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Original Article

Prevalence of malaria and contributing factors in children under five years of age attending Nakasongola General Military Hospital. A cross-sectional study.

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Abstract.

Background.

Children under 5 years old are the group most vulnerable to malaria infection because of less developed immune systems. This study aimed to determine the prevalence of malaria and contributing factors in children under five (5) years of age who attend the OPD in Nakasongola General Military Hospital.

Methods.

A descriptive cross-sectional study was used employing a quantitative approach to data collection. The caregivers of children below five years of age who were sent to the laboratory for malaria testing were requested to participate in the study, and those willing were enrolled until the required sample size was reached. Data on socioeconomic factors and coverage of ITN use were collected using a pretested structured questionnaire. Data were analyzed using SPSS version 27 software, and results were presented in tables and graphs.

Results.

66 (53.2%) of these children were males, 30 (24.2%) were between 12 and 23 months of age, and the overall prevalence of malaria was 44.4%. Among the malaria-positive children, 60.0% were males and between 36 and 47 months of age (25.5%). Malaria infection was associated with low caregivers' age (38.2%) among caregivers 15 – 19 years old, rural residence (70.9%), primary level education (56.4%), and peasant farming (30.9%). Children who slept under ITNs were more likely to be protected from malaria infection (98.3%).

Conclusion.

Malaria infection is highly prevalent in children aged between 36 and 47 months.
Socioeconomic factors, such as the age and education level of the household head, use of mosquito bed nets for sleeping, place of residence, and age of the children, were significant factors associated with malaria prevalence among children under 5 years of age.

Recommendations.

National studies should be conducted to identify the different geographical regions of the country that are most at risk of malaria, using updated malaria risk maps.

Keywords: *Prevalence of malaria, contributing factors, children under five, under-five morbidity, pediatric malaria, malaria risk factors, Nakasongola General Military Hospital.*
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Background.

Malaria is an acute, life-threatening, febrile parasitic infection caused by *Plasmodium* parasites, which are transmitted to people through the bites of infected female *Anopheles* mosquitoes. Two of the five parasite species that cause malaria in humans, *P. falciparum* and *P. vivax*, pose the greatest threat. Symptoms of malaria include fever, headache, chills, pains in joint pain, vomiting, anemia, hemoglobinuria, retinal damage, and convulsions. Left untreated, *P. falciparum* malaria can progress to severe illness and death within twenty-four hours (WHO, 2020).
Malaria is preventable and curable. The WHO-recommended malaria prevention tools and strategies include effective vector control and the use of preventive antimalarial drugs. The two core vector control interventions are sleeping under bed nets that have been treated with long-lasting insecticides (insecticide-treated nets, ITNs) and spraying the insides of houses (where most *Anopheles* species feed and rest) with insecticides (indoor

residual spraying, IRS). Malaria can also be prevented by the use of mosquito coils and repellents.

In 2020, nearly half of the world's population was at risk of malaria. Some population groups are at considerably higher risk of contracting malaria and developing severe disease: infants, children under five years of age, pregnant women, and patients with HIV/AIDS, as well as people with low immunity moving to areas with intense malaria transmission, such as migrant workers, mobile populations and travelers.

According to the latest World Malaria Report, there were an estimated 241 million cases of malaria worldwide in 2020. The estimated number of malaria deaths stood at 627,000 in 2020. The WHO African Region continues to carry a disproportionately high share of the global malaria burden. In 2020, the region was home to 95% of malaria cases and 96% of malaria deaths. Children under five accounted for about 80% of all malaria deaths in the Region (WHO, 2020). Sub-Saharan Africa continues to carry a high portion of the global malaria burden, with 90% of malaria cases and 92% of malaria deaths, with children being particularly vulnerable, accounting for 70% of all malaria deaths. Malaria remains a major cause of morbidity in children under the age of 5 years in sub-Saharan Africa, and one child dies every 2 minutes (WHO, 2015).

In East African countries, the prevalence of malaria in children under five years of age is high. For instance, the prevalence of malaria from recent studies in Burundi was 27% in 2016–2017; in Kenya, it was 5% in 2015; in Rwanda, it was 7% in 2017; in Tanzania, it was 7% in 2017; in South Sudan, it was 32% in 2017 and in Uganda it was 30.3% in 2016 (Habyarimana & Shuan, 2020).

Malaria is the leading cause of morbidity in Uganda, with 90 – 95% of the population at risk, and it is the most frequently reported disease at both public and private health facilities in Uganda. It accounts for 30 – 50% of outpatient visits at health facilities and 15 – 20% of inpatients or hospital admissions. In Uganda, 27.2% of inpatient deaths among children under five years of age are due to malaria. A significant percentage of deaths occur at home and are not reported by the facility-based Health Management Information System (HMIS). (Uganda National Malaria Control Division (NMCD), 2020). This study aimed to determine the prevalence of malaria and contributing factors in children under five (5) years of age who attend the OPD in Nakasongola General Military Hospital.

