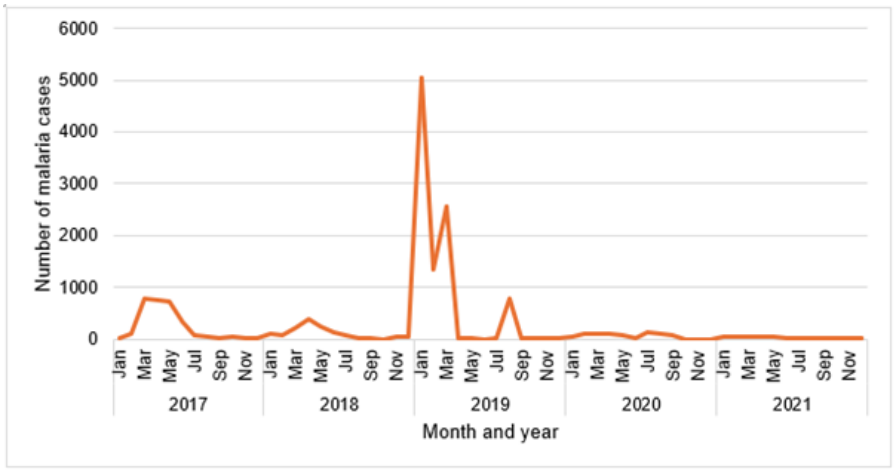

Figure 6: Malaria cases per month per year.

Factors Influencing the Transmission of Malaria

This section presents the study's outcome of factors that influenced malaria infections in the district of Rundu. The factors included, travelling, which revealed if the patient tested positive post four weeks outside the country. Other factors were to determine if the household has been sprayed within 12 months, if the patient owns a bed net and if the patient slept in a mosquito net three days prior to being tested positive of malaria infection.

Conclusion

In this study, the researcher presented the results of the data collected from the District Health Information Software version 2 for Rundu district. Using SPSS, the trends in malaria prevalence and associated risk factors among residents of Rundu district were identified. The analysis revealed that, at least 50% of participants who tested positive for malaria in the district between 2017 and 2021 were male. The most affected age group was for participants between the age of 5 to 14 years. In addition, the analysis found that malaria prevalence in Rundu district has been declining since 2019 and 55% of participants did not own a mosquito net. The analysis concluded with an investigation on malaria distribution in relation to age groups of participants who hand their houses sprayed in the past 12 months. It was found that 41.63% for the age group 5 - 14 years who tested positive actually had their houses sprayed with mosquito insecticide in the past 12 months, this statistic was similar in the same age group but for those whose households were not sprayed.

Several significant patterns in malaria transmission and prevalence were revealed after data analysis. The study findings indicated a downward sloping of malaria prevalence since 2019, while risk factors such as seasons, age and ownership of a mosquito net were found to be highly associated with malaria prevalence in the district. Furthermore, a relationship between positive cases and those who either had or did not offer their households to be sprayed in the past 12 months during the collection of the data was established. To add on, the significance of these findings lies in its provide vital information regarding malaria prevalence in Namibia, especially in Rundu district.

This study has shown that malaria prevalence in Rundu district, Namibia, has been fluctuating over time and the trend will likely continue in the upcoming years. It was then concluded that these fluctuations are influenced by seasonal and environmental factors such as warm to hot weather and savannah habitant. These variations underline the nature of malaria transmission and the need for adaptable control measures to effectively eliminate the disease. Additionally, the study found that, Rundu demographic factors played a significant role in malaria susceptibility, with males and children aged 5 to 14 years exhibiting higher vulnerability to infections compared to females and other age groups, respectively. It can then be concluded that men as providers of the family are more likely to stay outside until late getting exposed to mosquito whereby children's between 5 - 14 years are exposed to mosquito in the early morning preparing to go to school. Also, these children are still minors and might not understand measures to take to protect themselves against malaria, leaving them exposed and vulnerable to the disease. Nonetheless, understanding these demographic patterns is important for targeting tailored interventions and allocating resources effectively.

Furthermore, a key takeaway is the association between malaria prevalence and employment status which shows the socioeconomic determinants of health. The findings highlighted that, unemployed individuals had a higher prevalence rate of malaria, suggesting a potential link between unemployment, living conditions, and exposure risks. The study then concludes that, a lack of income which is related to employment, increases individuals' exposure to health hazards such as anopheles' species. To add on, these individuals are more likely to miss out from any health activities or awareness as they are usually at home or engaging into agricultural activities, isolating themselves from the general population. This increases their

exposure rate to malaria. In light of these findings, addressing these socioeconomic factors is essential for reducing malaria transmission and improving overall public health outcomes.

Acknowledgement

None.

Conflict of Interest

None.

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