FACTORS INFLUENCING THE PREVALENCE OF MALARIA AMONG CHILDREN BELOW 10 YEARS AT NYIMBWA HEALTH CENTER IV, LUWEERO DISTRICT. A CROSS-SECTIONAL STUDY.

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ABSTRACT.

Background:
Broad objective: To assess the factors influencing the prevalence of malaria among children below 10 years at Nyimbwa Health Center IV, Luweero district.
Specific objectives: To determine, evaluate, and assess the demographic, economic, and environmental factors that influenced the prevalence of malaria among children below 10 years at Nyimbwa Health Center IV, Luweero district.

Methodology:
A cross-sectional study in which both qualitative and quantitative data were collected from a sample of 81 respondents who were obtained using a simple random sampling technique, The data collection method was a face-to-face interview using a questionnaire.

Results:
Malaria cases were children aged between 9 and 10 years(33%),60% lived in villages, 52% of cases were males and 48% females, 42% were Baganda, (46%) from families earning between UGX 110,000 to 300,000 monthly, 79% from houses constructed with cement, 89% used latrines,52% got water from boreholes,72% lived in homes with nearby stagnant water (72%).85% lived in houses with no holes, 79% reared some animals and 57% disposed of wastes in rubbish pits.

Conclusions:
The study established that factors like the age and sex of the children, the economic status of the family, presence of stagnant water greatly influenced the prevalence of malaria. Other factors included education levels of guardians, religions, places of residence, source of water for domestic purposes, method of excreta, and waste disposal.

Recommendations:
Guardians should make sure children sleep under treated mosquito nets, exclusive breastfeeding for at least the first six months and a balanced diet for older children, clearing bushes and draining stagnant water near homes to keep away from breeding mosquitoes. Health workers should create awareness of malaria prevention and effective treatment of positive cases. The government should equip health facilities with adequate staff, drugs, and necessary equipment, and timely delivery of free mosquito nets to the population.

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BACKGROUND OF THE STUDY.

Malaria is a disease caused by protozoan parasites of the genus Plasmodium which is transmitted to humans by blood-feeding infected female Anopheles mosquito. Plasmodium Falciparum, Plasmodium vivax, Plasmodium ovale, and Plasmodium malariae are the four human plasmodium species (Balcha et al, 2023). Malaria can cause fever, chills, and flu-like illness. If not treated can cause severe complications and sometimes death.

Globally, Malaria is one of the primary global health problems with an estimated 247 million Malaria cases in 2021 in 84 malaria-endemic countries, an increase from 245 million cases in 2020 with most of this increase from countries in the World Health Organisation African region. Estimated deaths from Malaria declined in 2021 to

619,000 deaths, between 2019 and 2021 there were 63,000 deaths. (WHO, 2022).

In the African region with an estimated 234 million cases in 2021, which accounts for about 95% of global cases occurring in Africa with sub-Saharan African countries recording higher cases. Malaria is still a considerable burden on children in Africa causing an estimated 10% of all deaths of children on the continent. (WHO, 2022)

In a study to determine plasmodium Falciparum parasite prevalence in East Africa, more than 12.7 million people resided in communities where parasite prevalence was predicted greater or equal to 30% including 6.4%, 12.1%, and 6.3% of Kenya, mainland Tanzania, and Uganda populations respectively. Conversely, areas that supported very low parasite prevalence (less than 1%) were inhabited by approximately 46.2 million people across the sub-region or 52.2%, 26.7%, and 10.4% of Kenya, mainland Tanzania, and Uganda populations respectively (VA Alegana et al,2021).

Prevalence of malaria remains high in many of the East African countries, for instance, from the malaria indicator survey studies, Tanzania had 7% in 2017, Burundi 22% in 2016-2017, Kenya 5% in 2015, Rwanda 7% in 2017, Uganda 30% in 2016 and South Sudan 32% in 2017 (R Kooko et al, 2023).

Uganda has the third highest cases of Malaria and deaths in Africa and is ranked fifth amongst countries in the world with the highest number of cases. (JF Nansubuga ,2021).
Luweero district is one of the districts in central Uganda, in research to determine land use/land cover changes and its relationship with malaria prevalence in Luweero district, it was found that the district is one of the hotspots for Malaria in Uganda with 24% rate. (JF Nansubuga, 2021).

General objective.