Methodology.

Study Design

The study was descriptive, using a cross-sectional survey design to allow quantitative data on the prevalence of malaria and the associated factors to be easily collected, simultaneously, at a particular point in time and within the shortest time possible.

Study Area.

The study was set in Nakasongola General Military Hospital, a UPDF-owned health unit located in Kanyonyi Village (Barracks Complex), Wajjala Parish, Lwampanga Sub-County, Nakasongola District, in the Central Region of Uganda. Nakasongola District has an estimated total population of 215,200, approximately a quarter of whom are children under 5 years of age (Uganda Bureau of Statistics (UBOS), 2020). The dominant tribe is Baruli, and the major economic activity is subsistence agriculture.

Nakasongola District is located along the southern shores of Lake Kyoga and is commonly affected by over-flooding during the rainy seasons. This water body provides a great breeding ground for the *Anopheles* mosquito, which transmits malaria to humans. Additionally, plenty of bushes, ditches, and poor tidiness are some of the common epidemiological factors that favor mosquito breeding in Nakasongola. The climate in Nakasongola, coupled with the shrub vegetation cover of the area, permits year-round malaria transmission, marked by transmission peaks typically following the end of the rainy seasons. The most recent malaria indicator survey (MIS) undertaken in the North Buganda region (2018–19) of which Nakasongola is part, reported a malaria parasitemia rate of 14.2% according to RDT and 8.8% according to microscopy (NMCD, 2020)

Populations.

The target population included all the caretakers and children under five years of age in Nakasongola District. The accessible population included children under the age of five years and their caretakers who attend Nakasongola General Military Hospital. The study population included caregivers and children under the age of five years who met the inclusion criteria.

Sample Size Determination.

The sample size was determined by calculations using the Kish and Leslie formula:

$$n = \frac{Z^2 P(1-P)}{d^2}$$, where:

n = total number of subjects required in the sample;

Z = a standardized normal deviate value that corresponds to the level of statistical significance, equal to 1.96;

P = an estimate of the prevalence of malaria in children under age 5 years in Uganda, which is 19.7% according to Roberts and Mathews' 2016 study on malaria prevalence under 5 years in Uganda;

d = margin of error, which corresponds to the level of precision of results desired = 0.05.

$$\frac{1.962 \times 0.197 (1-0.197)}{0.052}$$

n = 124.

Sampling Technique.

This study employed a simple random sampling technique to give all the caregivers of children below the age of five years an equal chance of participating in the study.

Sampling Procedure.

All the children below five years of age who came to the OPD saw, first, the clinician first, and those with malaria signs and symptoms were sent to the laboratory for malaria testing using RDT and microscopy methods. The caregivers of those children sent to the laboratory for malaria testing were requested to participate in the study, and those willing were enrolled until the required sample size was reached. The children who were tested for malaria were used to determine the sample size.

Data Collection Method

To determine the prevalence of malaria among children under 5 years of age attending Nakasongola General Military Hospital (NGMH), blood specimen collection and processing were done by the medical laboratory personnel of NGMH on children sent to the laboratory for malaria testing by the clinician at the OPD. Malaria test results were recorded as either positive or negative. Results were recorded in the Laboratory's Daily Activity Register and then provided to the consenting caregiver.

Data Collection Tool.

A structured questionnaire was used to collect data on socio-economic factors, such as the type of residence: urban or rural; ownership, treatment, and use of mosquito nets in the household; gender and age of the child; number of members in the household; and caregiver's age, education level, marital status, occupation, and knowledge of malaria. The questionnaire comprised both closed and open-ended questions developed in the English language.

Data Collection Procedure.

The researcher was introduced to the In-Charge of the health facility, who then introduced the researcher to the staff and patients. The aim of the study was then explained to the staff and patients to identify those who were eligible for the study. The children who were eligible for the study were seen by the medical clinical officer(s) who had requested microscopy or RDT tests in the laboratory, to screen those with positive and negative results, respectively. The caregivers of eligible children gave written informed consent to allow the children to participate in the study.

After consent was provided, the research assistant(s) administered a brief questionnaire to elicit responses about socioeconomic data and determinant factors. The questions were interpreted by the research assistants in the local languages of Ruluri, Luganda, Runyankole, and Ateso, respectively. The children who tested positive were used to determine the prevalence of malaria in children under the age of five years attending Nakasongola General Military Hospital. The prevalence was the number of children who tested positive over the total number of children who engaged in the study.

Study variables.

The study included dependent and independent variables.

