

Prevalence and factors contributing to malaria infection among the under five children attending Buvuma Health Centre IV in Buvuma Island District

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Prevalence and factors contributing to malaria infection among the under five children attending Buvuma Health Centre IV in Buvuma Island District.

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Abstract

Background: Malaria is the leading cause of morbidity and mortality among under-five children in Uganda especially in hard-to-reach areas such as islands. This study aimed at determining the prevalence and factors associated with malaria infection among under-five children attending Buvuma Health Centre-IV in Buvuma District.

Methods: Across-sectional study was conducted among the under-five children attending the facility, data was collected using a structured questionnaire and malaria diagnostic test results. Descriptive statistics were used to determine prevalence, and multivariate logistic regression was performed to identify factors independently contributing to malaria infection.

Results: Overall, 57.6% of the 243 participants tested positive for malaria. In this study, bivariate analysis was done on all variables that were seen necessary to cause or risk malaria infection. In Multivariate analysis, children whose caregivers incurred transport costs of UGX 11,000–15,000 ($p=0.020$) and those living in households without window or door screening ($p=0.038$) were significantly more likely to test positive for malaria. Children from middle-income households (UGX 210,000–400,000) were also more likely to have malaria ($p=0.042$). Children aged 48–59 months ($p=0.035$) and those living in households with 3–4 rooms ($p=0.011$) were less likely to test positive.

Conclusion: Malaria prevalence in Buvuma Island setting remains high. Structural housing characteristics, healthcare accessibility and social-economic factors were significantly associated with the infection. Strengthening household-level vector control, promoting early care-seeking and improving community malaria services may reduce the burden among under-five children.

Keywords: Malaria, under-five children, prevalence, risk factors, Uganda.

Background

The global estimated malaria cases in 2020 were 241 million and 627,000 deaths across 85 malaria-endemic countries with Africa especially Sub-Saharan African (SSA) countries causing the greatest burden of the disease. This estimate showed an increase of 14 million cases from the 227 million 2019 cases and such an increase was highly attributed to the negative impact of COVID-19 pandemic on access to malaria services (WHO, 2021b, 2021a).

The African region, regrettably, accounts for 96% of all malaria cases and 96% of malaria deaths where under-five children account for 80% of all deaths in the region. Six Sub-Saharan Africa

(SSA) countries namely Nigeria (27%), the Democratic Republic of Congo (12%), Uganda (5%), Mozambique (4%), Angola (3.4%), and Burkina Faso (3.4%) account for more than half (55%) of all global malaria cases; highlighting malaria as a public health concern(WHO, 2021b) With such high malaria concentration in SSA there is a reflection that there is slow progress of interventions to eliminate malaria and this has been attributed to an inter- play of several broader factors such as the lack of robust financing mechanisms, parasite and mosquito resistance, weak regional and national political commitment, poverty, poor/disorganized health systems, and general poor health-seeking behavior(Teaching et al., 2010; WHO, 2015)

In 2016, globally, Uganda was ranked sixth and in Africa was ranked the third coming after Nigeria and Democratic Republic of Congo in the mortality due to malaria with over 16 million cases and over 10,000 deaths per year however this was attributable to the weather changes over the years. Between 2023 to date, Uganda is ranked third contributor to malaria cases globally(Kooko et al., 2023).

While almost half of the world population, especially those in endemic areas are at risk of malaria infection, pregnant women and under-five children in SSA are even at greater risk of malaria-related mortality and morbidity(Cohee et al., 2020; Obasohan et al., 2021; WHO, 2021b). In Uganda, the prevalence is highest in the rural areas and factors mainly are attributed to Child's age, type of residence, wealth index, housing type, mother's education level, mosquito net-use. Malaria is a major cause of under-five mortality in SSA and severe malaria cases remain high among this group(WHO, 2021b). The lack of a fully functional immune system among <5years children means that a case of uncomplicated malaria could rapidly progress to severe malaria and potentially followed by anemia and death(Anumudu et al., 2007; Namayanja et al., 2023). Studies have previously identified factors including socioeconomic status i.e. household size and wealth

66 index, access to and use of ITNs, mother/caregiver educational level, child's age, place of
67 residence, environmental conditions, and access to health services as key determinants of malaria
68 among <5years children in SSA(Emina et al., 2021; Habyarimana & Ramroop, 2020; Obasohan et
69 al., 2021).

70 In Uganda, Malaria has remained a leading cause of ill health and death at a prevalence of
71 23.3%(Kooko et al., 2023) and imposes a heavy socio-economic burden on families and the nation,
72 costing a family on average 9 USD or 3% of its annual income per episode(Uganda National
73 Malaria Control Division (NMCD), Uganda Bureau of Statistics (UBOS), 2020).

74 With several interventions in place, there has been a remarkable decline in the malaria prevalence
75 among the <5years children in Uganda from 43.3% in 2009 to 23.3% in 2019(Uganda National
76 Malaria Control Division (NMCD), Uganda Bureau of Statistics (UBOS), 2020). However, this
77 remains high compared to other countries. For instance, the malaria prevalence based on the last
78 two recent malaria indicator survey studies from Tanzania was 14% in 2016 and 7% in 2017;
79 Burundi 22% in 2013 and 27% in 2016–2017; Kenya 5% in 2015; Rwanda 2% in 2015 and 7% in
80 2017; Uganda 30% in 2015 and 30.3% in 2016; South Sudan 32% in 2017(14,15). The malaria
81 prevalence among the <5years children has remained high notably around Lakes Victoria, Albert,
82 Edward and River Nile and these water bodies provide an ambient breeding sites for Anopheles
83 mosquito, the vector responsible for transmitting malaria in humans(Minakawa et al., 2012;
84 Uganda National Malaria Control Division (NMCD), Uganda Bureau of Statistics (UBOS), 2020)
85 with the most affected region being the central region with lake Victoria the includes the island
86 districts of Kalangala and Buvuma (Uganda National Malaria Control Division (NMCD), Uganda
87 Bureau of Statistics (UBOS), 2020)

