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## MOSQUITO NET UTILIZATION AMONG CHILDREN (5–15 YEARS): DETERMINANTS FROM BUSIA COUNTY, KENYA

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**Abstract:** **Background:** Malaria remains the leading cause of mortality in sub-Saharan Africa, majorly affecting pregnant women and children below five years. In Kenya, malaria kills an approximately 10,000 people annually. This burden is greatest in the lake endemic region, where Busia County is located. The World Health Organization and global initiatives like the roll back malaria and, the President's Malaria Initiative recommend use of insecticide-treated nets and active case management of malaria among others, as basic and most affordable methods of preventing malaria in children. Several studies have looked at socio-economic and cultural factors affecting uptake of malaria prevention interventions among vulnerable populations such as pregnant women, but little has been done on determinants of net use among children (5-15years) and its effects on malaria prevalence in Busia County this age group had the highest malaria prevalence<sup>1</sup>. This study investigated determinants of net use among children (5-15 years) and the prevalence of malaria in the same group. **Methods:** This was a cross-sectional community-based study that targeted 111,311 children under 15years in Busia County. A sample size of 302 respondents was proportionately selected at ward level in the 2 sub counties, 130 and 172 from Samia and Matayos respectively, in each sub county, simple random sampling was used to select respondents. Data on participant demographics, mosquito net ownership was collected using questionnaires and blood sample for Malaria microscopy and mRDT was taken to determine prevalence and species identification among the respondents.

**Results:** Malaria prevalence among (5-15) year-olds in Samia and Matayos sub-Counties was (35%) (Microscopy 34.6%, mRDT 35%). The predominant species was *p. falciparum* (76%). *P. malariae* was (18%) *P. ovale* (1%), *p. falciparum* with *p. malariae* (4%), and *p. falciparum* with *p. ovale* (1%). *P. ovale* was the least dominant (1%). Net ownership and use on the night prior to the survey were high (90%) and (93%) respectively. Of those who didn't use nets, (32%) said they were torn, (23%) lacked nets, (14%) felt nets were expensive to buy, (14%) feared bedbugs, (12%) reported being tired of tying the net daily due to lack of fixed sleeping spaces, while (5%) didn't know how to hang nets.

**Keywords:** Malaria prevalence, Plasmodium species, Mosquito net utilization, School-age children (5–15 years), Busia County, Kenya.

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### Introduction

Malaria remains the leading cause of mortality in sub-Saharan Africa; majorly affecting pregnant women and children below five years<sup>2</sup> In Kenya malaria kills an approximately 10,000 people annually.

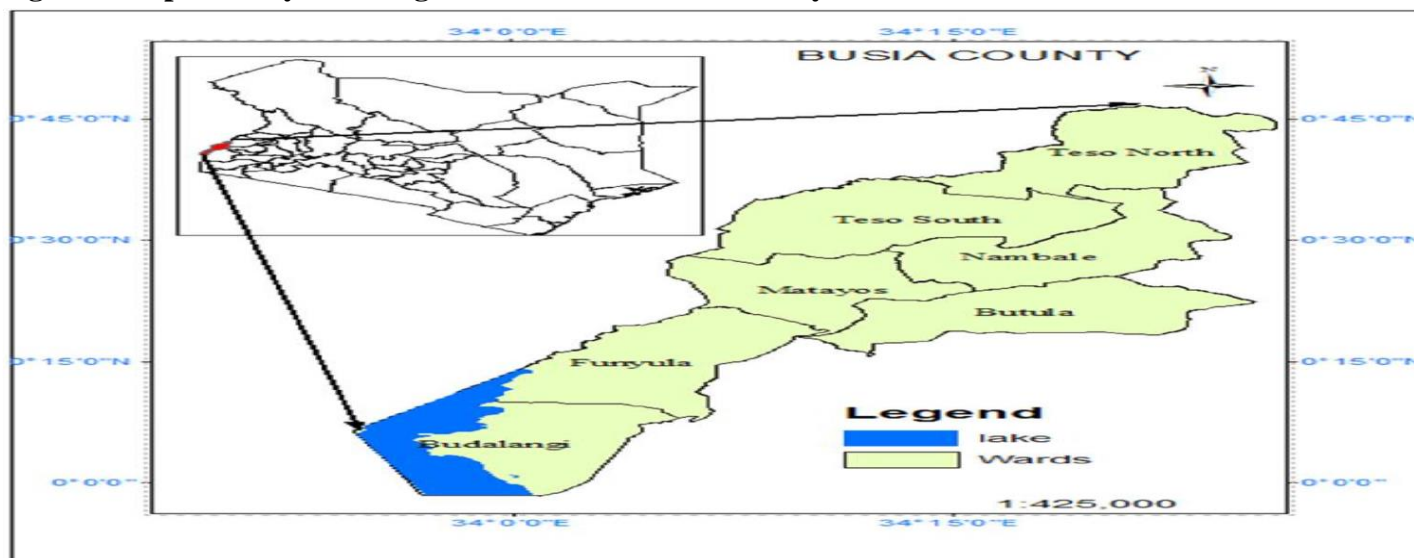
Among the 8 lake endemic counties of Kenya Busia county carries the greatest malaria burden (39.5%)<sup>1</sup>. The World Health Organization and global initiatives like the roll back <sup>3</sup> malaria and the President's Malaria Initiative<sup>4</sup> recommend use of insecticide-treated nets and active case management of malaria among others, as basic and most affordable methods of preventing malaria in children. Several studies have looked at socio-economic and cultural factors affecting uptake of malaria prevention interventions among vulnerable populations such as pregnant women, but little has been done on determinants of net use among children (5-15 years) and its effects on malaria prevalence in Busia County this age group had the highest malaria prevalence<sup>1</sup> This study investigated determinants of net use among children (5-15 years) in Samia and Matayos sub counties in Busia County western Kenya.

