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Assessment of Malaria Incidence and Associated Risk factor among Children Aged 1-15 Years in Specialist Hospital, Jimeta-Yola.

[1]Samuel Danley and [2]Elizabeth Oluwatosin Olugbami
[1*]Sociocapital Impact Group. No.4 Natasha Akpoti Street, Kado Abuja Nigeria.
[2]Modibbo Adama University Yola, Along Yola-Mubi Road, Adamawa State. Nigeria
*Email: Sammyvimeh@gmail.com

ABSTRACT
This study aims to assess the incidence of malaria and associated risk factors among children aged 1-15 years attending Specialist Hospital Jimeta-Yola, Adamawa State, Nigeria. Utilizing a cross-sectional study design, data were collected from 188 pediatric patients through structured questionnaires, venipuncture blood samples for malaria diagnosis, and packed cell volume (PCV) assessments. Key socio-demographic, environmental, and behavioral risk factors were examined to understand their influence on malaria prevalence. The findings indicate a high malaria prevalence rate of 95.7%, with Plasmodium falciparum being the most detected species. Younger children (ages 1-3) were more susceptible to malaria, while a significant portion of cases ($p > 0.05$) was observed in children from families with lower socioeconomic status and inadequate housing conditions. Environmental risk factors, such as the presence of stagnant water around homes, and inconsistent use of mosquito nets were strongly associated with higher malaria incidence. The study underscores the need for targeted malaria control measures, including improved access to preventive resources, community health education, and the strengthening of healthcare infrastructure to reduce malaria transmission and improve health outcomes among children in endemic areas.
Keywords*: Malaria, Risk Factors, paediatric patients*

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INTRODUCTION

Malaria remains a significant public health challenge globally, particularly in sub-Saharan Africa, where it disproportionately affects children under the age of 15. According to the World Health Organization (WHO), in 2022, over 249 million malaria cases were reported worldwide, with 94% occurring in the African region. Nigeria alone accounted for 27% of these cases and 31% of malaria-related deaths, highlighting the nation's critical burden in the fight against malaria (WHO, 2023).

In Nigeria, the risk of malaria transmission is ubiquitous throughout the year, with particularly high incidence rates in the northern and northeastern regions, including Adamawa State. Jimeta-Yola, situated in Adamawa State, is no exception, with the disease posing a persistent threat to child health and survival. This is compounded by socio-economic disparities, environmental conditions, and inadequate healthcare infrastructure that exacerbate the vulnerability of pediatric populations.

Malaria is primarily transmitted through the bites of infected female Anopheles mosquitoes, with Plasmodium falciparum being the predominant and most deadly parasite in the region. While the disease is preventable and treatable, late diagnosis and inadequate treatment often lead to severe complications, including anemia, organ failure, and death. Children aged 1-15 years are particularly susceptible due to their developing immune systems and increased exposure to mosquito breeding sites.

This study focuses on assessing the incidence of malaria and its associated risk factors among children attending the Specialist Hospital in Jimeta-Yola. By examining socio-demographic, environmental, and behavioral determinants, the research aims to provide targeted insights into the region's unique epidemiological profile. This knowledge is essential for designing effective intervention strategies that prioritize high-risk groups and optimize resource allocation, ultimately contributing to the reduction of malaria transmission and improvement of health outcomes among children in this endemic area.

keywords: Malaria incidence, Risk factors, *Plasmodium falciparum*, Environmental factors, Packed Cell Volume (PCV).

Statement of the Problem

Nearly half of the world's population is at risk of malaria. In 2022, an estimated 249 million people contracted malaria in 85 countries. That same year, the disease claimed approximately 608 000 lives (WHO, 2023).

Some people are more susceptible to developing severe malaria than others. Infants and children under 5 years of age, pregnant women and patients with HIV/AIDS are at particular risk. Some people in areas where malaria is common will develop partial immunity. While it never provides complete protection, partial immunity reduces the risk that malaria infection will cause severe disease. For this reason, most malaria deaths in Africa occur in young children, whereas in areas with less transmission and low immunity, all age groups are at risk (WHO, 2023). Understanding the incidence rates and associated risk factors is crucial for effective prevention and control measures.

Despite ongoing malaria control efforts, there remains a lack of comprehensive data on the incidence of malaria and risk factors such as environmental, socio-demographic, and behavioral factors associated with the disease among children aged 1-15 years in Yola specifically. This knowledge gap hinders the development and implementation of targeted interventions aimed at reducing malaria burden and improving health outcomes in this vulnerable population.

Aim and Objectives of the Study

This study aims to address the gap in knowledge and provide insights into the demographic and clinical characteristics contributing to malaria prevalence and its associated risk factors among children aged 1-15 years.

The Objectives of the study are:

- To determine the frequency of malaria cases and their severity among children aged 1-15 years attending a Specialist Hospital.
- To identify socio-demographic, environmental, and behavioral factors associated with increased risk of malaria among pediatric patients.
- To assess the relationship between these factors and malaria severity.

MATERIAL AND METHODS

Materials

Study Area

The study was carried out at the Specialist Hospital in Adamawa State, Nigeria's Yola North Local Government Areas (LGA). For the residents of its catchment area and neighboring states, the medical facility provides secondary and tertiary care. There are distinct dry and rainy seasons in the region's tropical climate. The rainy season, which normally lasts from June to October and peaks in August and September, accounts for around 25% of the average 1113.3 mm of annual rainfall. The dry season, on the other hand, runs from late October through April or May. Yola can reach as high as 43°C in April and as low as 20.3°C in December and early January. The year-round relative humidity varies, with February being the driest month and January recording about 26%. On the other hand, relative humidity levels are higher from May to October, peaking in July and August at about 80%. The breeding and spread of parasitic diseases are facilitated by these climatic conditions.

Because of human activities like farming, grazing, building, and gathering wood for fuel, the majority of the vegetation in Yola and the surrounding areas is secondary vegetation. The region's ecological balance and disease dynamics are affected by this change to the native vegetation. With a diverse population working in a range of professions, including civil service, agriculture, fishing, petty trading, poultry, and livestock keeping, Yola North LGA is the administrative center of Adamawa State.