88 To eliminate malaria, the global and national control strategy has strongly stressed the idea of

89 malaria control by insecticide-treated bed nets (ITNs), increased case detection and subsequent
90 treatment, indoor residual spraying (IRS) plus other vector control measures(Uganda National
91 Malaria Control Division (NMCD), Uganda Bureau of Statistics (UBOS), 2020; WHO, 2015)
92 Previous studies have highly been focusing on the hospital environment and investigating malaria
93 among children while giving less attention to the significance of socio-economic factors towards
94 malaria and in addition to strengthening the health systems, success of malaria control largely
95 depends upon the socio-economic status and knowledge of the affected populations since malaria
96 is usually labeled as a ‘disease of the poor’(Enayati & Hemingway, 2010; Roberts & Matthews,
97 2016a) thus this study aims at analyzing the prevalence and the associated factors; socioeconomic,
98 knowledge and geographical that contribute to malaria among the <5years children particularly
99 attending Buvuma HC IV in Buvuma district. This will ensure appropriate interventions, resources
100 allocation and utilization to curb sustained morbidity and mortality due to malaria in Buvuma.

101

102 **Methodology**

103 **Study design**

104 The study was a cross-sectional study using quantitative data collection methods.

105 **Study area**

106 The study was carried out in Buvuma district located in south-central Uganda with an area
107 coverage of 9, 545sq.kms of which 4, 221sq.kms is land area and the rest covered by water. It’s
108 bordered by Mukono district in the northwest, Buikwe in the north, Kalangala in the west and
109 south and Mayuge district in the east. Buvuma is a hard-to-reach district comprising fifty-two (52)
110 islands in Lake Victoria. The main island is purposefully selected because it contributes to the

111 highest number of all people, approximately 110,832 living in 35,410 households in the district.
112 Buvuma district has a Health Centre IV that functions as a district referral facility headed by a
113 medical officer. The population is heterogenous comprising of Indigenous islanders who are
114 mostly peasants and fishing communities which are mobile with no permanent settlements.
115 Buvuma's official link to the mainland is the government ferry which works thrice a day on
116 working days and twice a day on weekends or public holidays.

117

118 **Study population**

119 The study population was children < 5 years and the target population were caretakers of children
120 < 5 years attending Buvuma Health Centre IV in Buvuma Island District.

121 **Inclusion Criteria**

- 122 • Caretakers of children below 5 years whose children were admitted on ward and those at
123 outpatient department.
- 124 • Caretakers with children below 5 years who reside at Buvuma Island district and attend
125 Buvuma Health Center IV.

126 **Exclusion criteria**

- 127 • Nonconsenting caretakers and those that are mentally ill.

128 **Sample size**

129 A formula for cross-sectional studies by Cochran's formula was used to estimate the
130 sample size.

$$N = \frac{Z_{\alpha/2}^2 p(1-p)}{d^2}$$

131

132 N= estimated sample

133 Z=Z-score for 95% confidence interval=1.96

134 P= Estimated prevalence of malaria among under-fives in Uganda according to Danielle et al was

135 19.7%

136 d= acceptable margin of error, 5%

137 The calculated sample size N= $[1.96^2 \times 0.197 \times (1-0.197)] / 0.05^2$

138 N= 243.

139

140 **Data collection techniques and sampling methods.**

141 The research followed a consecutive sampling technique. Caretakers whose children below 5 years

142 were recruited both from out-patient department and in-patient admissions until the sample size

143 was attained. The caretakers of the children were requested to consent for participation. Semi-

144 structured questionnaires were used. The questionnaires were pretested by the researcher in the field

145 before actual data collection to ensure data validity. Pretesting was carried out on 10 participants

146 at the hospital. The questionnaires were written in English and translated to the Luganda language.

147 Five data collectors comprising 2 VHTs and 3 health workers were trained on data collection and

148 supported the process.

149 Date collection was conducted from December 2025 to January 2026; during this period there are

150 high malaria transmissions in Uganda. The first data collection in September-October was halted

151 due to the migrations by fishing communities that couldn't attend the health facilities, hence

considering December-January which period is also considered to have high malaria transmissions in Uganda. The blood samples were obtained from the under five children that were brought to the hospital and were taken from the fingers and heels by the hospital laboratory personals. These were tested on spot by either rapid diagnostics tests or microscopy but not both. The results were recorded either positive or negative if the malaria parasites were found or not found in the blood sample respectively.

After the interview the participants were appreciated and on each day each data collectors interviewed about 15 participants under close supervision of the principal investigator. The researcher ensured courteous interaction, avoiding any provocative language, rendering anonymity of participants and confidentiality of information where necessary.

Data quality control

Each questionnaire was checked thoroughly to ensure that it was answered fully. The questionnaires were kept in envelopes after being administered and later stored in box files which were kept under lock and lock. Data was stored on the computer with passwords. Double data entry was used to ascertain correspondence of entered data and to minimize errors. This data was also kept on a flash disk and a CD for backup purposes.