### Materials and Methods

#### Study area

This study was carried out in 2 sub counties in Busia County Samia (on the map as Funyula) sub county represented the rural dwelling while Matayos sub county represented the urban dwelling.

**Figure 1** map of Kenya showing the location of Busia County



#### Study design

A mixed cross-sectional study helped use to evaluate the various determinants of net use among children (5-15 years) in Matayos and Samia sub counties in Busia county.

#### Study population

The study population was an estimated number of 111311 children 5-15 years.

**Table 1:** Sample allocation per Sub County

Sub county	Stratum sample ( $n_0 = f \times sNo$ ) size (to the nearest figure)
Matayos	172

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Samia	130
<b>Total</b>	<b>302</b>

Random systematic sampling was used to randomly get participants in the house hold visited every 4<sup>th</sup> household with a 5-15 year old was sampled with the children as participants.

### Data collection tools

A semi-structured questionnaire was used to collect qualitative data. Upon consenting a blood sample for malaria microscopy and malaria rapid test...

### Analysis

Analysis was done using SPSS v.17, where quantitative data was analyzed using descriptive statistics.

### Ethical consideration

Ethical approval was sought from University of Eastern Africa, Baraton serial number **UEAB/REC/26/04/2022** We obtained a research license from the National Commission of Science Technology and Innovation license number **NACOSTI/P/22/21033**. Voluntary and written informed consent was obtained before data collection. In addition, the data collected for this study was confidential and only used for the purpose explained in the consent forms.

## Results

### Demographic characteristics of the study participants

The table shows the demographic characteristics of the study participants the majority of the participants 176(58.2%) were female, 123(40.72%) were male while 3(0.9%) were uncomfortable disclosing their sexual orientation.

For the education level majority of the participants 140(46.3%) had primary education followed by 66(21.9%) who were attending secondary education, 39(12.9%) were in tertiary education institutions, while 57(18.9%) had no form of education.

Majority of the respondents 288(95.4%) confessed the Christian faith, 11(3.64%) were Muslims while 3(1%) did not declare any faith.

**Table 2 Demographic characteristics of the study participants**

Variable	frequency (n)	%
<b>Gender</b>		
Female	123	40
Male	176	58.2
Not declared	3	0.9%
<b>Total</b>	<b>302</b>	<b>100</b>
<b>Education level</b>		
None	57	18.9
Primary	140	46.35
Secondary	66	21.9
Tertiary	39	12.9
<b>Religion</b>	<b>302</b>	<b>100</b>

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Christian Muslim	288 11	95.4 3.64
Not declared	3	1
<b>Total</b>	<b>302</b>	<b>100</b>

### Prevalence of malaria among children

On malaria prevalence 2 tests were used that is microscopy (gold standard) and malaria rapid diagnostic test kits (qualitative test).

For microscopy the majority 197(65.23%) tested negative while 105(34.76%) tested positive giving a prevalence of 34.76%.

For malaria rapid diagnostic test kits the majority 196(65.23%) tested negative while 106(35.09%) had a positive result giving the qualitative test a prevalence of 35.09%

**Table 3:** malaria test results.

<b>Malaria Microscopy test result</b>	n	%	
Positive	105	34.76	
Negative	197	65.23	
<b>Total</b>	<b>302</b>	<b>100</b>	
<b>Malaria rapid test results</b>			
Positive Negative	106	35.09	
	196	64.9	
<b>Total</b>	<b>302</b>	<b>100</b>	

### Malaria Species identified

The positive malaria slides were further analyzed to identify the malaria species, majority of the species identified 230(76.15%) were predominantly plasmodium falciparum, 54(17.88%) were plasmodium malariae, 3(0.99%) were plasmodium ovale.