To assess the factors influencing the prevalence of malaria among children below 10 years at Nyimbwa Health Centre IV, Luweero district.

METHODOLOGY.

Study Design.

In this study, a descriptive cross-sectional des was used to identify factors influencing the prevalence of malaria among children below 10 years in Nyimbwa Health Center IV, Luweero district. This is because the study took a short time and the method was easily applicable.

Study Area.

The study was conducted at Nyimbwa Health Centre IV in Niemba sub-county, Katikamu south constituency, Luweero district located in central Uganda. The health facility is located about 3 kilometers from Bombo town and half a kilometer off Gulu highway and offers health services like general medicine, antenatal services, laboratory services, dental services, HIV counseling and testing, ART services, and many others.
This study was carried out at Nyimbwa Health Centre IV, Luweero district in central Uganda.
The study focused on children below 10 years who were seeking treatment from the health facility at the time of the study.
The study was carried out between July 2023 and August 2023.

Study Population.

The study focused on children below 10 years who were seeking health care from the health facility at the time of study and data was majorly collected from their guardians or any mature person they came with. The study population comprised several people of different ethnicities like Baganda, Bakiga, and Banyankole. Religions like Muslims, Catholics, Anglicans, Born agains. Socioeconomic statuses, cultural practices, and beliefs. The population that was included in the study not only came from the vicinity of Nyimbwa health center IV or just Nyimbwa sub-county but also from areas 10km with an inclusion of those from nearby districts of Wakiso, Nakaseke, and Nakasongola. Both literate and illiterate respondents were dealt with provided they happened to meet the inclusion criteria.

Sample Size determination.

This was determined using the Kish Leslie formula for sample size determination, which states that;
N=z²(pq)/d²
Where **N**=required sample size
z= Normal curve constant that represents the level of confidence (1.96)
p=proportion of the target population will be estimated to have malaria and will be assumed to be 70% (0.7)
q=1-**p** (proportion in the target population that won't have malaria)
Therefore **q**=1-0.7
            =0.3
d=degree of precision desired which ranges from 0.01 to 0.1
Thus **N**=(1.96²×0.7×0.3)/(0.1²)
        =80.6736 ~ 81
A sample size of 81 respondents was involved.

Sampling Technique.

A non-probability convenience sampling technique was used to recruit the desired sample size because using this method respondents are easy to access, it is relatively cheaper, and time conscious.

Sampling Procedure.

Using a convenient sampling technique, children aged below 10 years who attended the facility specifically those whose guardians were willing to participate in the study and present at the time of data collection provided the children had laboratory-proven positive malaria parasite test.

Data Collection Method.

A face-to-face interview was used to collect respondent's information, this was between the researcher or researcher assistant and the respondents because it allowed me or the research assistant to interpret questions that some respondents were not able to understand.

Data Collection Tool.

A questionnaire tool was used for data collection in this study. The questionnaire had revised questions and this helped the researcher to collect information about demographic, economic, and environmental factors influencing malaria prevalence among children below 10 years at Nyimbwa Health Center IV Luweero district. Questions were printed in the English language with both close-ended and open-ended questions.

Data Collection Procedure.

An introductory letter was obtained from Medicare Health Professionals College through the District Health Officer to the chief administrative officer of the Luweero district to seek permission to carry out the study from Nyimbwa Health Center IV. I explained the procedure and importance of the study to the respondents, then consent was obtained from those who were to participate in the study. Questionnaires were provided to the respondents with the help of research assistants and questions will be interpreted for those participants who could not understand them and for those who couldn't read or write. After the procedure, questionnaires were collected and counted to make sure that they add up to 81 and finally respondents were appreciated for their participation and cooperation.

Study Variables.

The study considered both dependent and independent variables.

Dependent Variable.

Prevalence of malaria among children below 10 at Nyimbwa Health Center IV, Luweero district

Independent Variables.

These included demographic, economic, and environmental factors influencing the prevalence of malaria among children below 10 years at Nyimbwa Health Centre IV, Luweero district

Quality Control.

Pretesting of the questionnaire.

A sample of 30 respondents of the same age group was used in pretesting the questionnaire. This sample was obtained from Bombo health center iii, they were asked to complete the study by answering the questions. Each time they read and answered the question, were asked to tell what exactly came into their minds, and notes about what they said were taken. The reason for pretesting was to identify poorly phrased questions and wrong-structured questions. At the end of pretesting these poorly phrased and wrongly structured questions were removed, changed, or restructured.