Data analysis

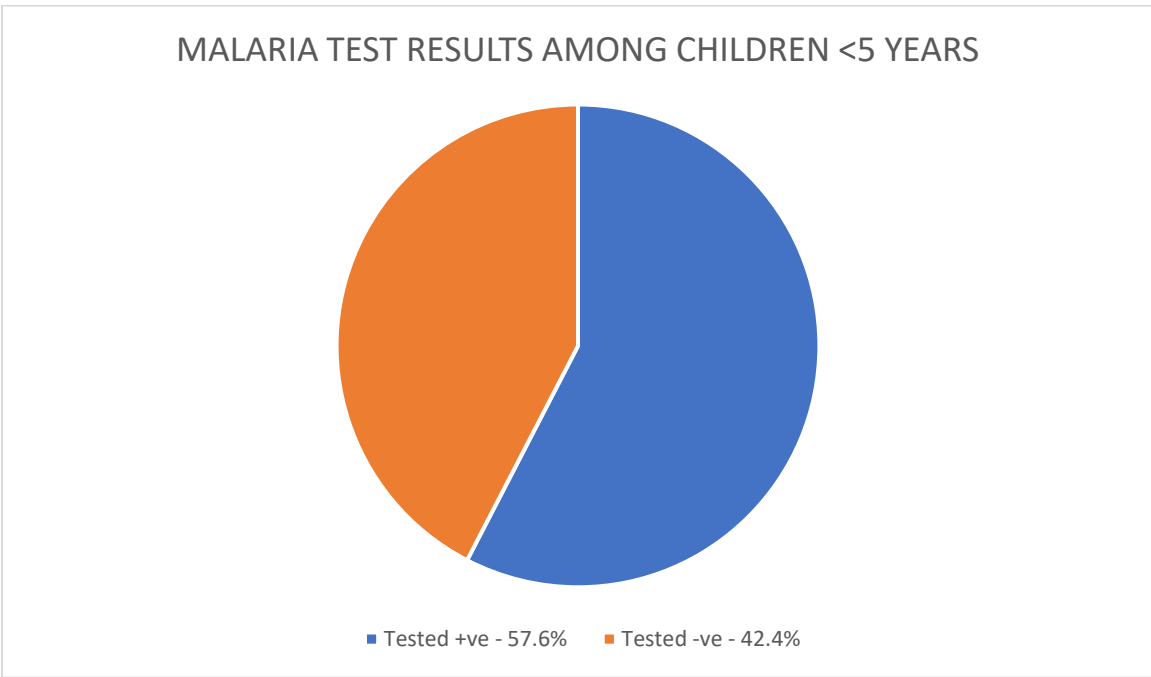
Data collected was checked for completeness and accuracy while in Microsoft excel spreadsheet, then cleaned and exported to STATA version 15 for analysis. Using descriptive statistics i.e. mean, median and standard deviation, the collected numeric data was analyzed, categorical information was analyzed by measure of frequencies and percentages. The prevalence of malaria was calculated from the formulae: Number of confirmed malaria cases of the <5years children / total

attendance of the <5years children at the hospital expressed as a percentage. The frequencies, percentages and measures of central tendencies obtained and displayed were presented in tables, graphs, percentages, pie charts and word expressions. Associations between independent variables and dependent variables were assessed using logistic regression at bivariate and multivariate level. A $P<0.05$ is considered statistically significant.

Results

Prevalence of malaria among the under-five children

The study was aimed at finding the prevalence of malaria and contributing factors among the under five children attending Buvuma Health Center IV in Buvuma Island District. All the 243 participants were interviewed and 57.6% of the children tested positive for malaria and 100% had ever heard about malaria. (Figure 1 here)



186 **Table 1: Socio-demographic characteristics of the respondents.**

187 The study had 243 children, with largest group being children of less than 12 months and 12-23
188 months each compromising 28.40% of the sample followed by 48-59moths at 20.2%. Majority of
189 caretakers were aged between 26-35 years and more females at 88.5% than males. **(Table 1 here)**

Variable.	Frequency (n=243)	Percentage
Age of the child		
<12months	69	28.40
12-23 months	69	28.40
24-35 month	24	9.88
36-47 months	32	13.17
48-59 months	49	20.16
Age of Care-taker		
15-25years	79	32.51
26-35years	128	52.67
≥36years	36	14.81
Sex of caretaker		
Female	215	88.48
Male	28	11.52
Relationship with the child		
Father	28	11.52
Mother	203	83.54
Other relatives	12	4.94
Religion		

Christian	176	72.43
Moslem	58	23.87
Traditional/ No religion	9	3.70
Education level		
Primary	149	61.32
Secondary / Tertiary	72	29.63
None	22	9.05
Means of transport		
Boat/car	7	2.88
Boda-boda	143	58.85
Walked	93	38.27
Total cost of transport		
1000-5000	42	17.28
11000-15000	23	9.47
6000-10000	68	27.98
16000-20000	14	5.76
None	96	39.51
Average income per month		
0-100,000	131	53.91
110,000-200,000	47	19.34
210,000 – 400,000	44	18.11
≥410,000	21	8.64

190

191 **Table 2: Housing Characteristics.**

192 Most children are in cemented (37.5%) houses or those with mud (34.6%). (Table 2 here)

Variable.	Frequency (n=243)	Percentage
Nature of your housing unit		
Timber house/wood	5	2.06
Cement	91	37.45
Mud	84	34.57
Others	63	25.93
Rooms in house		
1-2rooms	156	64.20
3-4rooms	81	33.33
≥5 rooms	6	2.47
Number of household members		
1-2members	20	8.23
3-4members	118	48.56
≥5 Members	105	43.21
Type of house window/door screening		
None	155	63.79
Metal	38	15.64
Plastic	7	2.88
Wooden	43	17.70

193

194 **Table 3: Environmental factors.**

195 Most children (61.75%) lived near swamp areas while 23.1% lived near/garden 14.0% on plain
 196 land and other with few neighbors (1.2%) Main source of water were dug holes at 69.1% followed
 197 by bore holes at 20.6%and and piped/rain/tap water (10.3%). Most of the water sources were at a
 198 distance of less than 100m at 62.55% followed by 100-500m with 30.4% then 7.41% for more
 199 than 500m.

200 **(Table 3 here)**

Variable.	Frequency (n=243)	Percentage
Nature of surrounding environment		
Bush/garden	56	23.05
Neighbors	3	1.23
Plain land	34	13.99
Swamp/lake	150	61.73
Source of water		
Borehole	50	20.58
Dug well /spring well	168	69.14
Piped / Rain/Tap water	25	10.29
Distance of water source from house		
<100m	152	62.55
100-500m	73	30.04

>500m	18	7.41
-------	----	------

Standing/stagnant water around the house

Yes	190	78.19
-----	-----	-------

No	53	21.81
----	----	-------

If yes, source of standing water

Rainwater collection	38	15.64
----------------------	----	-------

pond/ borehole/trench	54	22.22
-----------------------	----	-------

Lake	117	48.15
------	-----	-------

None	34	13.99
------	----	-------

Use of any mosquito breeding site

elimination method

Yes	26	10.70
-----	----	-------

No	217	89.30
----	-----	-------

201

202 **Table 4: Knowledge and awareness**

203 **(Table 4 here)**

Variable.	Frequency (n=243)	Percentage
------------------	--------------------------	-------------------

Ever heard about malaria

Yes	243	100.00
-----	-----	--------

204

The perceived routes of transmission of malaria, perceived causes of malaria, participants source of information about malaria and the signs and symptoms that the participants had ever heard about are represented in percentages and in figures as indicated in the figures 2, 3, 4 and 5 respectively.