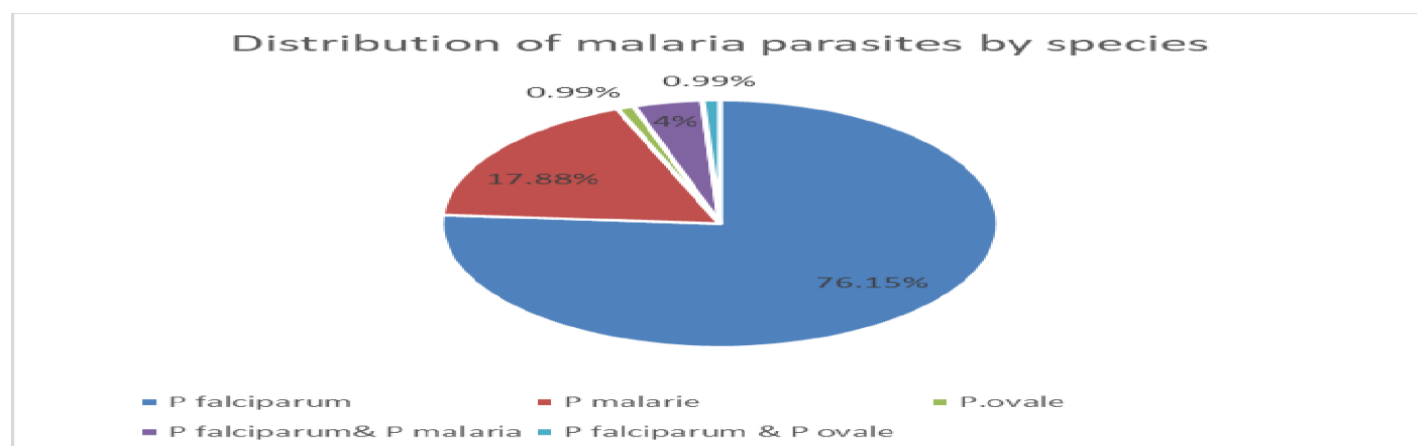
We also had mixed infections where 12(4%) had both plasmodium falciparum and plasmodium malariae. we also found 3(0.99%) being plasmodium falciparum mixed with plasmodium ovale.

**Table 4:** Malaria Species identified

<b>Malaria species identified</b>	n	%	
P falciparum	230		76.15
P malarie	54		17.88
P.ovale	3		0.99 4
P falciparum& P malaria	12		0.99
P falciparum & P ovale <b>Total</b>	3		<b>100</b>
	<b>302</b>		

**Pie chart 1 showing the distribution of malaria parasites by species**

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### Net ownership verses net use a night prior to the survey

On ownership of treated nets the majority 197(65.23%) did not own treated nets while 105(34.76%) owned a treated net.

On net use on the night prior to the survey a majority 197(65.23%) did not sleep under a net while only 105(34.76%) slept under a treated net.

**Table 5:** net ownership verses net use a night prior to the survey

Net ownership	n	%	
Had a treated net	105	34.76	
Did not have a treated net	197	65.23	
<b>Total</b>	<b>302</b>	<b>100</b>	
Net use the night prior to the survey	n	%	
Slept under a net the night before	105	34.76	
Did not sleep under a net the night before	197	65.23	
<b>Total</b>	<b>302</b>	<b>100</b>	

### Reasons for not sleeping under a net

Various reasons were given for not sleeping under treated nets, here majority 97(32.1%) reported torn nets as the reason for not sleeping under them, 70(23.1%) reported that they did not have nets to sleep in, 42(13.9%) reported that nets were expensive to buy, 42(14%) feared nets as a cause of bedbug infestation, and finally the minority 15(5%) reported lacking knowledge about net hanging.