Dependent variable

In this study, the prevalence of malaria among children under five years old in Nakasongola General Military Hospital was the dependent variable.

Independent variables

The independent variables considered in this study comprised several socio-economic and demographic factors. Such variables included the type of residence: urban or rural; ownership, treatment, and use of mosquito nets in the household; gender and age of the child; number of members in the household; and caregiver's age, education level, marital status, occupation, and knowledge of malaria.

Quality Control

Introduction

This section describes the pre-testing of the research tool, training of the research assistants, time for data collection, inclusion criteria of the study, and the standard operating procedures (SOPs).

Pretesting the research tool.

The tool of this study, a questionnaire, was pretested on respondents chosen from a nearby health facility, where it was administered to 13 respondents to assess the legibility, reliability, and validity of the questions. The pilot study was done to ensure that the questions are not ambiguous, so as to generate the desired information with minimum bias. The findings were used to adjust the questionnaire accordingly. The data collected was checked for accuracy and competency, and any errors and omissions identified were rectified.

Training research assistants.

The study involved four research assistants who were trained on the research objectives, data collection, and eligibility, and they were fluent in the local languages because the interpretation was of key importance to some individuals who could not read and/or write. These research assistants comprised a medical clinical officer, enrolled nurses, and a midwife, who helped the researcher to implement the program, collect and process field data for the

fulfillment of the survey objectives, ensure the accuracy of data, and avoid bias and distorted information, and manage resources to meet the stipulated time deadlines of the study. The research assistants were trained on how to interpret the questions in the questionnaire, gather information, check for completeness of the information, and observe the SOPs. The research assistants were also trained in data entry, presentation, and analysis skills.

Time for data collection

Data collection took eight (8) weeks, starting from 12th December 2022 to 7th February 2023. This was to give ample time for the data collection and analysis to obtain quality and accurate results.

Inclusion criterion

The study included all children under the age of five years who sought treatment at Nakasongola General Military Hospital and whose guardians consented to participate in the study.

Standard operating procedures

All participants involved in the study were required to regularly wash their hands with soap solution and observe social distancing of a minimum of two meters apart, and the children's caretakers were expected to always wear their face masks during the study.

Data Analysis and Presentation.

The research assistants were supervised by the researcher during the data collection procedure to ensure that the questionnaires were filled out correctly and completely. The collected data was kept under key and lock to ensure confidentiality and to protect the research participants. Once the data had been collected, the questionnaires' assigned codes were entered into the Epidata Entry 3.1 software. After entry, the data was exported to Statistical Package for Social Science (SPSS) version 27 software for cleaning and analysis. Data analysis included both descriptive and bivariate analysis. Data concerning categorical variables were summarized and presented in frequency tables and bar graphs. Computing means and standard deviations were used to summarize the data of numerical variables.

Ethical Approval.

Approval was obtained from the Medicare Health Professionals College's Research Committee to carry out the research in Nakasongola General Military Hospital. The researcher then obtained a letter from the College's Academic Registrar, introducing the researcher to the in charge of Nakasongola General Military Hospital. Permission to carry out the study in the health facility was sought from the Hospital Administrator, to whom the researcher explained the objectives of the study.

Participation in the study was complete of free will. Informed consent was obtained from the household (HH) heads who agreed to participate in the study with their child(ren). During the study, the participants were allowed to ask any questions and were assured of confidentiality. The questionnaires were confidential to each individual, and the information that was obtained was strictly confidential and only for academic research purposes. Participants who chose to stop participating in the study at any time, even if they had already given consent, were allowed to withdraw from the study. Refusal to participate or intent to withdraw from the study did not bear any penalty or result in the loss of any benefits to which the participants were otherwise entitled.

Informed consent

A consent form was filled out by the respondents after explaining the purpose of the study to them. The respondents were assured of confidentiality as no names would appear on the questionnaire. No participant was forced to participate in the study, and all the study materials used during the interviews were safely kept under lock and key, only accessible by the researcher.

Results.

Demographic Characteristics of the Children.

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Figure 1: Distribution of CU5 in NGMH by sex

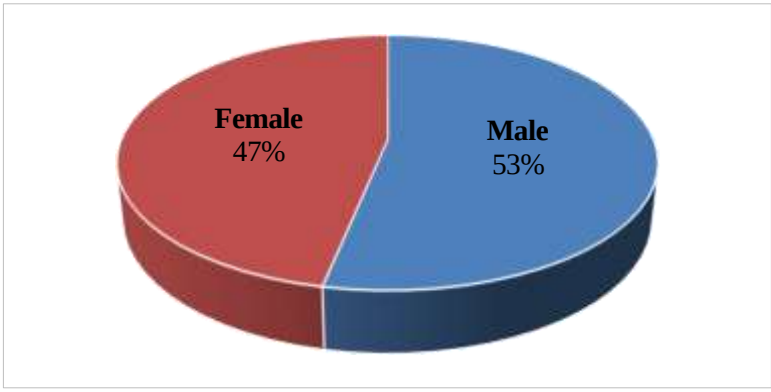

Figure 1 shows that 66 (53.2%) of these children were males and 58 (46.8%) were females.