Figure 2: Percentage representation of perceived routes of transmission of Malaria (Figure 2 here)

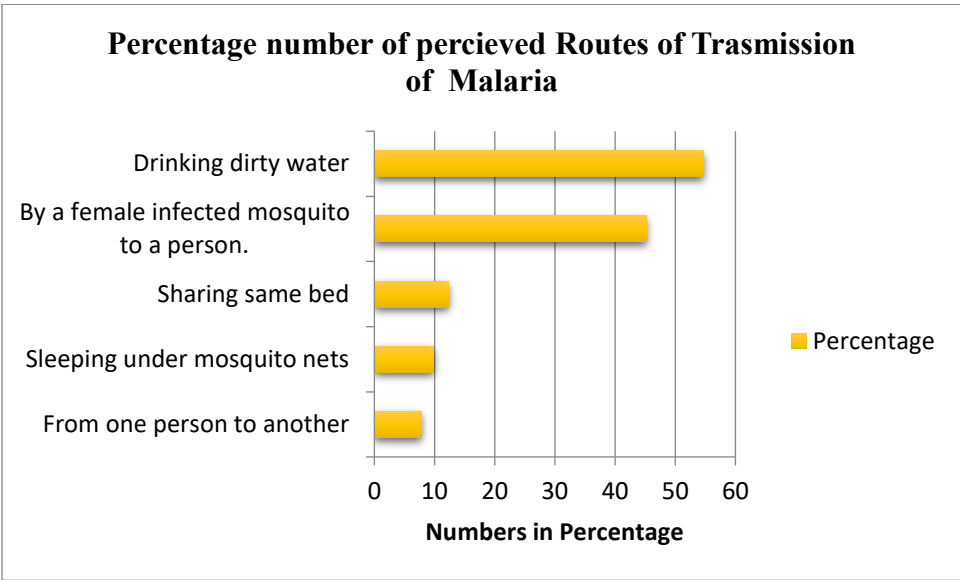


Figure 3: Percentage representation of perceived causes of malaria (Figure 3 here)

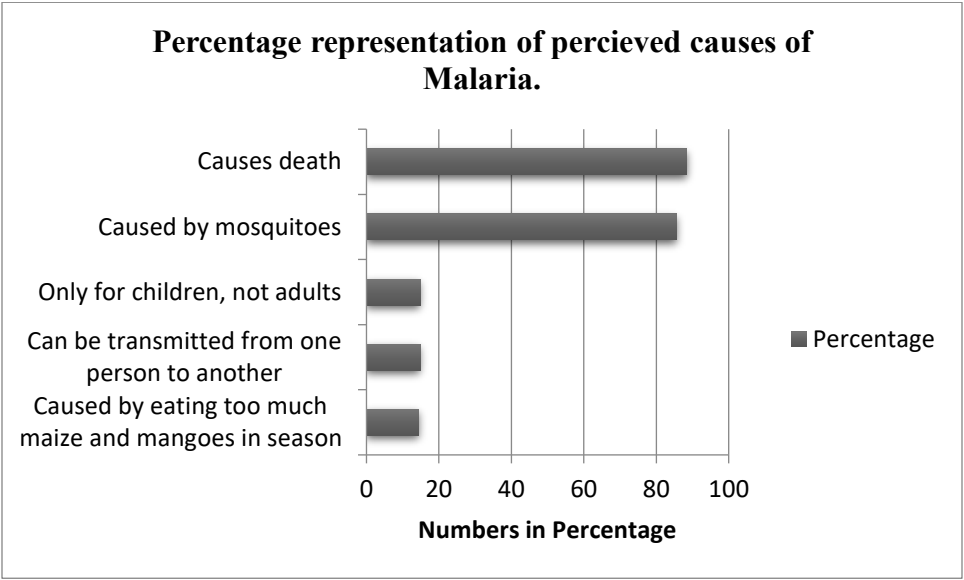
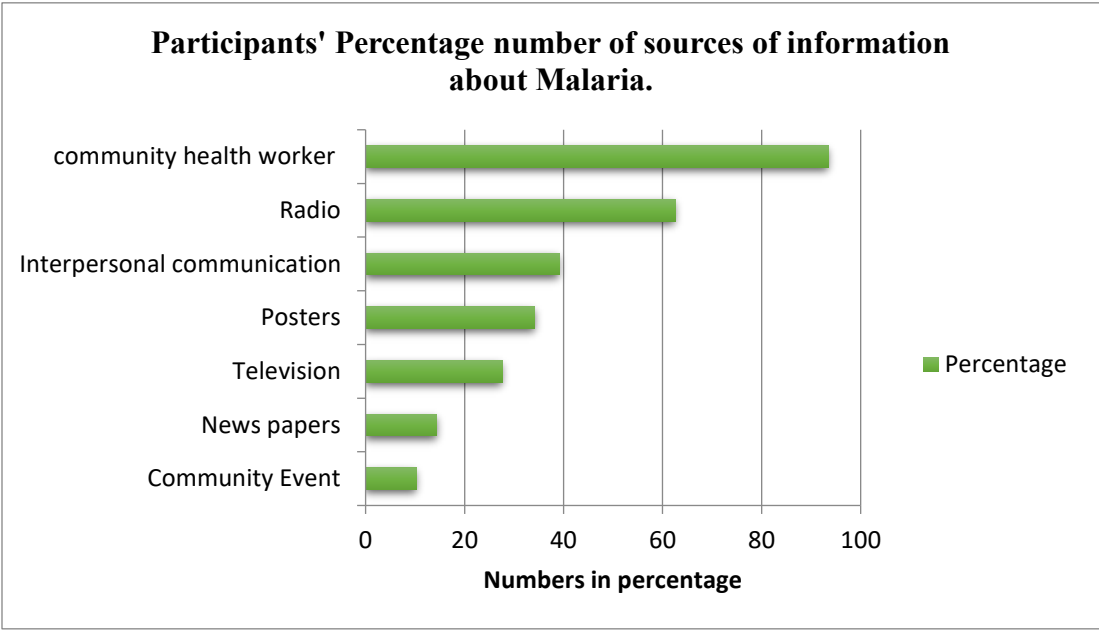
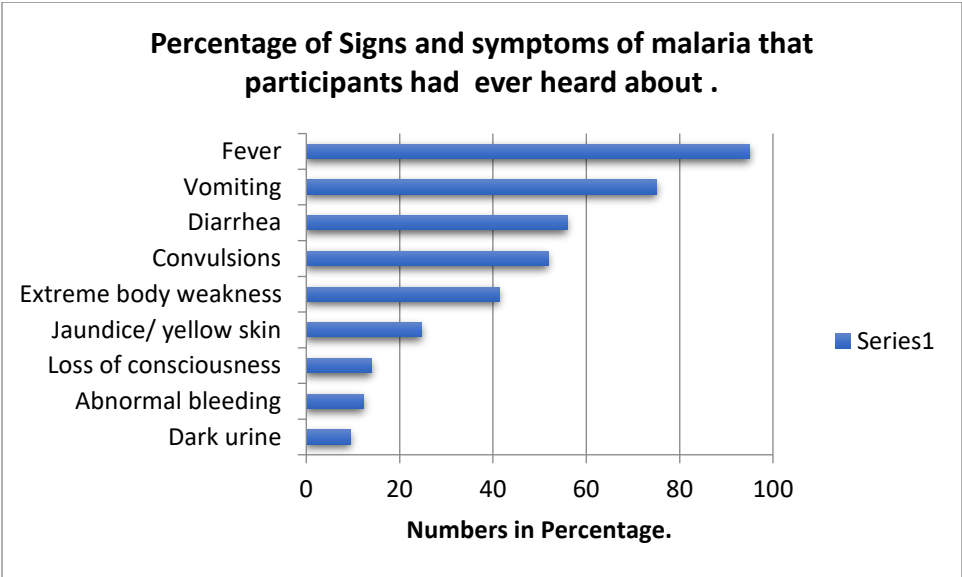