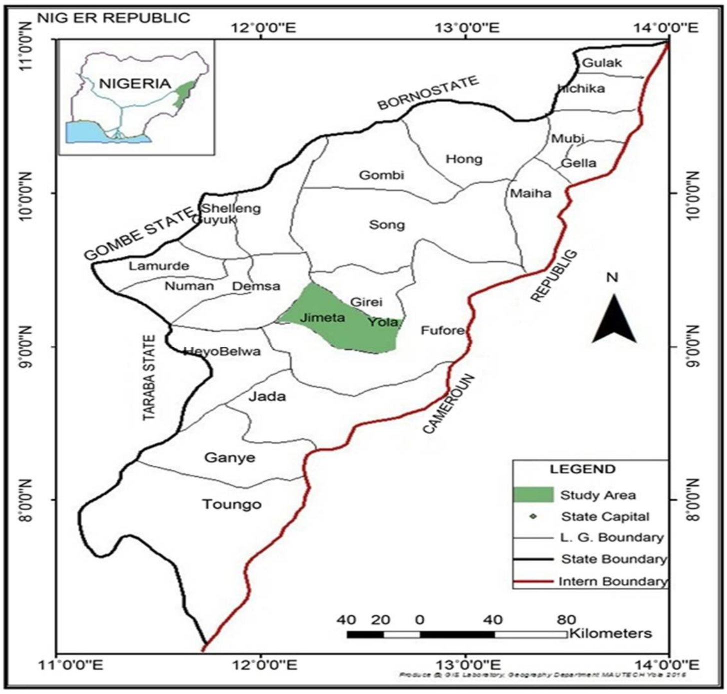

Figure 1: Map of Adamawa State showing Jimeta-Yola, the site where Specialist Hospital is Located (Adebayo 1999).

Participants

The source population consisted of all children aged one to fifteen who visited the designated medical facility, Specialist Hospital, Yola, during the study period.

Questionnaire

A structured questionnaire was prepared to collect data covering:

- Demographic information,
- Socio-economic status,
- Environmental information (housing conditions, rural or urban environment)
- Behavioural information
- Malarial recurrence within a year, and
- Malaria prevention and control practices.

Data Collection

Data collection tools

Data collected from questionnaires was systematically organized and cleaned using Excel.

Statistical software

Data analysis, prevalence calculations, and risk factor identification were conducted using IBM Statistical Package for the Social Sciences (SPSS) for Windows version 29.0.

Consent forms (for parents/guardians)

Participants' informed consent is obtained through this method. Each respondent received a thorough explanation of the study's goals and methodology. An independent interpreter acting as their legal guardian translated the questionnaire from English to their native tongue for those respondents who were illiterate, and back translation to English was done to ensure consistency in the responses. The respondents were informed that they could decline or stop taking part at any moment. Before the study began, all adult respondents and parents/guardians acting on behalf of their children provided written and verbal informed consent. Throughout the study, privacy and confidentiality were maintained.

Ethical approval letter

An application letter was sent to the Adamawa State Ministry of Health prior to sample collection, and they granted an ethical clearance. The management of Yola Specialist Hospital was also notified about the research and their consent was obtained. Before requesting their consent, the parents/guardians were informed of the study's significance. The information was kept private.

Methods

Cross-sectional study

Children who were admitted or visited the hospital for treatment during the study period provided data.

Survey
The participants' parents or guardians used and completed the survey questionnaires for related risk factors.

Sample collection and Laboratory Tests
A licensed laboratory scientist helped with the blood sample collection. Venipuncture was used as the sample collection method (50). Every blood sample was properly labeled and matched the subject's number on the survey. The hospital used laboratory tests, particularly blood smears and microscopy, to confirm the diagnosis of malaria. To improve visibility under a microscope, a blood sample was drawn from the patient and stained with Giemsa dye. Next, the stained blood smear was inspected under a microscope to check for malaria parasites like *Plasmodium vivax* or *Plasmodium falciparum*. The diagnosis of malaria was validated by the presence of parasites in the blood. The hospital measured the Packed Cell Volume (PCV) in addition to microscopy of the patient's blood. A patient's blood sample was taken as the first step in the Packed Cell Volume (PCV) analysis. After being extracted into a sterile tube, the blood was centrifuged to separate its constituent parts. A centrifuge, which separates blood into various components so that the red blood cell volume can be calculated, was used to take the PCV measurement.

Data Analysis
Data was imported into Excel, cleaned, and exported to IBM SPSS (version 29.0, IBM Corp., Armonk, NY, USA) for analysis. Quantitative data were expressed as mean ± standard deviation, and malaria prevalence was determined using frequencies. Variables with a P-value < 0.05 were considered significant, with 95% confidence intervals for odds ratios. The independent variable with the lowest odds ratio was the reference ("Ref").
SPSS analyses included: Descriptive Statistics, Frequency Analysis, Cross-tabulation & Chi-Square Test, T-tests & ANOVA, Cluster Analysis, Correlation Analysis.

RESULT
Out of the 188 subjects analyzed, 106 of them had positive malaria tests. *Plasmodium falciparum* was the species of malaria observed.
Frequency Analysis on Socio-Demographic Information
The frequency and percentage of children ages 1 to 15 who visited the Specialist Hospital in Jimeta-Yola for malaria cases are displayed in Table 4.1, which also shows the age distribution data. 30.3% of the total, or 57 children, fell into the 1-3 year age group, suggesting that malaria is more common in younger children. With 41 children, the group aged 4-6 makes up 21.8% of the total, which is the second-highest. There were 44 children (23.4%) in the 7-9 age group, which is a larger percentage than the 4-6 age group. There are 25 children (13.2%) in the 10–12 age group, which indicates a decline in malaria cases when compared to younger groups. Finally, with 21 children (11.1%), the 13–15 age group has the lowest frequency, supporting the idea that older kids are less susceptible to malaria.
According to the data on gender distribution, 97 boys, or 51.5% of the total number of children, were present. However, 91 of the children were girls, accounting for 48.4% of the total (Table 4.1). According to the data on the distribution of educational levels, 66 children, or 35.1% of the total, do not attend school. 32 kids (17.0%) in the nursery category are enrolled in nursery school. 63 children (33.5%) are in primary school, which accounts for a sizable percentage of those impacted. The smallest of the groups, with 27 children (14.3%), is the secondary school group (Table 4.1).
Several insights are revealed by the data on the occupations of parents or guardians of children undergoing treatment for malaria at the Specialist Hospital in Jimeta-Yola. Farmers are 19.6% of the group, with 37 parents/guardians identified as such. With 84 parents or guardians, traders make up the largest occupational group (44.6%). 51 parents/guardians, or 27.1% of the group, are civil servants. Furthermore, 33.5% of guardians and parents do not have a job. According to the data, parents or guardians are most likely to be traders (44.6%), followed by civil servants (27.1%) and farmers (19.6%) (Table 4.1).
Families seeking treatment for malaria cases at the Specialist Hospital in Jimeta-Yola exhibit a wide range of incomes. Most families, 43.6% of them, make between #50,000 and #100,000 a month, placing them in the middle income range. On the lower end of the income spectrum, 12.7% of families make less than #10,000, and 23.4% make between #10,000 and #50,000. On the other hand, a smaller but noteworthy percentage, 17%, make more than #100,000 a month (Table 4.1).