Training of research assistants.

A session was organized in which two research assistants were oriented on the objectives of the study, how to handle respondents with calmness and patience, and different ways of answering questions if they happened to be asked. They were taught how to record patients' responses during the interview process and how to interpret the nonverbal communication of patients.
Ample time for data collection
Data was collected within a month during the health center attachment which was enough to collect the data from all 81 respondents.

Inclusion criteria.

- Children with positive laboratory tests for malaria parasites below 10 years of age, with or without a history of fever in the past 48 hours.
- Children with positive laboratory tests for malaria parasites and their guardians had consented to take part in the study.

Exclusion criteria.

- If more than one case of malaria was from a single family, one was considered, and the other left.
- Children with other clinically detectable reasons for fever other than malaria parasite infection.
- Those with signs of severity of malaria infection indicating a need for referral were not included in the study.

Data analysis and presentation.

Data collected was entered into Microsoft Excel and was analyzed by SPSS software and the results are presented in the form of frequencies, tables, percentages, pie charts, and graphs in the fourth chapter.

Ethical consideration.

A letter of introduction to the study area was obtained from Medicare Health Professionals College addressed to the District Health Officer (DHO), Luweero district seeking permission to conduct a study from Nyimbwa Health Center IV. Permission was sought from the in-charge of Nyimbwa Health Centre IV to carry out the research from the facility.

The respondents were allowed voluntary participation in the study and their right to withdraw from the study at any time without any repercussion.

Strict confidentiality was maintained mainly by assigning serial numbers instead of their names.

Respect for the interests of the respondents, norms, and values.

The study included both girl and boy children with equal chances of participation.

RESULTS.

Demographic data of respondents.

Table 1: shows the demographic characteristics of the respondents.

Characteristic	Category	Frequency	Percentage (%)
Age	Below 2 years	10	12
	3 to 5 years	19	24
	6 to 8 years	25	31
	9 to 10 years	27	33
Place of residence	Town	33	40
	Village	48	60
Tribe	Baganda	34	42
	Basoga	4	05
	Banyankole	5	06
	Nubian	31	38
	Others	7	09
Religion	Muslim	27	33
	Catholic	18	22
	Anglican	19	24
	Born again	14	17
	Others	3	04
Gender	Male	42	52
	Female	39	48
Level of education of the guardians	Up to primary seven	33	41
	Up to senior four (UCE)	27	33
	Senior six and above	21	26

Source: Primary data (2023)

From Table 1, the majority of the respondents, 27(33%) were aged between 9 and 10 years, and 25(31%) were aged between 6 and 8 years. 19(24%) were between 3 and 5 years. 10(12%) were below 2 years old.

In most of the cases, 48(60%) lived in villages whereas the rest, 33(40%) lived in towns. Majority, 34(42%) were Baganda, 31(38%) were Nubians, 5(6%) were Banyakole, 4(5%) were Basoga and 7(9%) belonged to other tribes.

Majority, 27(33%) were Muslims, 18(22%) were Catholics, 19(24%) were Anglicans, 14(17%) were Born again and 3(4%) belonged to other religious beliefs.

Most of the respondents, 42(52%) were males and the rest, 39(48%) were females.

Most of the respondents 33(41%) had an education level of up to primary seven, 27(33%) had reached senior four, and 21(26%) had gone up to senior six and above.

Economic characteristics of respondents.