Figure 2: Distribution of CU5 in NGMH by age groups

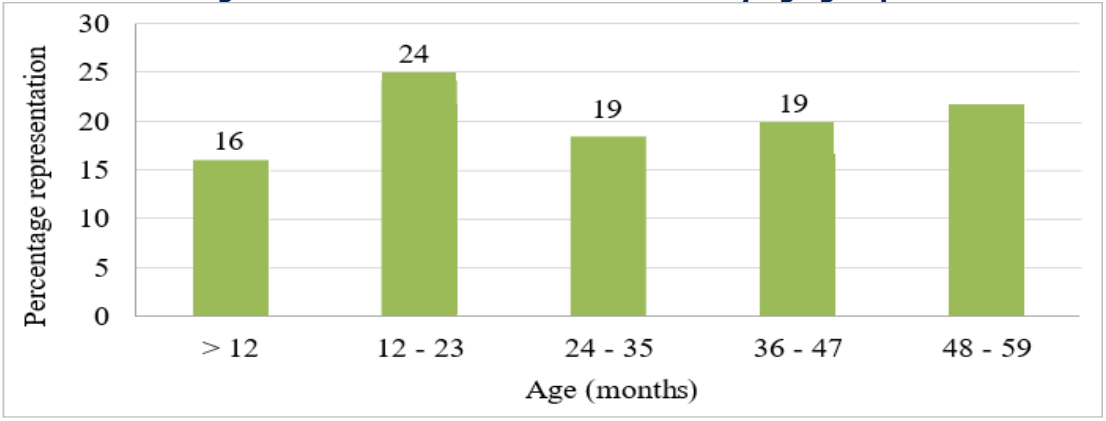

Figure 2 shows that of the 124 CU5 who were included in the study, the majority, 30 (24.2%), were between 12 and 23 months of age, and the least, 20 (16.1%), were aged below 12 months. The mean age of CU5 was 28.7 months, with a standard deviation of 16.3. The minimum and maximum ages of CU5 were 2 and 59 months, respectively.

Prevalence of Malaria in Children Under Five Years of Age.

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Figure 3: Prevalence of malaria in children under five years of age

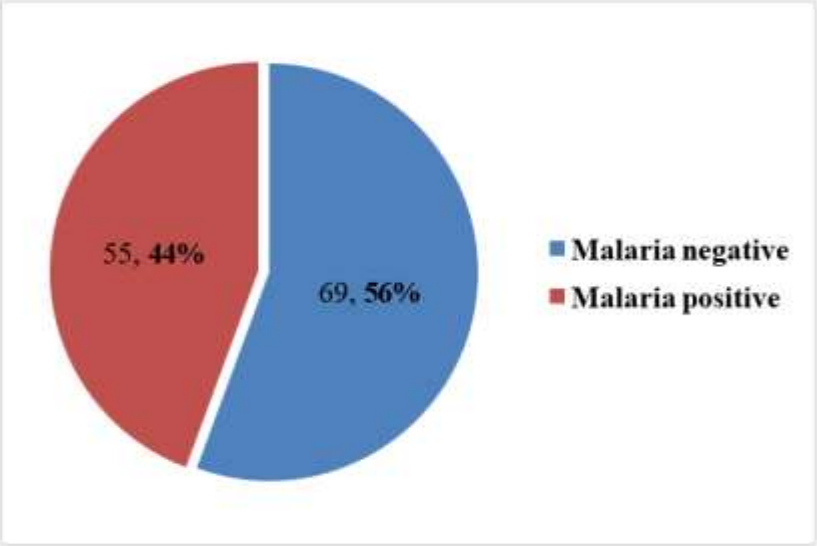

Figure 1 shows that the overall prevalence of malaria was 44.4% (n = 55) in this study.