Table 4.1: Frequency Analysis: Socio-Demographic Information

Age of the Child	**Frequency**	**Percentage**
1-3 years	57	30.3
4-6 years	41	21.8
7-9 years	44	23.4
10-12 years	25	13.2
13-15 years	21	11.1
Gender of the child	**Frequency**	**Percentage**
Male	97	51.5
Female	91	48.4
Education level of the child	**Frequency**	**Percentage**
Not in school	66	35.1
Nursery	32	17.0
Primary	63	33.5
Secondary	27	14.3
Parent/Guardian educational level	**Frequency**	**Percentage**
No formal educational level	37	14.3
Primary	20	10.6
Secondary	68	36.1
Tertiary	63	33.5
Parent/Guardian occupation	**Frequency**	**Percentage**
Farmer	37	14.3
Trader	84	44.6
Civil servant	51	27.1
Unemployed	15	33.5
Family Income level per Month	**Frequency**	**Percentage**
Below #10,000	24	12.7
#10,000 - #50,000	44	23.4
#50,000 - #100,000	82	43.6
Above #100,000	32	17.0

Frequency Analysis on Environmental Factors

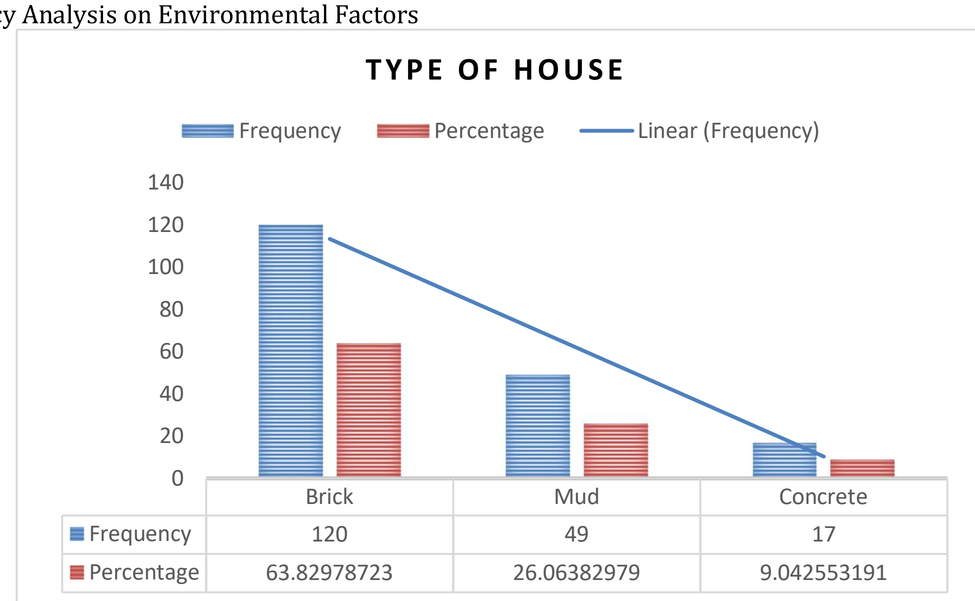

Figure 2:Type of House

Brick homes are the most prevalent, with 63.8% of families living in them, according to data on housing types for children who are treated for malaria cases at the Specialist Hospital in Jimeta-Yola in Figure 2. On the other hand, 9.0% reside in concrete homes and 26.0% in mud homes. Given that brick homes are more common and provide superior mosquito protection, these households may be at lower risk of contracting malaria.

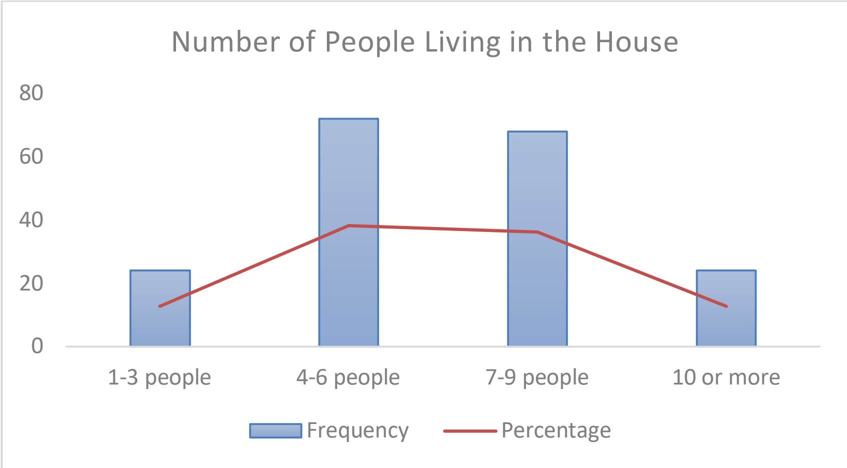

Figure 3: Number of People Living in the House

According to the household size data in Figure 3, the largest percentage of households—38.2%—have four to six people living in them. Furthermore, 12.7% have one to three residents, 12.7% have ten or more, and 36.1% have seven to nine residents. Because larger households may increase the risk of exposure, these household size dynamics may have an impact on the transmission of malaria.

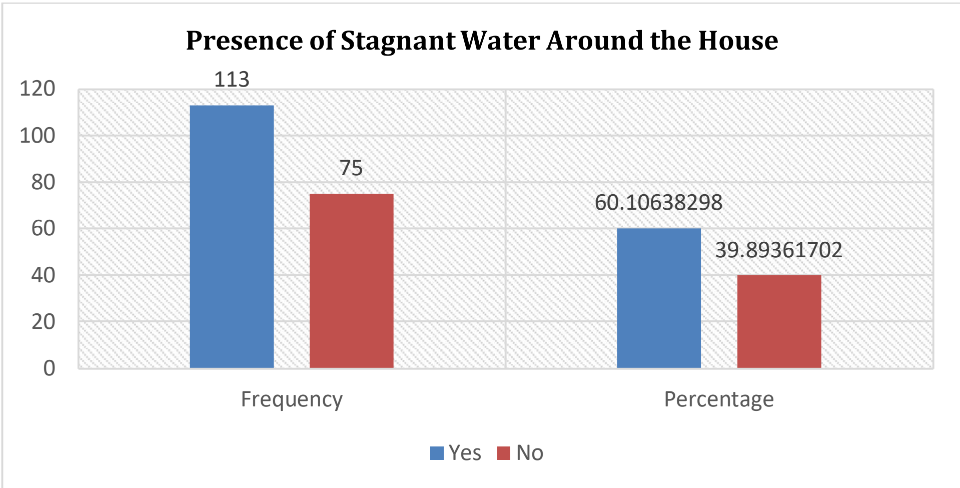

Figure 4: Presence of Stagnant Water around the House

Figure 4's data on standing water near residences indicates a substantial environmental risk factor for the spread of malaria. While 39.8% of households do not have stagnant water nearby, the majority (60.1%) do.