Figure 1 shows the estimated monthly income for the children's guardians in percentages (n=81)
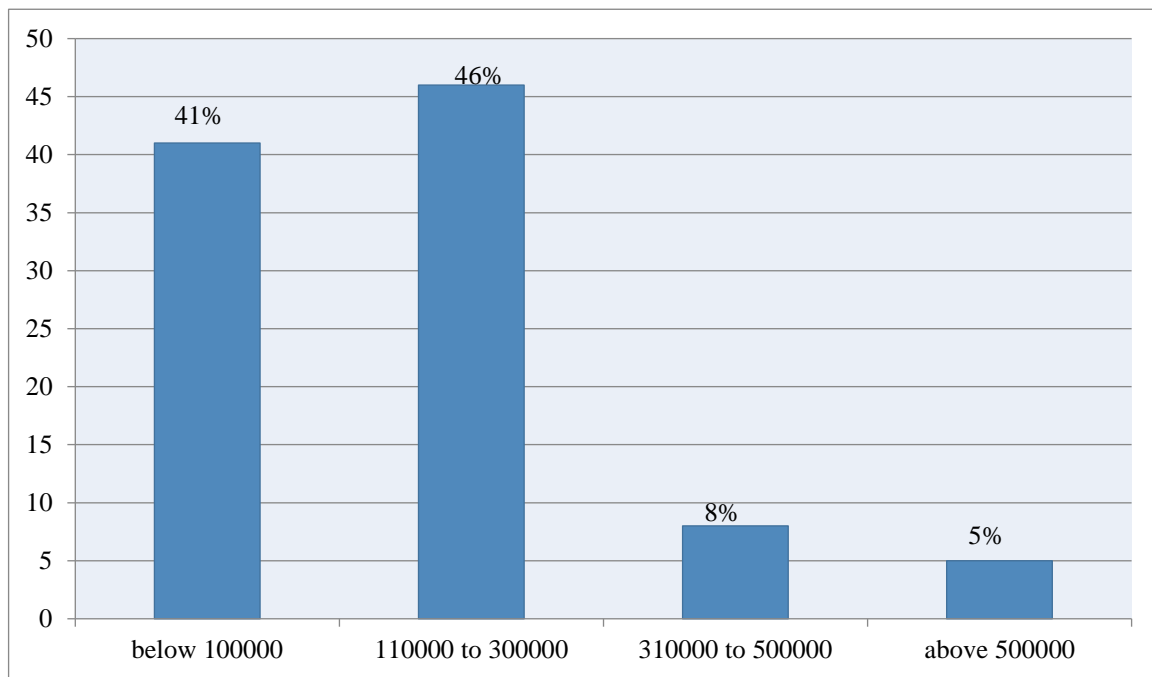
Source: *Primary data (2023)*

From Figure 1, it can be concluded that most of the cases of malaria, 46% were from families earning an estimated amount of money between 110,000 and 300,000 UGX, 41% were from families earning below 100,000UGX, 08% from families earning between 310,000 and 500,000UGX and 5% were from families earning above 500,000UGX.

Figure 2 A pie-chart showing percentages of the sample and the different kinds of houses they live in. (n=81)
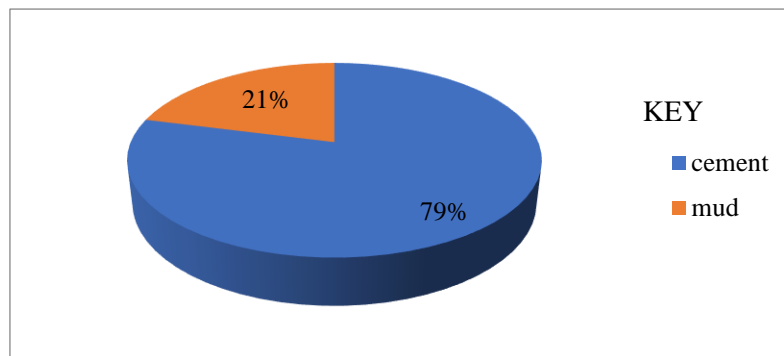
Source: Primary data (2023)

From Figure 2, most of the respondents, 79% of respective individuals lived in houses that were constructed with cement Walls whereas 21% of the sample lived in houses with walls constructed with mud.

