

# Knowledge, attitudes, and practices regarding use of malaria prevention measures among pregnant women in Busia County, Kenya

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## ABSTRACT

Malaria poses severe health risks for pregnant women in Sub-Saharan Africa, especially in Kenya, where it remains a leading cause of morbidity and mortality. Despite the availability of Insecticide-Treated Nets (ITNs) and Intermittent Preventive Treatment in pregnancy (IPTp), utilization remains low, necessitating studies on Knowledge, Attitudes, and Practices (KAP) to inform effective interventions. In a parallel-group randomized trial (September 2023 to February 2024), 156 pregnant women aged 15–49 in Busia County were block-randomized to receive either SMS reminders on ITN and IPTp use (intervention group) or no reminders (control group). Primary outcomes were ITN utilization and IPTp adherence. Using a structured questionnaire, a KAP assessment was conducted regarding ITNs and IPTp for malaria prevention. Ethical approval was obtained, and informed consent was secured from all the participants. Healthcare providers and Community Health Workers (CHWs) were key information sources at baseline; post-intervention, SMS reminders became significant in the intervention group (46%). ITN use remained high across both groups, while IPTp recall, and adherence improved. Positive attitudes (>90%) and high perceived severity (94%–98%) persisted. Post-intervention, the intervention group showed greater perceived benefits (19% vs. 8%,  $p=0.018$ ), and self-efficacy remained high, supporting SMS feasibility and acceptability. Strong adherence to ITN and IPTp use was driven by high perceptions of malaria's severity and the benefits of preventive measures, underscoring the importance of ongoing education. Combining CHW education with SMS reminders may enhance malaria prevention in pregnant women, supporting sustained practices and improving maternal and infant health in high-risk areas.

**Keywords:** Attitudes, and practices, Insecticide-Treated nets, Intermittent preventive treatment in pregnancy, Knowledge, Malaria prevention, Maternal health, Pregnant women, SMS reminders.

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**Institutional Review Board Statement:** The Ethical Committee of the Kenya Medical Research Institute Scientific and Ethics Review Unit, KENYA has granted approval for this study on 6 March 2023 (Ref. No. KEMRI/SERU/CMR/4624).

**Transparency:** The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

**Competing Interests:** The authors declare that they have no competing interests.

**Authors' Contributions:** Design of study and tools, implementation and supervision, analysis of data for publication, interpretation, R.S., J.N., M.O. All authors have read and agreed to the published version of the manuscript.

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### Highlights of this paper

- This study assessed the impact of SMS reminders on knowledge, attitudes, and practices (KAP) related to malaria prevention among pregnant women in Busia County, Kenya, revealing improved IPTp adherence and perceived benefits in the intervention group.
- High ITN utilization and strong perceptions of malaria severity and preventive benefits were observed, underscoring the feasibility and acceptability of combining CHW education with SMS reminders.
- The findings demonstrate that integrating SMS reminders with community-based education can enhance malaria prevention practices and improve maternal and infant health outcomes in high-risk regions

## 1. INTRODUCTION

Malaria continues to pose a serious threat to public health across Sub-Saharan Africa, with pregnant women facing heightened risks due to their lowered immunity (World Health Organization, 2023). During pregnancy, malaria can lead to dangerous complications such as maternal anemia, low birth weight, and increased mortality for both mother and baby. These outcomes have a profound impact, contributing to significant challenges in maternal and neonatal health (Guyatt & Snow, 2001; Menéndez, D'Alessandro, & Ter Kuile, 2007; Shulman & Dorman, 2003).

In Kenya, where 75% of the population faces the threat of malaria, the disease is especially prevalent in the Lake Victoria basin and coastal regions, leaving pregnant women and young children at the greatest risk (DNMP, 2021; Mkubwa, Kagura, Chirwa, Ibisomi, & Kinyanjui, 2022). Critical interventions like Insecticide-Treated Nets (ITNs) and Intermittent Preventive Treatment in pregnancy (IPTp) play a key role in safeguarding maternal and child health (WHO, 2021). However, their uptake remains a challenge, with only 49% of pregnant women receiving the recommended IPTp doses and 73% reporting ITN use (DNMP, 2021).