Behavioral Factor

The daily outdoor playtime of children receiving treatment for malaria at the Specialist Hospital in Jimeta-Yola suggests a primarily indoor lifestyle, as shown in Table 4.2. Significantly, 76.0% of kids spend less than an hour outside every day, indicating that they do not get enough exposure to the outdoors. However, only 6.3% of kids spend more than two hours playing outside, while 17.5% of kids play outside for one to two hours.

A noteworthy 80.8% of children, or 152 in total, who were treated for malaria cases at the Specialist Hospital in Jimeta-Yola reported sleeping under a mosquito net, according to data on sleeping habits. But according to Table 4.2, 19.1% of kids—36 in all—do not sleep under a mosquito net.

The following trends can be seen in the data on children's nighttime outdoor activities who are receiving treatment for malaria at the Specialist Hospital in Jimeta-Yola: Nearly half (48.4%) of the kids regularly spend their evenings outside. A smaller percentage (12.7%) say they never engage in nighttime outdoor activities, while another sizable portion (38.2%) say they do so occasionally (Table 4.2).

The following information relates to the use of preventive measures during the rainy season by children who are treated for malaria at the Specialist Hospital, Jimeta-Yola. Constantly (81.9%): During the rainy season, 154 kids (81.9%) said they regularly used preventive measures. Sometimes (11.1%): 21 kids (11.1%) said they occasionally take preventative action. Never (6.3%): Twelve kids (6.3%) said they had never taken precautions during the rainy season (Table 4.2).

Table 4.2: Frequency Analysis: Behavioral Factors

Q. Child playing outside (per day)	**Frequency**	**Percentage**
Less than one hour	143	76.0
1-2 hours	33	17.5
More than 2 hours	12	6.3
Q. Child Sleeping Habits	Frequency	Percentage
Sleeps under a mosquito Net	152	80.8
Sleeps without a mosquito Net	36	19.1
Q. Nighttime outdoor activity	Frequency	Percentage
Often	91	48.4
Occasionally	72	38.2
Never	12	6.3
Q. Use of preventive measures during the rainy season	Frequency	Percentage
Always	154	81.9
Sometimes	21	11.1
Never	12	6.3

Frequency Analysis: Malaria Incidence

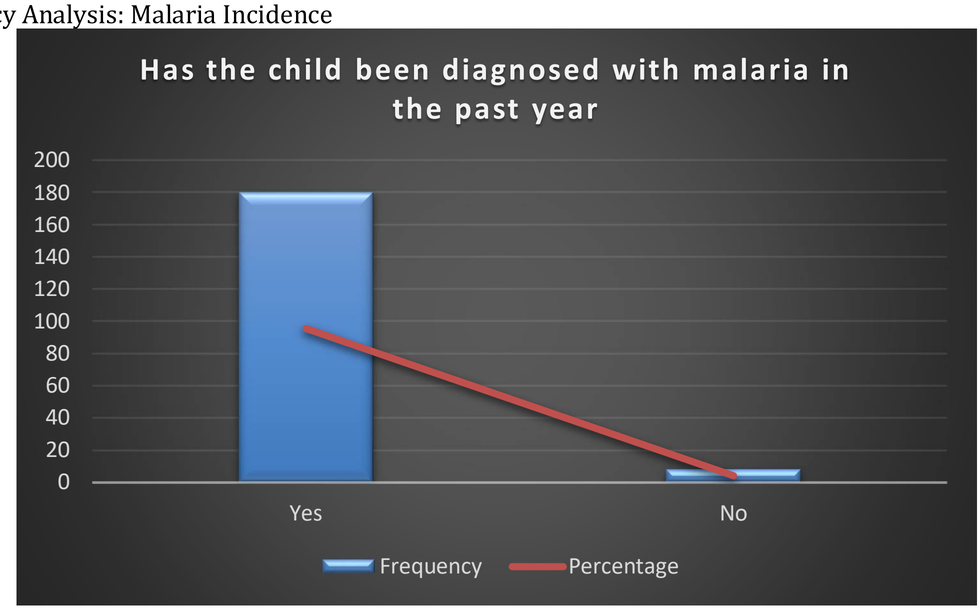

Figure 5: Has the child been diagnosed with malaria in the past year

Figure 5 displays the data on children who were diagnosed with malaria during the previous 12 months at the Specialist Hospital in Jimeta-Yola. Yes (95.7%): 180 (95.7%) of the children who participated in the survey said they had received a malaria diagnosis within the previous 12 months. No (4.2%): Merely 8 children (4.2%) reported that they had not received a malaria diagnosis within the previous 12 months.

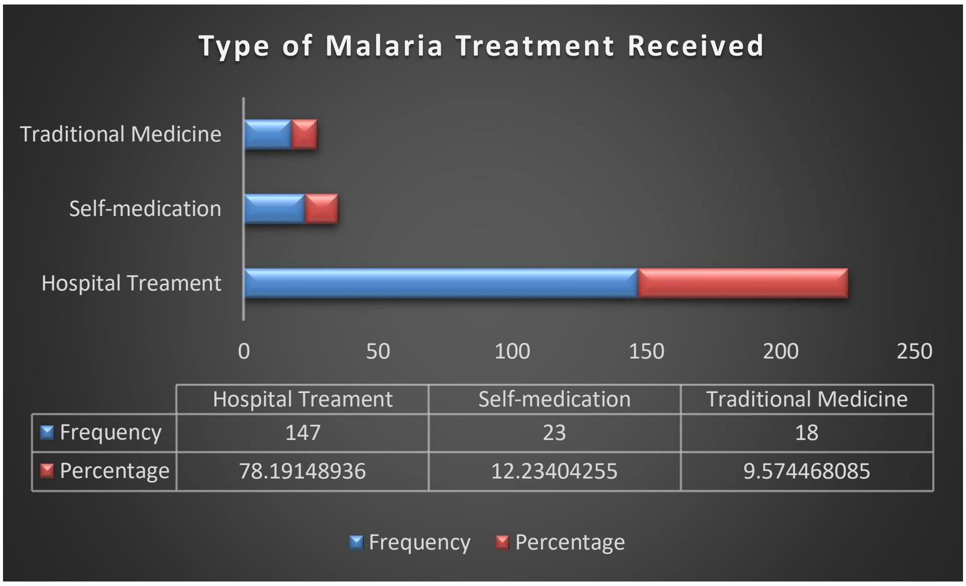

Figure 6: Type of Malaria Treatment Received

According to Figure 6, 78.1% of children who were diagnosed with malaria within the previous year were treated in hospitals. As an alternative, some sought treatment through traditional medicine (9.5%) or self-medication (12.2%). Alternative, 12.2% of people turned to self-medication, and 9.5% to traditional medicine.