Figure 4: Percentage representation of participants' source of information about malaria (Figure 4 here)



218

219 **Figure 5: Percentage representation of the signs and symptoms of malaria that participants**
220 **heard about. (Figure 5 here)**



221

222

223 **Table 5: Personal protection measures**

224 Among the 243 children survey, most caregivers did not use mosquito repellants (94.2%) and only
225 5.8% reported using them. Most households had 1-3 good mosquito nets (86.4%) of which most
226 of them were mainly obtained though government (84.0%) and 81.5% of children sleep under a
227 mosquito net. (Figure 5 here)

Variable.	Frequency (n=243)	Percentage
Do you use repellants		
No	229	94.24

Yes	14	5.76
-----	----	------

If yes, what type of repellent do you use

DEET/ Picaridin	8	3.29
None	212	87.24
Others	23	9.47

Use insecticide-treated mosquito nets

No	103	42.39
Yes	140	57.61

How often do you use insecticide-treated mosquito nets

Always	95	39.09
Never	94	38.68
Occasionally	54	22.22

Good mosquito nets do you have

1-3nets	210	86.42
≥4nets	25	10.29
Nothing	8	3.29

Source of the nets

Government distribution	204	83.95
Bought	22	9.05
None	11	4.53

Both	6	2.47
------	---	------

Child sleeps under a mosquito net.

Yes	198	81.48
-----	-----	-------

No	45	18.52
----	----	-------

**Ever done any indoor spraying
done in your house.**

No	214	88.07
----	-----	-------

Yes	29	11.93
-----	----	-------

Who did In-door spraying

No one	221	90.95
--------	-----	-------

Self	22	9.05
------	----	------

228

229 **Table 6: Health-seeking behavior**

230 Of the 243, 35.4% were admitted to the correct health facility while 64.6% were not. Most (61.3%)
 231 had referrals from home while 16.5% were from other units. When seeking care most children
 232 (36.9%) were taken to a clinic, 27.9% to a hospital while others used community health workers,
 233 and would self-medicate (**Table 6 here**)

**Is the child admitted to this
facility?**

No	157	64.6
----	-----	------

Yes	86	35.39
-----	----	-------

If yes, how were you admitted

Referral from home	149	61.32
--------------------	-----	-------

Referral from another unit	40	16.46
None	54	22.22

Where did you seek attention first.

Clinic	82	36.94
Hospital	62	27.93
Community health worker	24	10.81
Self-medication	43	19.37
None	9	4.05
Others	2	0.90

Time taken to seek medical attention from the onset of symptoms

<24hours	66	27.16
24-48hours	106	43.62
>48hours	47	19.34
Unknown	24	9.88

VHT in the village

Yes	204	83.95
No	39	16.05

VHTs have Malaria Medicines

No	220	90.53
Yes	23	9.47

235 **Table 7: Logistic regression at both bivariate and multivariable analysis for Malaria test**
 236 **being positive.**

237 In this data, bivariate analysis was done on all variables that were seen necessary to cause malaria
 238 infection or risk malaria infection. Those that had p-value of less than or equal to 0.2 were
 239 considered for multivariate analysis where a value was significant if the P-value was less than 0.05
 240 at 95% CI.