The Knowledge, Attitudes, and Practices (KAP) framework plays a vital role in understanding how community behaviors align with malaria prevention efforts. By pinpointing gaps in knowledge, addressing misconceptions, and uncovering practical barriers, KAP studies help design more effective and targeted health interventions (Mutanyi, Onguru, Ogolla, & Adipo, 2021; Pell et al., 2013). Tackling these challenges is key to improving the use of ITNs and IPTp among pregnant women (De-Gaulle et al., 2022; Nyaaba, Olaleye, Obiyan, Walker, & Anumba, 2021). This study leverages the KAP framework to explore malaria prevention behaviors in Busia County, one of Kenya's malaria high-risk regions.

To explore new ways of promoting ITN and IPTp uptake, this study implemented a parallel-group randomized trial from September 2023 to February 2024 in Busia County, examining the impact of SMS reminders on pregnant women's use of malaria prevention measures. This paper reports on one of the objectives of the study on knowledge, attitudes, and practices regarding ITNs and IPTp, comparing responses in intervention and control groups before and after the SMS intervention.

## 2. MATERIALS AND METHODS

### 2.1. Study Design

A parallel group-randomized trial (GRT) was carried out in Busia County, Kenya, to evaluate how SMS reminders influence the use of ITNs and IPTp among pregnant women. Participants were block-randomized by sub-county to account for regional differences, with the sample size determined based on anticipated changes in ITN and IPTp uptake. The main focus was on measuring the uptake of ITNs and IPTp in both study groups before and after the intervention.

## *2.2. Study Site and Population*

The study was conducted in Busia County, a high-prevalence malaria region in Kenya's Lake Victoria area, where malaria prevalence is 27% compared to a national average of 8% (Bashir, Nyakoe, & van der Sande, 2019). Pregnant women aged 15–49 years from all sub-counties were eligible if they were in their second or third trimester, provided informed consent, and had access to SMS-enabled mobile phones.

Exclusion criteria included a history of pregnancy complications, chronic illnesses, or current pregnancy-related danger signs.

## *2.3. Data Collection Procedures*

Baseline data were collected from September to October 2023, with post-intervention data from January to February 2024. Data were gathered using a structured, interviewer-administered questionnaire on Android devices via Microsoft® Office Forms.

The questionnaire, validated for relevance and reliability, evaluated participants' knowledge, attitudes, and practices (KAP) regarding malaria prevention.

## *2.4. Data Analysis*

Data were analyzed in STATA 15, with checks for internal consistency and outlier identification. Descriptive statistics (proportions, frequencies, and measures of central tendency) provided a dataset overview. Categorical variables were compared using cluster-adjusted Pearson's chi-square or Fisher's Exact test. Attitudes toward ITNs were measured using a recoded Likert scale (-2 for "strongly disagree" to +2 for "strongly agree"), averaged to yield an attitude score, while practices were assessed through a Health Belief Model perspective. Bivariable and multivariable analyses identified factors affecting IPTp use, controlling for confounding effects, with significance set at <0.05.

## *2.5. Ethical Considerations*

The study protocol was approved by the Scientific and Ethics Review Unit of KEMRI (SERU No. 4622) and the Busia County Department of Health. Informed consent was obtained from all participants after explaining study objectives and potential risks.

Confidentiality was maintained by anonymizing participant data and securely storing information, with researcher contact information provided for participant inquiries.

# **3. RESULTS**

## *3.1. Characteristics of the Respondents*

Of 158 pregnant women screened, 156 were included after excluding two with pregnancy danger signs. Table 1 provides socio-demographic details: the majority were aged 18–27 years (57; 37% aged 18–22, 54; 35% aged 23–27), with 89% married.

Most participants were unemployed (83; 53.3%), followed by farmers (30; 19.2%) and self-employed traders (27; 17%). About 46% had primary education, and 46% secondary education, while 9% had tertiary education (Table 1).