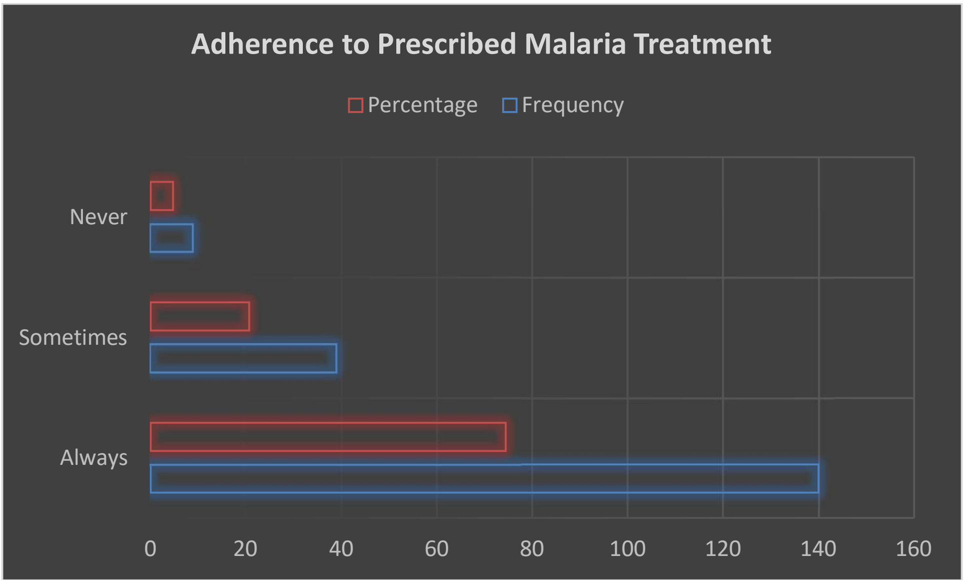

Figure 7: Adherence to Prescribed Malaria Treatment

The majority of children (74.4%) who are diagnosed with malaria consistently finish the entire course of treatment as directed, as seen in Figure 7. Nevertheless, 20.7% only occasionally adhere, and 4.7% never finish the course of treatment.

Descriptive Statistics of PCV Value

The average PCV is 28.23%, according to Table 4.3. 29% was the median PCV. Half of the children had a PCV value below 29%, according to this median value, which was marginally higher than the average. 8% was the lowest PCV that was noted. Conversely, the highest PCV was 54%. 8.98% was the standard deviation.

Table 4.3: Descriptive Statistics of PCV Value (%)

Average	**28.2**
Median	29
Min	8
Max	54
STD	8.9

Cluster Analysis: Comparison between Negative (-) and Positive (+) Malaria Test Results within age groups.

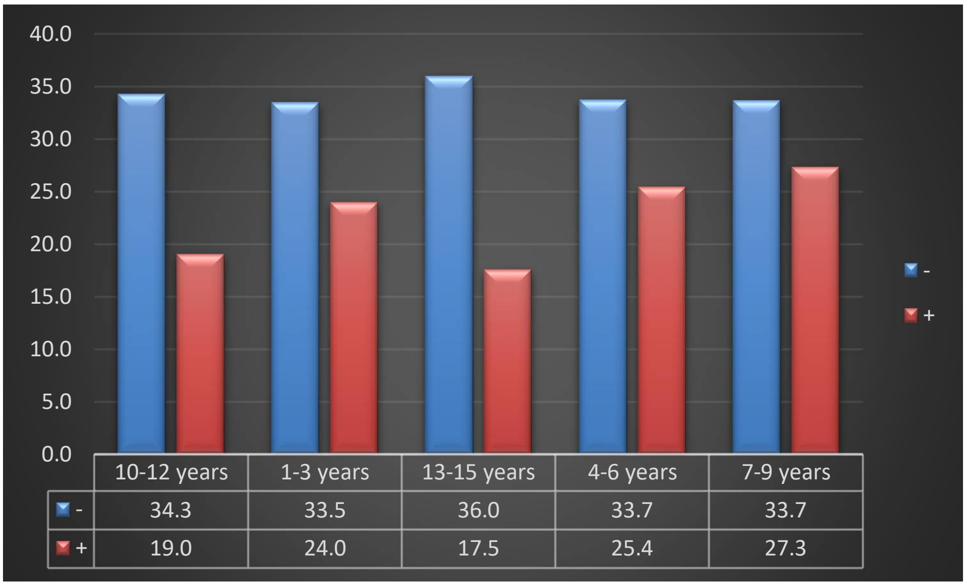

Figure 8: Comparison between Negative (-) and Positive (+) Malaria Test Result

It appears that the prevalence of malaria is generally higher in younger children (10-12 years) compared to older children (13-15 years). 10-12 years: This group shows the highest number of positive malaria cases. 13-15 years: This group has the lowest number of positive malaria cases. 1-3 years, 4-6 years, 7-9 years: These groups show moderate levels of malaria incidence. The number of negative tests consistently outnumbers positive tests across all age groups. The difference between negative and positive tests is most pronounced in the 13-15 years age group. Age-Related Susceptibility younger children might have weaker immune systems, making them more susceptible to malaria infection. Environmental Factors the prevalence of malaria-carrying mosquitoes might vary seasonally or geographically, influencing the infection rates in different age groups. Socioeconomic Factors access to healthcare, preventive measures (like mosquito nets and repellents), and nutritional status could impact the risk of malaria in different age groups.