241 Children aged 48 to 59 months were less likely to test positive for malaria as compared to those
 242 below 2 months of age (AOR=0.071, 95% CI 0.006–0.83, p=0.035). In addition, lack of window
 243 or door screening increased risk of testing positive for Malaria (AOR=27.15, 95% CI 1.21–610.69,
 244 p=0.038) with additional higher risk seen in those that resided in cemented houses. It was also
 245 statistically significant that high transportation costs were associated with high Malaria odds
 246 indicating increased cost of disease burden. Absence of VHTs was significantly associated with
 247 Malaria AOR=0.02, 95% CI 0.001–0.37, p=0.009). While use of mosquito repellants was not
 248 significant after adjustment. **Caution** is that some odds ratios were extremely unstable due to
 249 sparse data thus interpretation may not rely on exact magnitude of direction but can rely on
 250 direction of association (**Table 7 here**)

251 **Table showing the Logistic regression at both bivariate and multivariable analysis for**
 252 **Malaria test being positive.**

Variable	p-values	CORs (95% CIs)	p-values	AORs (95% CIs)
Age of the child				
<12months	Ref	ref	Ref	Ref
12-23 months	0.167	1.62(0.82 - 3.22)	0.907	0.87(0.082 -9.15)
24-35 month	0.020	3.13(1.19 - 8.19)	0.596	0.52(0.05 - 5.81)

36-47 months	0.044	2.41(1.02 - 5.68)	0.950	1.11(0.05 -25.29)
48-59 months*	0.477	0.75 (0.34 - 1.66)	0.035	0.071(0.006- 0.83) *
Age of Care-taker				
15-25years	Ref	ref		
26-35years	0.334	1.32(0.75 - 2.34)		
≥36years	0.749	0.88(0.39 - 1.98)		
Sex of caretaker				
Female	Ref	ref		
Male	0.388	0.42(0.64 - 3.12)		
Relationship with the child				
Father	Ref	Ref		
Mother	0.507	0.77(0.35 - 1.69)	0.789	1.31(0.18-9.76)
Other relatives	0.031	0.09(0.01- 0.80)	0.468	0.11(.00003 - 41.08)
Religion				
Christian	Ref	Ref		
Moslem	0.169	0.65(0.35 -1.20)		
Traditional/ No religion	-	-		
Education level				
Primary	Ref	Ref		
Secondary / Tertiary	0.120	1.57(0.89 - 2.76)		
None	0.247	0.56(0.21 - 1.50)		
Means of transport				
Boat/car	Ref	Ref		

Boda-boda	0.112	3.88(0.73 - 20.71)		
Walked	0.358	0.44(0.78 2.51)		
Total cost of transport				
1000-5000	Ref	Ref		
6000-10000	0.017	2.63(1.19-5.80)	0.149	6.01(0.52 -69.01)
11000-15000*	0.003	5.85(1.82 -18.85)	0.020	49.18(2.39 -1010.72) *
16000-20000	0.006	9.75(1.93 - 49.33)	0.146	37.63(1.78 - 795.8)
None	0.005	0.30(0.13 - 0.69)	0.905	18.83(0.36 -982.786)
Average income per month				
0-100,000	Ref	Ref		
110,000-200,000	0.166	0.62(0.32-1.22)	0.552	2.11(0.18 - 24.67)
210,000 – 400,000	0.000	0.1(0.04 - 0.27)	0.042*	28.511(1.12-722.86) *
≥410,000	0.002	0.13(0.04 - 0.46)	0.147	31.33 (0.3 - 3295.68)
Nature of your housing unit				
Timber house/wood	Ref	Ref		
Cement	0.000	9.51(3.5 - 25.92)	0.048	85.16(1.032 -7021.62)*
Mud	0.000	18.85(6.84 - 51.96)	0.109	24.6(0.5 -1239.43)
Others	-	-	-	--
Rooms in house				
1-2rooms	Ref	Ref		
3-4rooms	0.000	0.24(0.13 - 0.45)	0.011	0.06(0.007 - 0.52) *
≥5 rooms	0.503	1.80(0.32 - 10.14)	0.733	0.34(0.0007- 163.3)

Number of household members

1-2members	Ref	Ref
3-4members	0.864	0.92(0.34-2.48)
≥5 Members	0.120	2.21(0.81 - 5.97)

Type of house window/door screening

Metal	Ref	-ref		
Plastic	-	-	-	-
Wooden	-	-	-	-
None	0.000	11.35(4.19 - 30.71)	0.038	27.15(1.21 - 610.69)

Nature of surrounding environment

Bush/garden	Ref	Ref
Neighbors	-	-
Plain land	0.748	0.87(0.37 - 2.06)
Swamp/lake	0.607	0.85(0.46 - 1.58)

Source of water

Borehole	Ref	Ref	Ref	Ref
Dug well /spring well	0.000	0.12(0.6 - 0.26)	0.004	0.01(0 .0006 -0.024)
Piped / Rain/Tap water	0.024	0.31(0.11 - 0.86)	0.666	0.42(0.01 - 22.31)

Distance of water source from house

<100m	Ref	Ref		
100-500m	0.000	0.15(0.08 - 0.30)	0.236	0.17(0.1 - 3.13)
>500m	0.002	0.04(0.005 - 0.32)	0.064	0.008(0.00005 - 1.32)
Standing/stagnant water around the house				
Yes	Ref	Ref		
No	0.156]	1.56(0.84 - 2.87)		
Use of any mosquito breeding site elimination method				
Yes	Ref	Ref		
No	0.016	3.46(1.26 - 9.51)	0.112	10.58(0.58 - 194.12)
Do you use repellants				
No	Ref	Ref		
Yes	0.971	0.98(0.33 - 2.92)	0.881	1.46(0.01 -17.48)
How many Good mosquito nets do you have				
1-3nets	Ref	Ref		
≥4nets	0.891	0.94(0.40 - 2.20)		
Nothing	0.081	4.24(0.84 - 21.51)		
Child sleeps under a mosquito net.				
Yes	Ref	Ref		