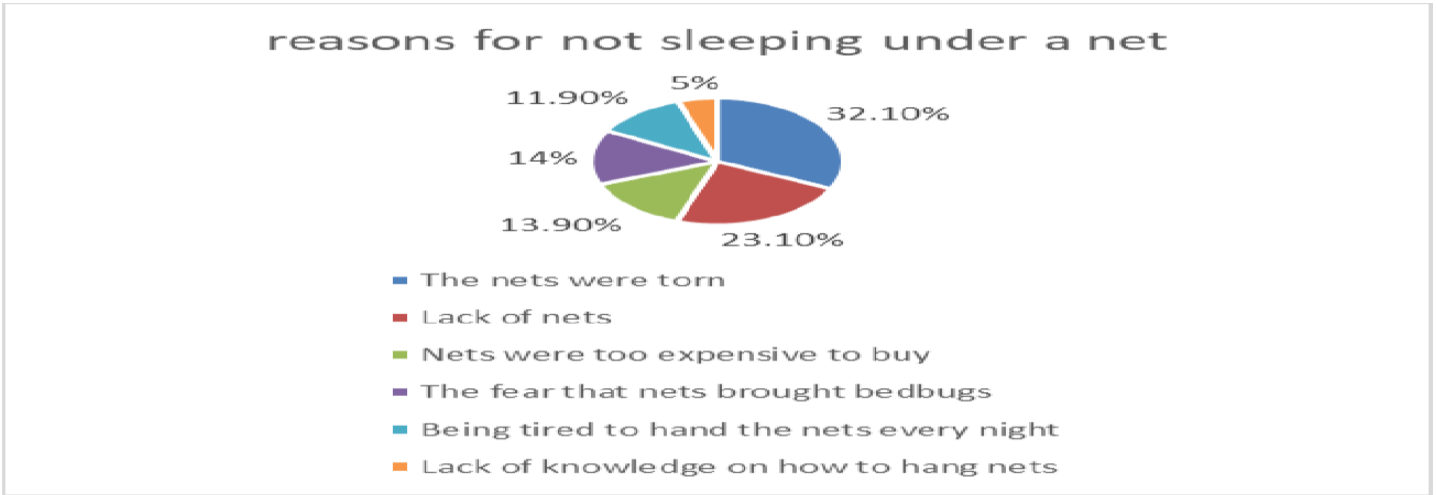
**Table 6 :** Reasons for not sleeping under a net

Reasons for not sleeping under a net	n		%
The nets were torn	97		32.1
Lack of nets	70		23.1

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Nets were too expensive to buy	42		13.9 14
The fear that nets brought bedbugs	42		11.9
Being tired to hand the nets every night	36		5
Lack of knowledge on how to hang nets	15		100
<b>Total</b>	<b>302</b>		

Pie chart 2 showing Reasons for not sleeping under a net



Discussion

Prevalence of malaria

In this study findings on the prevalence of malaria was reported under microscopy at 34.6% and under malaria rapid diagnostic test (MRDTs) at 35% this high prevalence agrees with the prevalence of malaria among the general population in Busia which was found at 38.5%<sup>1</sup> however there is a disagreement with the results of the Kenya Malaria Indicator Survey of 2020 on the prevalence of malaria among children age 5 to 14 years in the lake endemic region which was found to be at 19%.<sup>1</sup>

The findings herein also disagree with a finding In Ethiopia which had a prevalence of 19.8% among Under-Five symptomatic Children Attending Mohammed Akile Memorial General Hospital<sup>5</sup>. On the flip side the findings here compare well with those of an Estimate of malaria disease burden among children in subSaharan Africa by age categories where children aged ≥12 years had a malaria prevalence of 36.5%.<sup>6</sup>

Species distribution

The finding in this study agree in totality about the predominant characteristics of plasmodium falciparum infection at between 66-76%<sup>7</sup> followed at a distant second by plasmodium malariae between 12-18% except in the Ethiopian findings where plasmodium vivax seems to be the predominant species<sup>8</sup>. Plasmodium ovale and other mixed infections are rear to find. In the Kenya malaria profile in 2023 P. falciparum was found to be the predominant species at (76%), followed at a distant second and third by P. malariae (4%) P. ovale (1%), respectively. All mixed infections were at (19%)<sup>9</sup>

According to the Kenya Malaria Indicator Survey of 2020 species distribution among the malaria positive microscopy slides had Plasmodium. Falciparum infection as the predominant species at 76% followed at a distant second by Plasmodium. Malariae at 4% plasmodium ovale infection was at 1 %.<sup>1</sup>



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In the same Kenya Malaria Indicator Survey of 2020 mixed infections plasmodium. Falciparum with Plasmodium. Malariae infections accounted for 19%. On the other hand Plasmodium. Falciparum with Plasmodium Ovale, plasmodium ovale 0% with Plasmodium. . Malariae had both a 0% tally<sup>1</sup>

In a study in Ethiopia on prevalence of malaria among younger than 5 years 61.04% had Plasmodium. Falciparum infection while 38.96% were infected by Plasmodium vivax<sup>10</sup>

In Adama City in Ethiopia a study on urban malaria during the low malaria Transmission season: among Adolescents and adults ( $\geq 15$  years of age) were found to be more vulnerable to malaria infection, in this study Plasmodium vivax was the most dominant species at 66%, Plasmodium falciparum came second at (20.5%), while all mixed infections were at (6%) it is important to note that P. vivax was found as a predominant species in the studies in Ethiopia so far<sup>7</sup>.