Figure 3 A pie chart showing percentages of individuals who lived in houses with holes and those who lived in ones without holes. (n=81)
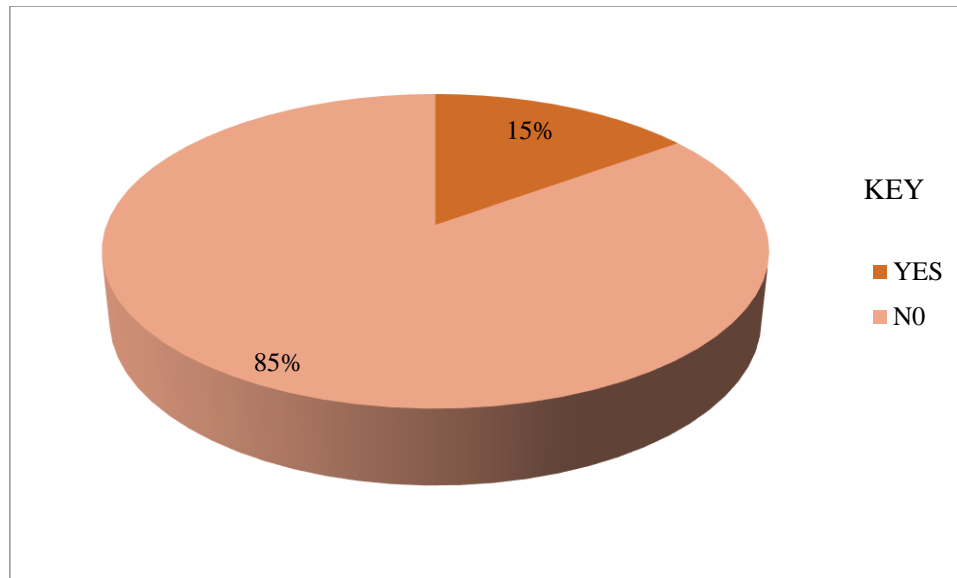
Source: Primary data (2023)

From Figure 3, the majority 85% lived in houses with no holes and 15% lived in houses with holes.

Table 2: shows the various methods of human excreta disposal by respondents. (n=81)

Method of disposal	Frequency (n=81)	Percentage (%)
Latrine	72	89
Toilet	9	11
Others	00	00

Source: Primary data (2023)

From Table 2, the biggest number of individuals, 72(89%) used latrines for excreta disposal, and 9(11%) used toilets.

Table 3: showing the respondents whose homes had electricity and those whose didn't. (n=81)

Have Electricity	Frequency	Percentage (%)
Yes	58	72
No	23	28

Source: Primary data (2023)

From Table 3, the majority 58(72%) had electricity in their homes, and the rest, 23(28%) didn't have electricity.

Table 4: Table showing the source of water for domestic purposes by respondent's families. (n=81)

Source of water	Frequency	Percentage (%)
Piped water(tap)	15	19
Borehole	42	52
Well	14	17
Rain harvesting system	10	12

Source: Primary data (2023)

Table 4 shows the biggest portion, 42(52%) fetched water for domestic purposes from boreholes, 15(19%) got water from taps, 14(17%) used water from wells, and 10(12%) got their water from rain harvesting systems.

**Environmental factors of respondents.**

Figure 4: A bar graph showing whether there was stagnant water near respondents' homes or not. (n=81)
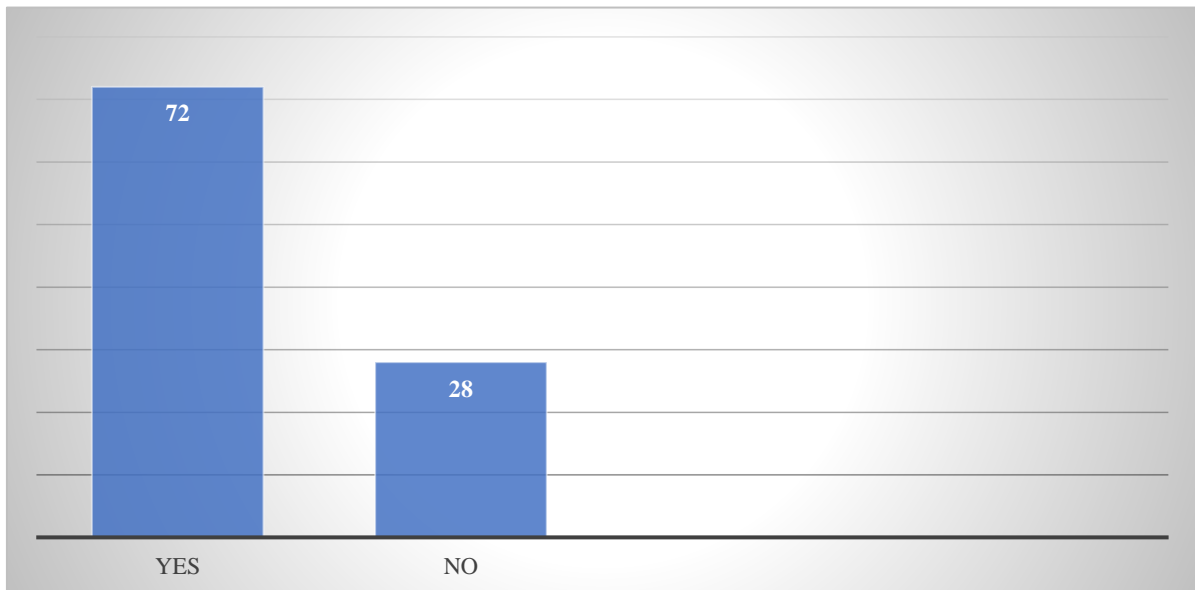
Source: primary data (2023)