Table 1: Prevalence of malaria in CU5 according to background characteristics

Background characteristic		Positive, n (%)	Negative, n (%)	Number of children
Age in months	< 12	8 (14.5)	12 (17.4)	20 (16.1)
	12 – 23	11 (20.0)	19 (27.5)	30 (24.2)
	24 – 35	12 (21.8)	11 (15.9)	23 (18.6)
	36 – 47	14 (25.5)	10 (14.5)	24 (19.4)
	48 – 59	10 (18.2)	17 (24.6)	27 (21.8)
Caregiver's interview status	Male	33 (60.0)	33 (47.8)	66 (53.2)
	Female	22 (40.0)	36 (52.2)	58 (46.8)
	Interviewed	55 (100.0)	67 (97.1)	122 (98.4)
	Not interviewed	0 (0.0)	2 (2.9)	2 (1.6)
Total		**55 (100.0)**	**69 (100.0)**	**124 (100.0)**

Table 1 shows that, of the 55 children under five years of age (CU5) who tested positive for malaria, 33 (60.0%) were males and 22 (40.0%) were females. Among the malaria-positive children, the majority, 14 (25.5%), were between

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36 and 47 months of age, while the least, 8 (14.5%), were below 12 months of age.

Socio-Economic Characteristics of the Parents/Caregivers and Malaria Prevalence

This section presents information on the socio-economic characteristics of the survey respondents, such as age, marital status, education, and residence, and prevalence of malaria in children under five years of age. Information on the demographic characteristics of the households in the study provides context to interpret health indicators, and this information sheds light on the living conditions of the population.

Table 2: Socio-economic characteristics of the parents/ caregivers and malaria prevalence in CU5 in NGMH, December 2022 – January 2023

Background characteristics of the parent/caregiver		Total, n (%)	Positive, n (%)	Negative, n (%)
Age in years	15 – 19	28 (22.6)	21 (38.2)	7 (10.1)
	20 – 24	24 (19.3)	14 (25.4)	10 (14.5)
	25 – 29	20 (16.1)	6 (10.9)	14 (20.3)
	30 – 34	17 (13.7)	2 (3.6)	15 (21.7)
	35 – 39	14 (11.3)	3 (5.5)	11 (15.9)
	40 – 44	11 (8.9)	6 (10.9)	5 (7.3)
	45 – 49	8 (6.5)	3 (5.5)	5 (7.3)
Residence	Urban	35 (28.2)	16 (29.1)	19 (27.5)
	Rural	87 (70.2)	39 (70.9)	48 (69.6)
Level of education:	None	14 (11.3)	10 (18.2)	4 (5.8)
	Primary	63 (50.8)	31 (56.4)	32 (46.4)
	Secondary	36 (29.0)	13 (23.6)	23 (33.3)
	Tertiary	9 (7.3)	1 (1.8)	8 (11.6)
Employment status:	Commercial farming	6 (4.8)	2 (3.6)	4 (5.8)
Petty business/boda-boda		10 (8.0)	7 (12.4)	3 (4.3)
Informal job/employment		16 (12.9)	8 (14.5)	8 (11.6)
Formal job/employment		24 (19.4)	10 (18.2)	14 (20.3)
	Casual labour	25 (20.2)	11 (20.0)	14 (20.3)
	Peasant farming	41 (33.1)	17 (30.9)	24 (34.8)
The caregiver was not successfully interviewed		2 (1.6)	0 (0)	2 (2.9)
Total		**124 (100.0)**	**55 (44.4)**	**69 (100.0)**

Table 2 shows that the highest prevalence of malaria parasite infection, 31 (56.4%), was observed among children of parents who had attained primary level education only. There was a lower prevalence of malaria in urban residents' children, 16 (29.1%), as compared to the rural residents' children, 39 (70.9%).

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Coverage of ITN Use among the Community Members

This section presents information on the availability and use of ITNs. Comparing ITN availability and ITN use indicators can help programmes identify if there is a behavioral gap where available ITNs are not being used. If the difference among these indicators is substantial, the programme may need to focus on behaviour change and how to identify the main drivers or barriers to ITN use to design appropriate interventions.

Ownership and utilization of ITNs and malaria prevalence.

Table 3: ITN ownership and utilization, and malaria prevalence.

Background characteristic	Variable	Total, n (%)	Positive, n (%)	Negative, n (%)
Availability of ITN: Yes		105 (86.1)	45 (81.8)	60 (89.6)
No		17 (13.9)	10 (18.2)	7 (10.4)
Total		**122 (100.0)**	**55 (100.0)**	**67 (100.0)**
CU5 sleeping under ITN, Yes		99 (94.3)	40 (88.9)	59 (98.3)
No		6 (5.7)	5 (18.1)	1 (1.7)
Total		**105 (100.0)**	**45 (100.0)**	**60 (100.0)**
HH interview status: Interviewed		122 (98.4)	55 (100.0)	67 (97.1)
	Not interviewed	2 (1.6)	0 (0.0)	2 (2.9)
Total		**124**	**55 (100.0)**	3 **(100.0)**
(100.0)				

Table 3 shows that only 105 (86.1%) of the 122 households (HHs) that completed the study own at least one insecticide-treated net (ITN), and only 99 (94.3%) of the 105 children in HHs that own at least one ITN sleep under an ITN. Children living in households with access to ITN had a higher prevalence of malaria, 45 (81.8%), compared with children living in households without access to ITN, 10 (18.2%). Out of the 105 HHs that own at least one ITN, the prevalence of malaria among those children who slept under an ITN was 40 (88.9), over 70 percentage points higher than for those who did not sleep under an ITN, 5 (18.1%).