Cross-tabulation and Chi-square Test

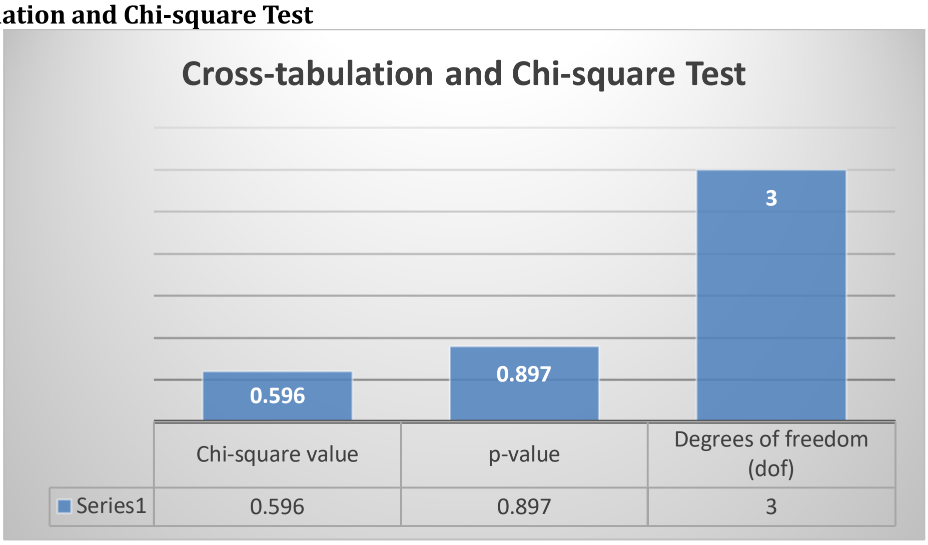

Figure 9: The cross-tabulation and Chi-square test results between malaria diagnosis and use of preventative measures

As seen in Figure 9:

Cross-tabulation

Children diagnosed with malaria most of them (148) had used preventative measures Always, while 20 used them Sometimes, and 11 Never. Children not diagnosed with malaria 6 used preventative measures Always, and 1 Never or Sometimes.

Chi-square test results

- Chi-square value: 0.596

- p-value: 0.897
- Degrees of freedom (dof): 3

The likelihood of receiving a malaria diagnosis within the previous year is not statistically correlated with the use of preventative measures, as the p-value (0.897) is significantly higher than the conventional significance level of 0.05.

Analysis of Variance of PCV value and Malaria status

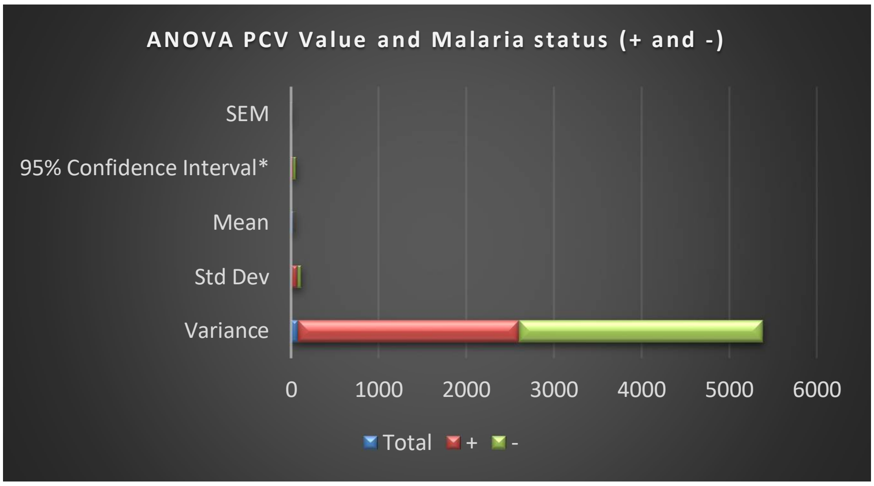

Figure 10: ANOVA PCV value and Malaria Status

KEY: SEM = Standard Error of the Mean, Std Dev = Standard Deviation

A statistical analysis of the association between PCV (Packed Cell Volume) and malaria status is presented in the ANOVA table in Figure 10.

+ Group (Malaria): The mean PCV is 8.2212.

- Group (No Malaria): The mean PCV is 6.3846.

+ Group: The standard deviation is 67.5889, indicating a wide range of PCV values in this group.

- Group: The standard deviation is 40.763, suggesting a less dispersed distribution of PCV values in this group.

95% Confidence Intervals

- For the + group, the true mean PCV is estimated to be between 23.8019 and 32.5484.
- For the - group, the true mean PCV is estimated to be between 22.2186 and 35.852.

Standard Error of the Mean (SEM)

- The SEM is smaller for the - group (0.7072) compared to the + group (0.8204), suggesting that the mean PCV estimate for the - group is more precise.

Correlation Analysis between Age of Child and PCV Value

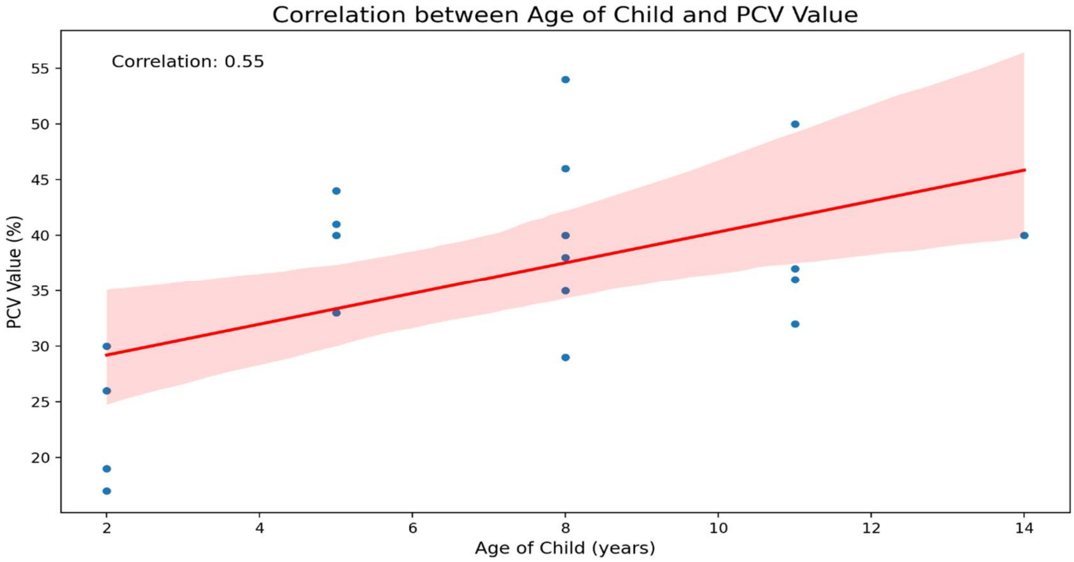

Figure 11: Correlation Analysis of PCV and the Age of the Child

The scatter plot illustrates the correlation between the PCV Value (y-axis) and the Child's Age (x-axis), as seen in Figure 11. In the dataset, each point corresponds to a distinct child. The regression line, represented by the red line, displays the relationship's general trend. From the chart, it shows:

1. Positive correlation: Age and PCV value have a moderately positive correlation, as indicated by the regression line's upward slope.
2. Strength of correlation: The chart shows a correlation coefficient of roughly 0.55. This suggests a somewhat favorable correlation.
3. Scatter: The regression line is surrounded by a significant amount of scatter in addition to a definite positive trend. This implies that although age affects PCV values, other factors probably have an impact as well.
4. Age range: The midpoints of the age groups we used in our analysis are represented by the x-axis, which displays the age range of roughly 2 to 14 years.
5. PCV range: The PCV values are displayed on the y-axis and seem to fall between 20% and 40%, with a few outliers falling outside of this range.

DISCUSSION

Important new information about the malaria burden in this area was provided by this study's evaluation of the incidence of malaria and related risk factors in children ages 1 to 15 at Specialist Hospital, Jimeta-Yola.

This study's malaria prevalence (95.7%, 106/188) was greater than that of other studies carried out in the same location, which found a prevalence of 50.6% (157/310) (Kunihya *et al.,* 2022). The study was carried out during the rainy season, which contributed to the prevalence rate of malaria infection. Additionally, a high number of malaria cases were found in August and September, suggesting that, among other reasons, Yola's poor drainage, poor sanitation, and water blockage contributed to an increased rate of malaria transmission. Plasmodium falciparum was the malaria species found in this investigation, which is consistent with the results of (Kunihya *et al.,* 2022).

Risk factors included sociodemographic characteristics like parental unemployment, lower educational attainment, and younger age (1-6 years). The Nigeria Malaria Indicator Survey (2021), which identified age and education as important predictors of malaria risk, is supported by these findings. This pattern emphasizes the significance of focused interventions for these age groups, such as improved preventative techniques like regular mosquito net use and timely medical care to lower the chance of developing severe malaria. A noteworthy trend in children's malaria susceptibility is revealed by this study, with younger age groups showing increased vulnerability. Children under the age of six are disproportionately affected, especially those ages one to three, who make up a significant portion of all malaria cases. This increased vulnerability is caused by a number of factors, such as immature immune systems and increased outdoor mosquito exposure. Pre-school-aged children, between four and six years old, also remain at considerable risk. It is interesting to note that children aged 7 to 9 have a slightly higher incidence of malaria, which may be related to increased outdoor activities and mosquito exposure.

Malaria susceptibility decreases as children reach the preteen and early teenage years (10–15). Stronger immune responses and increased awareness of preventive measures are credited with this declining trend. The age-related pattern in malaria susceptibility that has been observed is consistent with the results of other studies, including the one conducted by (Ranjha *et al.,* 2023). This consistency across studies reinforces the importance of age-specific approaches in malaria prevention and treatment strategies.

A fairly equal distribution of malaria cases between genders is suggested by the gender distribution data for children who attend the Specialist Hospital for malaria cases. The data shows that boys have a slightly higher incidence of malaria, but the difference is small (51.5% male vs. 48.4% female) (Kunihya *et al.,* 2022). This suggests that in this population, the risk of contracting malaria is almost equal for boys and girls, and interventions should target both sexes without making any notable distinctions in malaria prevention and treatment.

Additionally, this study examined the relationship between malaria prevalence and educational attainment, finding that children in primary school and those not enrolled in any educational program (35.1%), primary school (33.5%) represented the largest groups affected by malaria. This implies that younger, less educated children are more susceptible to infection, most likely as a result of their families' socioeconomic struggles or a lack of knowledge about preventive measures. These results are consistent with the research of (Makenga *et al.,* 2023), which identified comparable risks in school-age children. Secondary school students (14.3%) seemed to be at a lower risk, which is indicative of improved self-management and awareness of preventive measures.

Parental or guardian occupations also played a significant role in determining children's risk of contracting malaria. The largest occupational groups were civil servants (27.1%), traders (44.6%), and farmers

(19.6%). Farmers who work outdoors are inherently more susceptible to malaria, but traders who frequently operate in open markets close to standing water are also at higher risk. Despite having greater access to healthcare, civil servants did not exhibit a significantly lower prevalence of malaria, suggesting that exposure to malaria is not entirely explained by occupation. Significantly, 33.5 percent of the children were from households with unemployed parents or guardians, highlighting the socioeconomic factors that increase the risk of malaria.

Another important factor influencing the risk of malaria was income levels. 12.7% of the study population were families with monthly incomes under #10,000, and they faced significant financial barriers that prevented them from accessing healthcare services and mosquito nets. Malaria was more common among those making between #10,000 and #50,000 (23.4%) because they also had financial difficulties. However, malaria incidence remained high even among families with relatively higher incomes (43.6%), indicating that financial resources alone are not enough to reduce malaria risk. Other studies (Isiko *et al.,* 2023) similarly observed that socio-economic status, while important, is not the sole determinant of malaria incidence. Access to healthcare and the surrounding environment are important factors.

When housing conditions were also looked at, it was found that even though brick homes provided better protection from mosquitoes, children living in these homes (63.8%) still had a high malaria burden. Children who lived in concrete homes (9.0%) and mud houses (26.0%) were at different levels of risk, with mud houses being especially at risk because of environmental conditions that encourage mosquito breeding (Nawa *et al.,* 2024). Despite the fact that contemporary housing greatly lowers the risk of contracting malaria, this study discovered that even families living in more structurally sound homes were susceptible to the disease.

Additionally, a significant proportion of households (60.1%) had stagnant water nearby, which further increases the risk of malaria, as stagnant water serves as an ideal breeding ground for mosquitoes, and community efforts to address this environmental issue, such as drainage improvements and clean-up initiatives, are crucial to reducing malaria transmission (Tsegaye *et al.,* 2021). In addition, the prevalence of malaria was higher in larger households (7-9 residents) than in smaller households (1-3 residents), suggesting that household size also affected the spread of the disease.