### **Net ownership**

In this study net ownership was found to be high at 90%, this finding was attributed to the mass net distribution exercise that preceded data collection, the finding herein contradicts other findings in Kenya that reported lower net ownership percentages. Like in the Kenya Malaria Indicator Survey of 2020 net ownership of at least 1 net in Lake Endemic zone was at 78% among children age 5 to 14 years. A study on net use among school children across different settings in Kenya on Ownership and Use of Insecticide Treated Nets among Primary School going Children reported an increase of both ownership and use where 7 out of 10 children of the study population owned and utilized ITNs<sup>11</sup>

### **Net use**

The finding on net use in this study reported a 93% net usage this percentage was much higher compared to other findings in Africa for instance a study in Ghana found that in Female-Headed Households 80% of children slept under ITN<sup>12</sup>. According to the Kenya Malaria Indicator Survey of 2020 the overall net use in the lake endemic region was at 35% among children age 5 to 14 years, this was much less considering the fact that the malaria endemic region carries the highest malaria burden in Kenya. In another study in Homabay 79.3% of pupils slept under ITNs on the night preceding the survey<sup>13</sup>. In Uganda, a study in Soroti District among children under 5 years only about 6 out of 10 children younger than 5 years consistently slept under bed nets<sup>14</sup>. Comparatively a study In West Africa, precisely Ghana on predictors of mosquito bed net uses among children under-fives found net usage at 57.4 %<sup>15</sup>.

### **Reasons for not using nets**

Various reasons have been given for not sleeping under a treated net, in this study 32% reported not using nets because they were torn, 23% did not own nets, most importantly 2 reasons have been advanced as the commonest predictors in the region. This study found that 14 % of the respondent did not use nets because they were expensive to purchase the finding here are slightly lower than those of a study in the Hodan District, Mogadishu, Somalia on Factors Affecting Utilization of Insecticide Treated Net among Children Less than Five Years, found that 20% of the respondents cite the cost of purchasing the nets as too expensive and an impediment to net use<sup>16</sup>. The findings herein on lack of knowledge on net hanging where 5% did not use nets due to lack of net hanging knowledge also agrees with the findings of the Kenya Malaria Indicator Survey of 2020 where 4.5% of in the lake endemic regions of Kenya did not use nets because they were unable to hang nets. Bedbugs were also found to influence net use, in this study 14% of respondents who did not use nets reported bedbugs as an impediment,

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this is higher than the 2.3% fear of bedbugs that was reported in the lake endemic region among children aged 5 to 14 years in the KMIS 2020

### **Strengths and limitations of the study**

The findings in this study can be relied on because the variable that was observed (treated nets) were provided at no cost to all households in both sub counties during the mass net distribution 2021. The results on the malaria test are also reliable since they were carried out by qualified laboratory officer (WHO accredited) we however encountered some challenges on few care givers who were elderly and had recall challenges on some aspects.

### **Conclusion**

The prevalence of malaria children (5-15) year-olds in Samia and Matayos sub-Counties was (35%) (Microscopy 34.6%, mRDT 35%). The predominant species was *p. falciparum* (76%). *P. malariae* was (18%) *P. ovale* (1%), *p. falciparum* with *p. malariae* (4%), and *p. falciparum* with *p. ovale* (1%). *P. ovale* was the least dominant (1%).

Net ownership and use on the night prior to the survey were high (90%) and (93%) respectively this high levels of net ownership and usage were attributed the mass net distribution that preceded the study. Of those who didn't use nets, (32%) said they were torn, (23%) lacked nets, (14%) felt nets were expensive to buy, (19%) feared bedbugs, (12%) reported being tired of tying the net daily due to lack of fixed sleeping spaces, while (5%) didn't know how to hang nets.

Malaria prevalence in this study was high (35%), varying slightly from the prevalence in Busia county (38.5%). The finding on prevalence is much higher than the findings in the lake where the prevalence of the under 14 years in the lake endemic was 19%.

### **Recommendations**

There is need to refocus malaria prevention approaches in Busia by entrenching community education on net hanging and repair, integrated vector management and surveillance of parasite insecticide resistance patterns since the malaria prevalence is still high despite the high levels of net ownership and use.

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