Reasons why insecticide-treated mosquito nets were not used

Figure 4: Reasons insecticide-treated mosquito nets were not used.

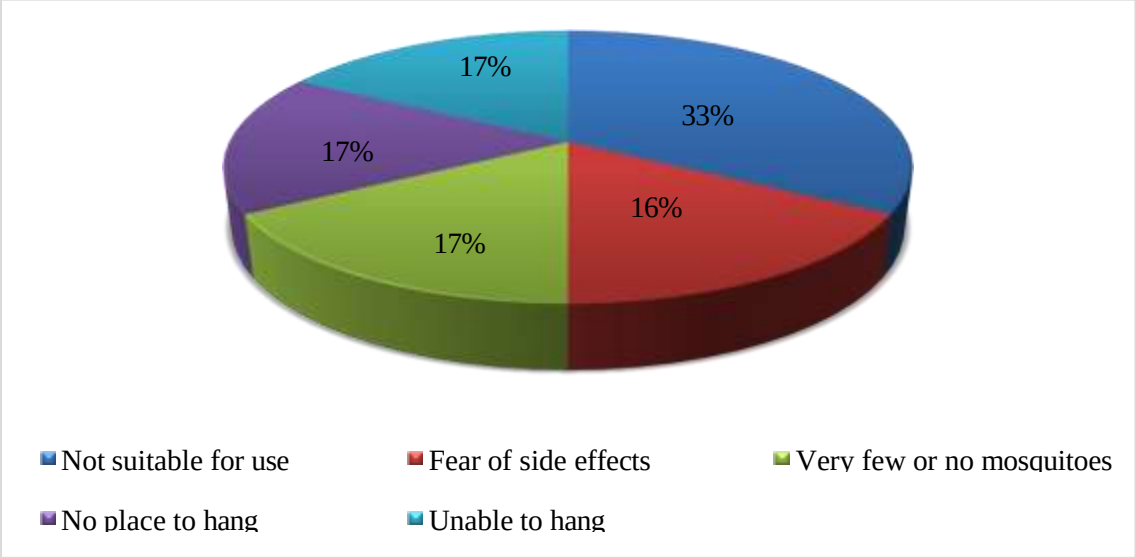

Figure 4 presents reasons why mosquito nets were not used by CU5 in the interviewed HHs the night before the study. The main reasons given for not using an ITN for sleeping the night before the study were: not suitable for use as the net is too old and/or has too many holes, 2 (33.2%); fear of side effects, 1 (16.7%); and very few or no mosquitoes due to the weather, 1 (16.7%). Other reasons for non-use included hanging issues, such as no place to hang as the housing structure affects net use, 1 (16.7%); and unable to hang due to the absence of a bed, 1 (16.7%).

Discussion of results.

Prevalence of Malaria in Children Under Five Years of Age.

This present study showed that the overall malaria prevalence was 44.4% among children under five years of age attending Nakasongola General Military Hospital. This high prevalence is attributed to the fact that this study was conducted in a major malaria transmission season, between December and January. This finding was consistent with a prior study in Sierra Leone, where the prevalence of malaria was 40.05% in children under five using a malaria rapid diagnostic test (RDT) (Bah, 2020).

In contrast, the prevalence was higher compared to a prior study in Arsi Negele, Ethiopia, where the prevalence of malaria was 22.8% in children under five (Mengistu & Solomon, 2015). This difference might be due to the difference in malaria control and prevention programs implemented in Ethiopia and due to the geographical and seasonal variation for the low prevalence of malaria parasites in the study site. Additionally, the prevalence was higher as compared to a study in malaria-endemic forest villages in India, in which it was 36.6% in children under 5 years old (Qureshi *et al.*, 2014). However, the variation in prevalence might be due to the rapid diagnostic test (RDT) used in the study.

The current study found that the malaria infection rate among children aged under 5 years increases with their increasing age in months, as evidenced by the highest prevalence (25.2%) among children aged between 36 and 47 months, and the lowest prevalence (14.5%) among those children aged below 12 months. Children, as they grow, seem more exposed to mosquito bites and, therefore, to malaria as the use of mosquito nets for sleeping generally reduces with increasing age among children. By progressively losing their maternal antibodies, older CU5 become more vulnerable to *Plasmodium*. A similar finding was observed in a previous study conducted in Arba Minch Zuria District, South Ethiopia in which the highest prevalence of *Plasmodium vivax* infection (53.8%) was observed among children aged between 37 – 59 months, and the lowest prevalence (25.0%) was observed among children aged between 12 – 24 months (Abossie *et al.*, 2020).