Figure 4 shows that most of the respondents, 72% had stagnant water near their homes, and the rest, 28% didn't.

Figure 5: shows the proportion of the respondents who were rearing some animals and those who didn't. (n=81)
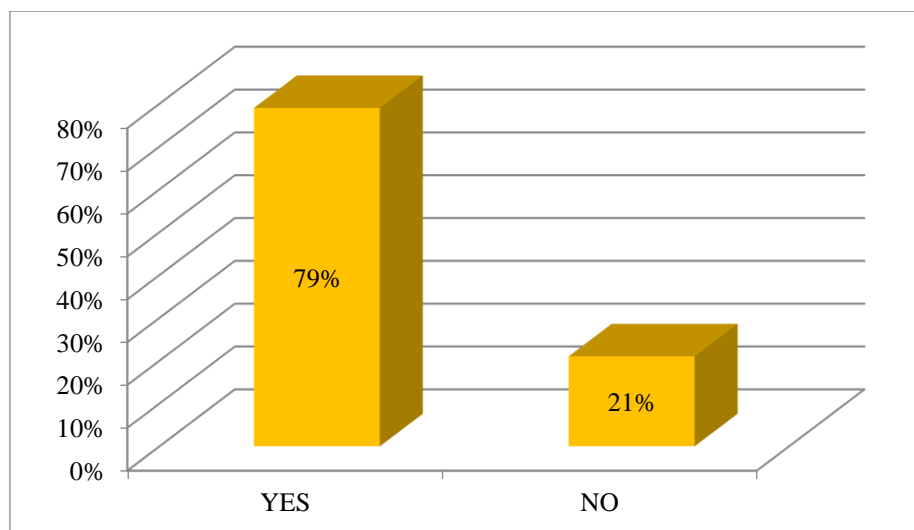
Source: Primary data (2023)

From Figure 5, the biggest number of respondents (79%) reared some animals whereas 21% did not rear any animal.

Table 5: shows the different methods of waste disposal used by the different respondents in their respective homes. (n=81)

Method of domestic waste disposal	Frequency	Percentage (%)
Rubbish pit	46	57
Burning	12	15
Other methods	23	28

Source: Primary data (2023)

From Table 5, the majority, 46(57%) of the respondents disposed of their domestic waste in rubbish pits, 12(15%) burnt their domestic waste, and 23(28%) used other methods of waste disposal.

DISCUSSION.

Demographic factors influencing the prevalence of malaria among children below 10 years.

It revealed that as a child gets older, the likelihood of malaria infection increases. This indicates that malaria prevalence increases with the increasing age of the children. These findings could be because of some factors like; Young children in their first 12 months of life are protected by maternal antibodies. Immunoglobulin G is actively transferred from the mother to the fetus during pregnancy. Breastfeeding children still get protection from secretory Immunoglobulin A. Supervision of older children is usually bothersome so caregivers find it difficult to protect older children hence exposure to mosquito bites. On the other hand, infants and young children are protected with clothing and mosquito nets wading off mosquitoes. The results of the study agree with the results of the study that was carried out in Sierra Leone (Morakinyo et al, 2018) in which older children had higher proportions of malaria as well as increased risk of infection.

The findings of the study showed that male children had a higher prevalence of malaria than females, this means that the prevalence of malaria was higher in male children than female ones. This might be because male children seek to know much and always play outdoors up to night hours exposing them to mosquito bites. These findings agree with the findings of the study carried out in Sierra Leone (MS Bah et al 2020) which also showed the prevalence of malaria to be higher in male than female children.