No	0.009	0.37(0.18 - 0.78)	0.191	0.14(0.007 - 2.68)
Ever done any indoor spraying done in your house.				
Yes	Ref	Ref		
No	0.016	3.18(1.24 - 8.12)	0.875	1.61(0.00 - 580.25)
VHT in the village				
Yes	Ref	Ref		
No	0.001	0.25(0.10 - 0.58)	0.009	0.02(0.001- 0.37)*
VHTs have Malaria Medicines				
Yes	Ref	Ref		
No	0.154	0 .53 (0.22 - 1.27)		

253

254 Discussion of results.

255 This study was carried out to determine the prevalence and factors contributing to malaria infection
256 among the under-five children attending Buvuma HC IV, Buvuma district. In this it was discovered
257 that 57.6% of the participants tested positive for malaria. These findings were almost similar to
258 those in Amolatar of prevalence 44.1%(Orech et al., 2024) however contrary to the previous
259 findings in previous study of 2012 in Buvuma that showed a prevalence of 40%. The Uganda
260 Ministry of Health target was to have a nationwide prevalence of malaria of 9% and below in 2020,
261 generally this has been almost achieved in the country as it's at a percentage of 21% however in
262 Buvuma its still high. These findings are more than the findings carried out in Ethiopia only 8.7%

had malaria (1). In this study, 57.6% of the 243 participants tested positive for malaria which is greater than the findings of the study carried out in Niger where 23.70% were positive for malaria(Nadakou et al., 2025)

In this data, bivariate analysis was done on all variables that were seen necessary to cause or risk malaria infection including; age of child 24 – 23 months ($p=0.020$) 36- 47 months (0.044), children being taken care of by other relatives ($p=0.031$), caregivers that earned monthly average income of 210,000- 400,000($p=0.000$) and $\geq 400,000$. children that slept in cement houses ($p=0.000$) and mud houses ($p=0.000$). The children sleeping in houses of 3-4 rooms ($p=0.000$), the type of house widow and door screening($p=0.000$), the source of water being dug well/spring ($p=0.000$) distance from the water source 100-500m($p=0.000$) and $>500m$ ($p=0.002$). Not using any mosquito breeding site elimination method ($p=0.016$), not sleeping under a mosquito net($p=0.009$) not doing any indoor residual spraying ($p=0.016$). Those that had p-value of less than or equal to 0.2 were considered for multivariate analysis where a value was significant if the P-value was less than 0.05 at 95% CI.

In multivariate analysis, factors that were statistically significantly revealed that children more likely to suffer from malaria were those whose transport cost was UGX 11,000-15,000 ($p=0.020$), and the absence of window/ door screening ($p=0.038$). These finding were different from findings of a study carried out in Ethiopia where Malaria infection was more likely to nearby the presence of stagnant water to resident areas(Resistance et al., 2020). High transport costs being associated with testing positive for malaria in this study indicate the possibility of coming from very far facilities which delayed treatment causing high parasite load and thus many complications while absence of window/door screening allowed entry of mosquitoes into the house thus resulting into malaria infection.

286 In this study, children from middle income households (with monthly income of UGX 210,000-
287 400,000(18.1%); $p=0.042$) were more likely to have malaria compared to those from low-income
288 households. This similar to findings from a study carried out in Niger where Children from middle-
289 income households were more likely to have malaria (Nadakou et al., 2025). The middle-income
290 households could have had this challenge because of the middle-income households may live in
291 peri-urban areas with higher mosquito exposure. The middle-income could also be having
292 inconsistent health behavior such as inconsistent use of mosquitos at night.

293 In this study, factors where one was less likely to test positive for malaria include a child aged 48-
294 59 months ($p=0.035$); living in a household with 3-4 rooms ($p=0.011$); These findings were less
295 than those in Tanzania where child age of 48–59 months were significantly associated with malaria
296 infection among under-five children (Animut et al., 2025). In this study children between 48-59
297 months were less likely to suffer from malaria as compared to those below 6 months due possibly
298 to improved immunity. Those living in a household with 3-4 rooms were less likely to suffer from
299 malaria due to fewer people sleeping per room thus less crowding which shows that nets may be
300 properly hung and maintained thus less exposure to mosquitoes.

301 Some unexpected results were the multivariate significance that those living in a cement house
302 ($p=0.048$) were more likely to suffer from malaria as compared to those living in timber
303 house/wood houses. This is scientifically Counterintuitive and inconsistently with established
304 malaria epidemiology as improved housing materials such as cement walls are generally associated
305 with reduced mosquito entry, less cracks for mosquito entry, better structural integrity and lower
306 malaria transmission. This was because of this result reflects residual confounding, sparse data bias
307 or model instability and thus should be interpreted with caution

Other unexpected results were less likelihood of testing positive for malaria in absence of Village Health Teams (VHTs) ($p=0.00945$) and using dug well/spring water source ($p=0.004$). These results are counterintuitive because as VHTs are expected to reduce Malaria risk while water source is not direct determinant of malaria transmission (Doty et al., 2019).

These associations may reflect reverse causality as VHTs may have been deployed in areas with higher malaria burden meaning that the outcome (malaria prevalence) may have influenced the exposure (VHT presence), rather than the exposure affecting the outcome detection bias or model instability (Bjerreg et al., 2024). Therefore, these findings should be interpreted with caution.

Limitations of the Study

This study was cross-sectional, which limits the ability to establish casual relationships. Associations observed between malaria and factors such as transport cost, window/door screening, and household characteristics cannot confirm causality. Reverse causality is possible, particularly for variables like the presence of VHTs. Some exposure categories had few participants. This may have caused sparse data bias or multicollinearity and contributed to unstable regression estimates, resulting in very large or very small adjusted odds ratios. Although multivariate analysis controlled for several factors, unmeasured variables such as proximity to mosquito breeding sites, environmental sanitation, and use of insecticide-treated nets may have influenced the results. This could explain some counterintuitive findings, such as higher malaria risk in cement houses. Data on some variables such as household income, number of rooms, transport costs were self-reported and could be subject to recall or misclassification bias. The study was conducted among under-five children attending Buvuma HC IV, Buvuma District, and may not be representative of children in other district or community settings. Local environmental, socio-economic and health

system factors may differ. Unexpected associations, including low malaria risk in households without VHTs and among dug well/ spring water users, may reflect reverse causality, detection bias, residual confounding, or model instability. These findings should be interpreted cautiously and may not reflect true casual relationships

Strengthen household level vector control interventions such as installation of window or door screens, proper use and maintenance of insecticide-treated nets (ITNs). Promote early healthcare seeking behavior and utilization of early facilities as the association between high transport costs and malaria positively suggested delayed health-seeking behavior. Reassessment of VHT employment strategies and reassessing if the deployment is reactive or preventative as is meant to be. Strengthening monitoring and supervision to ensure preventive strategies should be done. Recommendations for future research with consideration of bigger sample size or conduct a longitudinal or cohort study to reduce sample bias as well as multicollinearity which cause abnormal confidence intervals or other outcomes.