Socio-Economic Characteristics of the Parents/Caregivers and Malaria Prevalence.

This section discusses information on the characteristics of the survey respondents, such as age, education, and literacy. Socioeconomic characteristics improve understanding of the factors that affect the use of health services and other health behaviors related to malaria control. The knowledge of the socio-economic factors associated with malaria among children under five years provides insight into the methods and policies that can be used to combat this public health problem effectively.

In this study, it was found that malaria prevalence was significantly variable among children from rural areas (70.9%), more than 40 percentage points higher than among children from urban settlements (29.1%). This significant difference may be attributed to the fact that the study site is predominantly covered by typical shrub vegetation, where malaria vectors are abundant in rural settlements. Thus, children of school-going age from rural areas may get infected while traveling to and from school as some pass through forests or agricultural plantations where malaria vectors are abundant, and may thus be more susceptible to mosquito bites than their urban peers This result is similar to another study conducted in Arba Minch Zuria District, South Ethiopia in which the higher prevalence of malaria infection (25.3%) was observed among children from rural areas than children from urban settlements (18.5%) (Abossie *et al.*, 2020).

In this study, the education level of the child's caregiver is an important risk factor for malaria, as evidenced by the highest prevalence of malaria (56.4%) which was observed among CU5 of caregivers with primary-level education, and the lowest prevalence (1.8%) among CU5 of caregivers with tertiary level education. This may be attributed to the fact that more educated individuals have a better understanding of health-related issues. Generally, the higher the level of education an individual has attained, the more knowledgeable they are about both the use of health facilities and health management for themselves and their children. This is in agreement with a study conducted in Guinea, which showed that malaria prevalence was higher (46.92%) among CU5 of parents with no formal education than (41.92%) with at least primary education (Beavogui *et al.*, 2020). This finding, however, is different from that of a study conducted in Bamenda Regional Hospital, North West Cameroon, in which a higher prevalence (63.64%) was noted among neonates whose mothers were university graduates than (9.09%) among neonates whose mothers were had attended only primary school (Nfor & Senyuy, 2020).

The present study indicated that malaria prevalence was highest (30.9%) among CU5 caregivers who were peasant farmers and lowest (3.6%) among CU5 commercial farmers. This may be because the peasant farmers' activities, like creating water channels across the farmlands, could act as breeding grounds for mosquitoes that transmit malaria to their children during farming time. This result is also similar to that of a study conducted in Guinea, which showed that malaria prevalence was higher (47.07%) among CU5 of mothers who were housewives/farmers than (39.2%) among CU5 of mothers with other professions (Beavogui *et al.*, 2020).

Coverage of ITN Use among the Community Members.

ITNs protect against mosquito bites and thus reduce the transmission of malaria parasites. Additionally, ITNs repel and kill mosquitoes. By reducing the vector population, ITNs help to reduce malaria risk at the individual level as well as at the community level when high coverage is achieved. The availability of an ITN is measured by the proportion of the population that has at least one ITN in the household. Comparing ITN availability and ITN use indicators can help malaria intervention programs identify if there is a behavioral gap where available ITNs are not being used. If the difference among these indicators is substantial, the program may need to focus on behavior change and how to identify the main drivers or barriers to ITN use to design appropriate interventions. This analysis helps malaria intervention programs, such as the National Malaria Control Division (NMCD), to determine whether they need to achieve higher ITN coverage, promote ITN use, or both (NMCD, 2020).

In this study, ITN availability was observed among the majority (86.1%) of the participants. Given the fact that the utilization of ITNs is considered a powerful vector control tool for the prevention of malaria transmission (WHO, 2017), furthermore, this study identified that the prevalence of malaria among CU5 of those HHs with ITNs was higher (81.8%) than among CU5 of those HHs without ITNs (18.2%). This may be because those HHs without ITNs use other malaria-preventing methods, such as spraying the insides of houses (where most *Anopheles* species feed and rest) with insecticides (indoor residual spraying, IRS), and by the use of mosquito coils and repellants. This finding differs from that of a study conducted in Arba Minch Zuria District, South Ethiopia, in which a higher prevalence of malaria infection (33.3%) was observed among children from HHs without ITN than among children from HHs with ITN (20.4%) (Abossie *et al.*, 2020).