The study results also showed the prevalence of malaria was higher in Baganda compared to other tribes, this indicates that malaria prevalence varied with the tribes of the children. This could be because the health facility is in a region that is inhabited mostly by the Baganda tribe as it's within the Buganda kingdom and so most of these Baganda seek treatment from the health facility, other tribes had lower prevalence because of their scarcity in the area. These findings disagree with the findings of the study that was carried out in Uganda in the Kanungu district (Katarina ost et al 2022) which showed a higher prevalence of malaria in the Batwa than Bakiga tribes.

The study findings revealed children whose guardians had obtained up to primary level education had a higher prevalence of malaria than those who had attained education up to Senior four, senior six, and above. This indicates that malaria prevalence decreased with increasing education levels of the children's guardians. Probably this could be because with increasing education levels, guardians are equipped with some knowledge to read and write so in case of malaria prevalence campaigns which are mostly in English and their local languages are to understand and hence can be implemented. Also, during education careers, malaria is something unavoidable to talk about so the educated are equipped with the knowledge about what malaria is and how to get rid of it. These findings agree with those of the study that was carried out in Rwanda to determine the geostatistical modeling of malaria prevalence among fewer than five children (JD. Nzabakiriraho et al 2021) which found out that malaria prevalence was higher in children whose mothers had no education while showed no positive cases among children whose mothers attained higher education.

Economic factors influencing the prevalence of malaria among children below 10 years.

The prevalence of malaria was higher in children from families earning 110,000 to 300,000 Uganda shillings monthly than those earning below 100,000 and those earning above 500, 000. This indicates that to some extent malaria prevalence decreased with increasing monthly income. This probably could be because 110,000 to 300,000 Uganda shillings is quite a small amount to cater for good housing, buying of mosquito nets, transport to the health facilities, and affordability of medication from private facilities which poses a threat of malaria burden.

However, families with earnings of below 100,000 Uganda shillings monthly had their children with malaria prevalence slightly lower than those from families earning between 110,000 to 300,000 possibly because most of the

population are farmers and do some small-scale businesses which puts them in the category of 110,000 to 300,000 than their counterparts earning below 100,000 who were few. Those who earn above 500,000 Uganda shillings are sought to be in a position to afford good housing, cater for medication from private facilities, and have transport to health facilities. These results agree with those of studies that were carried out in Nigeria (O.B. Awosolu et al 2021), Uganda which showed children from households with lower economic statuses had a higher prevalence of malaria than those from households with higher economic statuses.

The study revealed that children who lived in houses that were constructed with cement Walls had a higher prevalence of malaria than those who lived in houses that were constructed with mud. This indicates that malaria prevalence varied with differences in the type of housing. This was because houses constructed with cement Walls predominate in the area of study, again people believe that with the beauty of the house they lived in, infections due to mosquitoes and sanitation issues were solved, so they tend to be reluctant to prevent malaria-like for instance they ignore use of mosquito nets, delay out at night allowing mosquitoes to enter their houses. These results disagree with those of the study carried out in Cameroon (Ngadjeu et al 2020) in which it was found that the risk of being bitten by a mosquito was lower in houses constructed with cement walls and higher in houses that were constructed with mud and plunk, this increased prevalence of malaria in children from households constructed with mud and plunk.

The study also revealed that malaria prevalence was higher in children whose homes had latrines for excreta disposal than those with toilets. This indicates that malaria prevalence changes with variations in excreta disposal facilities. This could be because some homes have pit latrines that are almost full and serve as breeding places for mosquitoes, increasing the risk of mosquito bites. Again, latrines are always at a distance from the dwelling house than most toilets which are constructed with the dwelling house so children are often exposed to mosquitoes when they opt to go the latrines mostly at night. These findings agree with the findings of the study that was carried out in Sub-Saharan Africa that showed children who used latrines had a higher prevalence of malaria than those who used toilets (D. Yang et al 2020).

Furthermore, the findings of the study revealed that children from homes that get water for domestic purposes from Boreholes had a higher prevalence of malaria than those who used other sources of Water. This indicates that the risk of malaria varied with the source of domestic water. This probably could be because some children who are aged from 6 to 10 years are at times sent to fetch water from the boreholes which are more common in the community than the taps, mostly during evening and night hours exposing them to mosquitoes increasing the risk of malaria. Also, almost all boreholes have ponds for the collection of water that overflows during fetching, this

water remains stagnant hence a breeding place for mosquitoes. These findings disagree with those of the study in India, which showed higher malaria prevalence in households with no proper water sources than those that used piped water (RK. Sharma et al 2021)

Environmental factors influencing the prevalence of malaria among children below 10 years.