The study also looked at behavioral practices like using mosquito nets, going outside, and following precautions during the rainy season. According to this study, 80.8% of kids slept under mosquito nets, which is encouraging for preventing malaria. However, 19.1% did not use nets, indicating a gap in protection that could be addressed through increased education and access to nets. Children who frequently engaged in nighttime outdoor activities (48.4%) were at higher risk of malaria due to increased mosquito exposure, particularly during peak transmission periods.

The results of this study showed that 81.9% of families regularly used preventive measures during the rainy season, which was encouraging. However, only 6.3% of families said they had never used preventive measures, highlighting the need for focused interventions to increase knowledge and provide access to preventive resources during times of high risk.

The prevalence of malaria and treatment-seeking behavior among children in a particular community were also investigated in this study. A high disease burden was indicated by the results, which showed that 95.7% of the children polled had received a malaria diagnosis in the previous 12 months. This implies that malaria is a serious health concern for this population, highlighting the pressing need for community-wide effective malaria prevention and control strategies. In terms of treatment-seeking behavior, the majority of children (78.1%) were treated in hospitals, which is positive and indicates that they are actively using community healthcare services. But a significant 12.2% of kids self-medicated, and 9.5% turned to conventional medicine, which raises questions about the possible dangers of self-diagnosis and self-treatment. Following treatment recommendations is essential to controlling malaria. It is encouraging for the management of malaria that 74.4% of children followed the entire course of treatment as directed by the study. Nonetheless, 4.7% of children never adhered, and 20.7% of children occasionally adhered, indicating areas that require improvement to guarantee that all children finish their treatment.

The results emphasize the necessity of better health education, treatment adherence, and efficient malaria prevention and control measures. Given the high number of children who receive a malaria diagnosis and the gaps in treatment compliance and health education, it is likely that malaria will continue to be a major public health concern.

With an average PCV of 28.23%, below the normal range of 35-45%, descriptive analysis of the children's PCV values shows a high prevalence of malaria-induced anemia among the children, suggesting a widespread problem of low hemoglobin levels. This anemia, which is associated with the destruction of red blood cells brought on by a malaria infection, is especially severe in cases where the minimum PCV was 8%, indicating an urgent need for medical attention.

With a p-value of 0.897, this study showed that there was no statistically significant correlation between the diagnosis of malaria and the use of preventive measures according to the cross-tabulation and Chi-square test. This finding suggests that other factors, such as environmental conditions and access to healthcare, may have a more substantial influence on malaria transmission, which is in line with (Chiziba *et al.,* 2024) which emphasizes the need to consider broader factors beyond preventive measures when addressing malaria transmission.
This study's ANOVA analysis, which is shown in Figure 9, clarifies the complex relationship between children's Packed Cell Volume (PCV) levels and malaria status. It also reveals a number of important findings that have important ramifications for the diagnosis and treatment of pediatric malaria. Contrary to expectations, the analysis showed that children with a malaria diagnosis had higher average PCV levels than children with a negative test result. Differences in hydration or physiological reactions to the infection could be the cause of this. The high standard deviation of PCV levels among children with malaria indicates that the disease affects people differently, necessitating more individualized treatment strategies.
This study's analysis of the relationship between a child's age and their Packed Cell Volume (PCV) value also revealed a moderately positive correlation (0.55) between the two variables. This suggests that although PCV levels tend to improve as children age, the relationship is not strong enough to be the only factor determining anemia levels, as the scatter plot illustrates.
The average PCV values of children who tested negative for malaria fell within the normal range (33.5-36.0%), whereas children who tested positive for the disease had significantly lower PCV values (17.5-27.3%), according to a comparison of the test results. This emphasizes how malaria negatively affects red blood cell counts.

CONCLUSION

This study successfully highlighted the multifaceted nature of malaria prevalence and its associated risk factors in children. Our knowledge of how demographic, environmental, and behavioral factors affect malaria incidence and anemia, as measured by Packed Cell Volume (PCV) levels, has improved as a result of the study. The results highlight the significance of a thorough strategy for the prevention and treatment of malaria, stressing the necessity of focused interventions that take into account the unique risk factors influencing this susceptible group. In the end, this study not only adds to the body of knowledge already in existence, but it also lays the groundwork for further investigations targeted at reducing the impact of malaria and enhancing the health of children in areas where the disease is endemic. The study's cross-sectional design, which makes it impossible to analyze seasonal transmission trends, and its reliance on self-reported data, which is prone to bias and lacks objective verification of bed net ownership and usage, are its two primary limitations. The results emphasize the need for integrated strategies that address the social, environmental, and behavioral determinants of malaria and have important policy and practice implications. Furthermore, the study emphasizes how crucial it is to keep funding malaria research and control initiatives, especially when it comes to creating novel approaches to deal with the intricate problems this enduring illness presents.

RECOMMENDATION

According to the study, children between the ages of one and six are most at risk of contracting malaria, and as they get older, their vulnerability gradually declines. These results highlight the urgent need for focused interventions aimed at younger populations. The impact of malaria on children can be lessened by healthcare initiatives that prioritize protection for the most susceptible age groups. Recommendations include:
Strengthen Malaria Prevention Programs

- Community Education: Put in place targeted educational programs that stress the value of regularly using mosquito nets and repellents as well as environmental management by clearing standing water close to homes. Prioritizing education for families with young children is essential.
- Availability of Preventive Resources: Increase accessibility to reasonably priced mosquito repellents and insecticide-treated mosquito nets. Families living in high-risk areas and those with lower incomes should be the focus of distribution efforts.

Improve Access to Healthcare and Treatment Adherence

- Improve Access to Healthcare: Make sure that kids with malaria get prompt, quality hospital treatment. Promoting the use of official healthcare services while discouraging self-medication and reliance on conventional remedies is crucial.
- Adherence to Treatment: Provide mechanisms for follow-up to guarantee that families finish the full course of treatment for malaria. Support mechanisms, such as reminder services or visits from community health workers, can significantly improve adherence rates.

Address Anemia through Nutritional Support

- Management of Anemia: Provide dietary interventions, such as supplements of iron and folic acid, especially for kids with low PCV levels. The underlying problem of childhood anemia can be addressed by incorporating nutritional education into malaria prevention initiatives.
- Regular Anemia Screening: To detect and treat anemia early, implement routine PCV screening for children in areas where malaria is endemic, particularly for those under five.

Targeted Interventions for Vulnerable Groups

- Young Children: Since they are the most impacted group, with the highest rates of malaria and the lowest PCV levels, focus malaria control and anemia management efforts on children ages 1-3.
- Families with Limited Resources: Tailor malaria prevention tactics to target families with lower socioeconomic status and those with less education, as they may face more barriers to accessing preventive resources.

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