In conclusion, multivariate analysis showed that higher transport costs and absence of window /door screening were independently associated with increased odds of malaria infection. Older age (48-59months) and living in households within 3-4 rooms were associated with lower odds of malaria. Some findings such as increased malaria risk in cement houses and apparent protective effect of absence of village health teams and use of dug well/spring water were counterintuitive and may reflect residual confounding, reverse causality, multicollinearity or model instability thus to be interpreted with caution.

Conclusions

The study revealed a high malaria prevalence (57.6%) among under-five children attending Buvuma HC IV, indicating that malaria remains a significant public health burden in Buvuma District despite national progress toward control targets, the prevalence observed exceeds both the national target and several regional comparison studies thus highlighting the need for intensified local interventions.

The multivariate analysis identified higher transport costs and absence of window or door screening as the independent predictors of increased malaria infection. These findings point to the critical roles of physical household protection and timely access to healthcare in malaria prevention. Older child age (48 – 59 months) and residence in households with 3 -4 rooms were associated with reduced odds of malaria, possibly reflecting improved immunity and reduced household crowding.

Some associations such as the higher malaria risk observed in cement houses, the effect of absence of VHTs and use of dug well/spring water were counterintuitive and inconsistent with the established malaria epidemiology, these findings likely reflect residual confounding, reverse causality, sparse data bias or model instability and should therefore be interpreted cautiously.

Overall, the study underscores the urgent need to strengthen household vector control, improve geographic access to malaria services and optimize community health strategies in Buvuma district. Furthermore, well-designed studies are required to clarify causal solutions and guide targeted malaria control efforts in island and hard-to-reach settings.

Recommendations

371 The findings of the study indicate that malaria prevalence among the under-five children attending
372 Buvuma HC IV remains unacceptably high at 57.6%, far above the national target therefore there
373 is a need for a strengthened and context-specific malaria control interventions in Buvuma District.

374 The household-level vector control measures should be prioritized, this is because the significant
375 association between absence of window and door screening and increased malaria risk underscores
376 the importance of structural housing improvements. The community health programs should
377 promote installation of window and door screens, particularly in high-risk households. Local
378 government and partners may consider subsidizing screening materials for vulnerable families, in
379 addition, consistent and correct use of ITNs should be reinforced through continuous community
380 sensitization, routine monitoring and replacement of the worn-out ones.

381 Efforts to improve timely healthcare access are essential. The association between higher transport
382 costs (UGX 11,000 – 15,000) and testing positive for malaria suggest the delayed care-seeking
383 among the children living far from the health facilities. Therefore, the district health team should
384 strengthen community-based malaria services including integrated community case management
385 that brings services of diagnosis and treatment closer to the households through outreach and
386 mobile clinics to hard-to-reach island communities. Also improving transport, referral systems and
387 community transport systems may reduce delays in seeking care.

388 The ministry of health and district should review the deployment and functioning of the village
389 health teams, the finding regarding absence of the VHTs suggests possible redeployment to high-
390 burden areas. There should also be strengthening in the supervision, performance monitoring to
391 ensure they are optimally positioned to prevent the disease burden.

The housing and overcrowding interventions may offer an additional benefit because children living in households with 3-4 rooms had lower malaria risk, this suggest that reduced crowding and improved sleeping arrangements may facilitate proper net use therefore community education on sleeping space organization and net hanging practices should be integrated into the malaria control programs.

Finally, future research should address the methodological limitations observed in this study. The researchers are encouraged to conduct studies with larger sample sizes where feasible, longitudinal or cohort designs to better establish temporal relationships and reduce sparse data bias. Future studies should incorporate environmental variables such as proximity to mosquito breeding sites, detailed ITN utilization patterns and entomological assessments, also qualitative studies may further help explain unexpected findings and health-seeking behaviors in island communities.

List of abbreviations

ACT - Artemisinin- based combination therapy.

ICCM - Integrated Community Case Management

IMCI - Integrated Management of Childhood Illness

IPD – In-patients Department

IRS - Indoor residual spraying

ITNs - insecticide-treated mosquito nets

LLINs - long-lasting insecticidal net

412 MRDT – Malaria Rapid Diagnostic Test

413 OPD – Outpatients Department

414 SSA – Sub-Saharan Africa

415 VHTs - Village Health teams

416 **Declarations**

417 **Ethical consideration**

418 Ethical clearance and approval were obtained from Clarke International University Institutional
419 Review Board (IRB) (CLARKE-2025-1645), clearance to conduct the study was also obtained
420 from Buvuma District Health Officer and the Medical Superintendent of the hospital. Written
421 informed consent was obtained from all participants in the study before collecting data. The
422 participants were informed of the potential risk and benefits of participating in the study. They
423 were accorded with their rights, among which is to withdraw from the study at any time without
424 any explanation, and this would not in any way affect the medical service they receive from the
425 facility. In addition, clients were entitled to full right to confidentiality of any information by
426 avoiding identifiers such as names on participants information but rather codes, these in
427 accordance with the ethical principles outlined in the Declaration of Helsinki.

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430 **Authors contributions**

PN conceived the concept for the study, worked on proposal development, study tools, coordinated the data collection process and conducted the data analysis. RPG reviewed the draft manuscript. Both authors reviewed and approved the final manuscript.

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