The study revealed that the prevalence of malaria was higher in children whose homes were located in low-altitude areas (valleys) than those whose homes were located in high-altitudes (hills). This indicates that malaria prevalence decreased with increasing height from the sea level. This could probably be because low-altitude areas are found to have some breeding places for mosquitoes like potholes and ponds that collect and retain water from the areas at a relatively higher altitude than them. Mosquitoes find it easy to fly shorter distances from breeding sites so those in valleys near these sites are at risk of mosquito bites than those in hilly places. These findings agree with those of the study that was carried out in Rwanda (G. Rudasingwa et al 2020) which indicated malaria prevalence decreases with increasing altitude.
The study findings didn't show any relationship between the amount of rainfall and temperature in the places of residence of the children as tools for this limited opportunity, all that was obtained was that all of the children who were included in the sample came from areas that received 2 seasons of rainfall and experience 2 dry seasons annually and so no association was noted between amount of rainfall or temperature and the prevalence of malaria.

The study revealed that the prevalence of malaria increased higher in children who lived in homes with stagnant water within a distance of about a quarter the length of a football pitch than with stagnant water at a longer distance. This indicates that malaria prevalence increased with the presence of stagnant water in the shortest length of the dwelling house. Probably this is because stagnant water acts as a breeding site for mosquitoes, which bite to expose one to malaria if they happen to have the malaria parasite. These findings are consistent with those of the study that was carried out in Kiryandongo General Hospital (Sande Kereen et al 2023) which also revealed that the risk of cerebral malaria was associated with the presence of stagnant water within 10 meters of households.

The study also revealed that those who used pits for disposal of domestic wastes had more malaria cases than those who used burnt and dispersed their wastes. This indicates that malaria prevalence varied with the method of domestic waste disposal. Probably this could be because domestic wastes are piled in pits and those that are dispersed serve as breeding sites for mosquitoes increasing the risk of mosquito bites as mosquito numbers increase. These findings agree with those of the study that

was carried out in Nigeria that showed that malaria prevalence was high among under-five children who lived in households whose waste disposal pits were less than 10 meters than those from households whose waste disposal pits were greater than 10 meters from dwelling units. (T. Bayode, et al 2022).

CONCLUSIONS.

The study established that older children had higher cases of malaria than their young counterparts, those who lived in towns had a lower prevalence of malaria than those who lived in villages, and male children were more affected than females. Therefore, demographic factors like age, sex of the children, education levels of the guardians, and places of residence greatly influenced the prevalence of malaria among children below 10 years.

Children who were from families of lower socio-economic statuses had a higher prevalence of malaria, those who fetched water for domestic purposes from boreholes, children who lived in houses constructed with cement walls, and the ones from households with latrines as the method of excreta disposal. Therefore, economic factors influencing the prevalence of malaria were; the guardian's monthly income, source of water for domestic purposes, construction materials for the dwelling house, and method of excreta disposal.

The presence of stagnant water near the dwelling unit of the children was the major environmental factor that influenced the prevalence of malaria. However, having houses located in raised areas like hills, and burning domestic wastes instead of disposing in rubbish pits proved protective against malaria so that the prevalence was lower in these households. Therefore, environmental factors like the presence of stagnant water near homes, the altitude of the homes, and domestic waste disposal methods influenced the prevalence of malaria among children below 10 years.

RECOMMENDATIONS.

Guardians are advised to protect their children against mosquitoes by making sure that children sleep under treated mosquito nets, exclusive breastfeeding for at least the first six months and a balanced diet for older children, clearing bushes around their homes and draining stagnant water near their homes.

Health workers are urged to health educate guardians on how to prevent the spread of malaria and also prompt and effective treatment of positive cases.

The government should equip health facilities with adequate staff, drugs, and necessary equipment, and also timely delivery of free insect-treated nets (ITNs) to the population.

LIST OF ABBREVIATIONS.

ART:	Anti-retroviral therapy
CDC:	Center for Disease Control
DHO:	District health officer
HCIV:	Health Center IV
LLINs:	Long-lasting insecticidal nets
RDT:	Rapid diagnostic tests
UAHEB:	Uganda Allied Health Examination Board
UCE:	Uganda certificate of education
WHO:	World Health Organisation

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