This present study showed that ITN utilization in children under 5 years is high (94.3%). This may be attributed to the high access to ITN by parents/caregivers for under-5-year-old children. Inconsistent with this finding, a study conducted in the Gamo-Gofa zone, Ethiopia, identified that only 37.2% of children under 5 years of age utilized ITNs at night. Additionally, children under 5 years of age who slept under ITN were significantly protected from malaria infection (98.3%) as compared to children who did not sleep under ITN (1.7%) in this present study. This is similar to a study conducted in Arba Minch Zuria District, South Ethiopia, in which children under 5 years of age who slept under ITN were significantly protected from malaria infection (93.3%) as compared to children who did not sleep under ITN (59.0%) (Abossie *et al.*, 2020).

According to this study, the main reason why mosquito nets were not used by CU5 in the interviewed HHs the night before the study was that the ITNs were deemed not suitable for use as the net was too old and/or had too many holes (33.2%). In contrast with this finding, in a study conducted in Soroti district, North Eastern Uganda, children under 5 years of age were not sleeping under ITNs because of the high cost of ITNs (79.3%) and fear of suffocation (46.6%) (Akello *et al.*, 2022).

Conclusions.

The findings from this study have provided insights into the demographic and socio-economic factors, such as age and education level of the household head, use of mosquito bed nets for sleeping, place of residence, and age of the children, which were significant factors associated with malaria prevalence among children aged under 5 years. Therefore, the findings from this study may help public health planners, policy-makers, and other related institutions in effective decision-making related to malaria control, especially as it pertains to children under 5 years.

The results from this study revealed that malaria infection is still highly prevalent in children under 5 years old, particularly those aged between 36 – 47 months, and among children of parents who had attained no formal education, which suggests the need for an intervention in these groups. The study indicated that households that had at least one ITN were more protected from malaria parasite infection than those that lacked ITNs.

Despite the household distribution of insecticide-treated nets, some children under 5 years of age did not sleep inside mosquito nets. The caregivers of these children reported fear of side effects and perceived low mosquito density as reasons for not using available mosquito nets in the study area.

This study found that the use of insecticide-treated nets is an important intervention to prevent malaria infection among children under 5 years. Thus, when ITNs are used consistently, the risk of getting mosquito bites might be avoided.

Study Limitations

Some respondents expected a token after the interview, which the researcher was not able to provide.

The researcher faced the problem of the language barrier, given that the study was set in an area where Ruluri is the dominant language. Other local languages used include Luganda and Ateso.

Recommendations.

Despite the household distribution of insecticide-treated nets, some children under 5 years of age did not sleep inside mosquito nets. Hence, ITN utilization should be enforced by the government; for instance, the local government should focus on health information dissemination about ITN utilization.

This study found that the use of insecticide-treated nets is an important intervention to prevent malaria infection among children under 5 years. This suggests that special consideration should be given to malaria control, such as the provision of ITNs. Supplementing this control measure with education on practicing safe living habits, such as reducing outdoor activities during peak biting hours of mosquitoes, can go a long way in aiding the reduction of the burden of malaria in Uganda.

The extent of the underdevelopment of the study area also presents a great challenge in the national efforts of malaria reduction, especially as the study area is located in a rural region of the country. As resources for malaria control in Uganda are limited, it is of great importance that national studies be conducted to identify the different geographical regions of the country most at risk of malaria through updated malaria risk maps. These risk maps, created through spatial modeling, can be an important tool for malaria control, where they can effectively guide the allocation of limited resources and interventions.

The large up-scaled efforts of malaria control in Uganda can be seen since the last MIS in 2019. However, eliminating malaria and achieving the sustainable development goals by 2030 in Uganda will require a targeted intervention approach to better prevent and manage malaria in the study site, along with further qualitative research studies warranted to evaluate the effectiveness of malaria chemoprevention approaches and its impact in reducing community transmission to inform and support malaria control and elimination efforts.

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List of abbreviations.

AIDS: Acquired immune deficiency syndrome
CU5: Children under five years of age
HH: Household
HIV: Human immunodeficiency virus
HMIS: Health Management Information System
IRS: Indoor-residual spraying
ITN: Insecticide-treated mosquito net
MIS: Malaria Indicator Survey
NGMH: Nakasongola General Military Hospital
NMCD: Uganda National Malaria Control Division
NMCP: National Malaria Control Program
NRM: National Resistance Movement
OPD: Outpatient Department
RDT: Rapid diagnostic test
SSA: Sub-Saharan Africa
SOPs: Standard operating procedures
UMIS: Uganda Malaria Indicator Survey
USD: United States Dollars
WHO: World Health Organization

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Availability of data.

Data used in this study are available upon request from the corresponding author.

Authors contribution.

SA designed the study, conducted data collection, cleaned and analyzed data, and drafted the manuscript, and LA supervised all stages of the study from conceptualization of the topic to manuscript writing and submission.

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