**Table 1.** Baseline characteristics of the study population.

Characteristic	Total (N=156)
	n (%)
Age group in years	
18-22	57(36.5)
23-27	54(34.6)
28 +	45(28.8)
Highest education level attained	
Primary	71(45.5)
Secondary	71(45.5)
Tertiary	14(9.0)
Marital status	
Unmarried	17(10.9)
Married	139(89.1)
Household socio-economic status	
Poorest	32(20.5)
Very poor	31(19.9)
Poor	31(19.9)
Less poor	31(19.9)
Least poor	31(19.9)
Occupation	
Farmer	30(19.2)
Some employment: Salaried	10(6.4)
Some employment: Casual worker	6(3.8)
Some employment: Trade/Self-employed	27(17.3)
Unemployed	83(53.3)
Number of children	
None	51(32.7)
1-2	72(46.2)
3+	33(21.2)
Religious affiliation	
Roman catholic	39(25.0)
Protestant/Other Christian	117(75.0)

**3.2. Knowledge, Attitudes, and Practices (KAP) Regarding ITNs and IPTp Among Pregnant Women in Busia County**

**3.2.1. Knowledge on Malaria Prevention**

At baseline, slightly less than half of participants reported exposure to malaria-related messaging (48% control, 57% intervention). Among those exposed, healthcare providers and CHWs were primary sources of malaria information (25% control, 31% intervention; Figure 1). Post-intervention, exposure increased to approximately three-quarters in both groups (77% control, 76% intervention). Post-intervention, message receipt from healthcare providers and CHWs increased markedly in the control group (healthcare providers 60%, CHWs 58%), while the intervention group showed little change from these sources. SMS reminders became a primary source for the intervention group post-intervention (46%).

### Exposure to malaria-related messages and sources

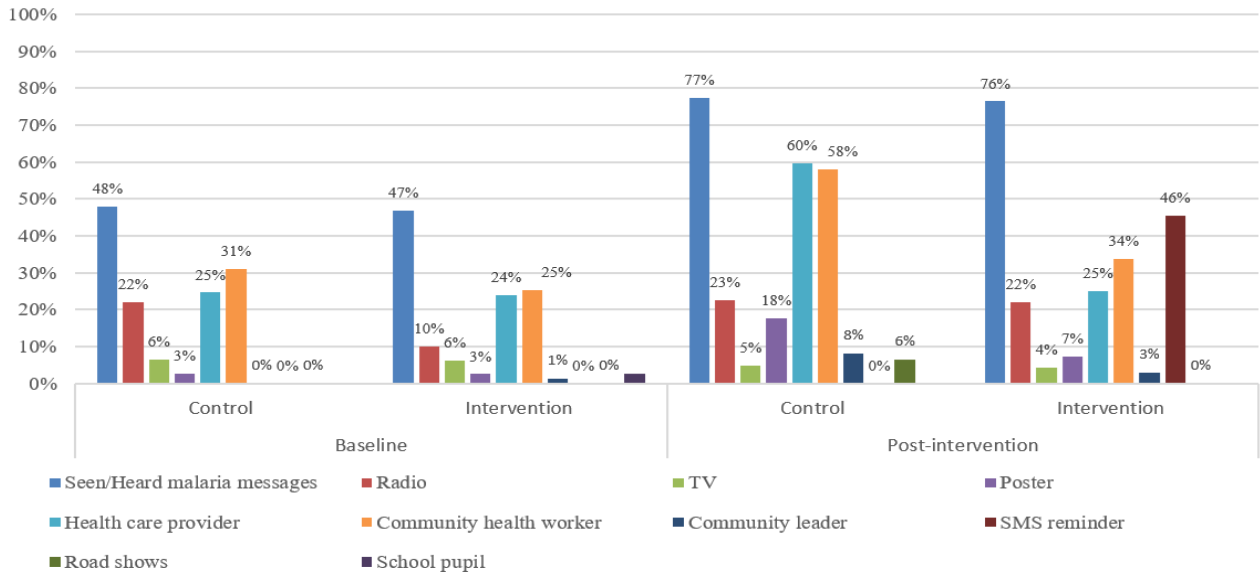


Figure 1. Exposure to Malaria-related messages and sources.

Initial message recall centered on ITN use (76% control, 78% intervention), shifting to prompt healthcare-seeking post-intervention (79% control, 69% intervention) and increased IPTp message recall (32%-63% control, 34%-56% intervention) (Figure 2).

### Messages recalled by exposed participants

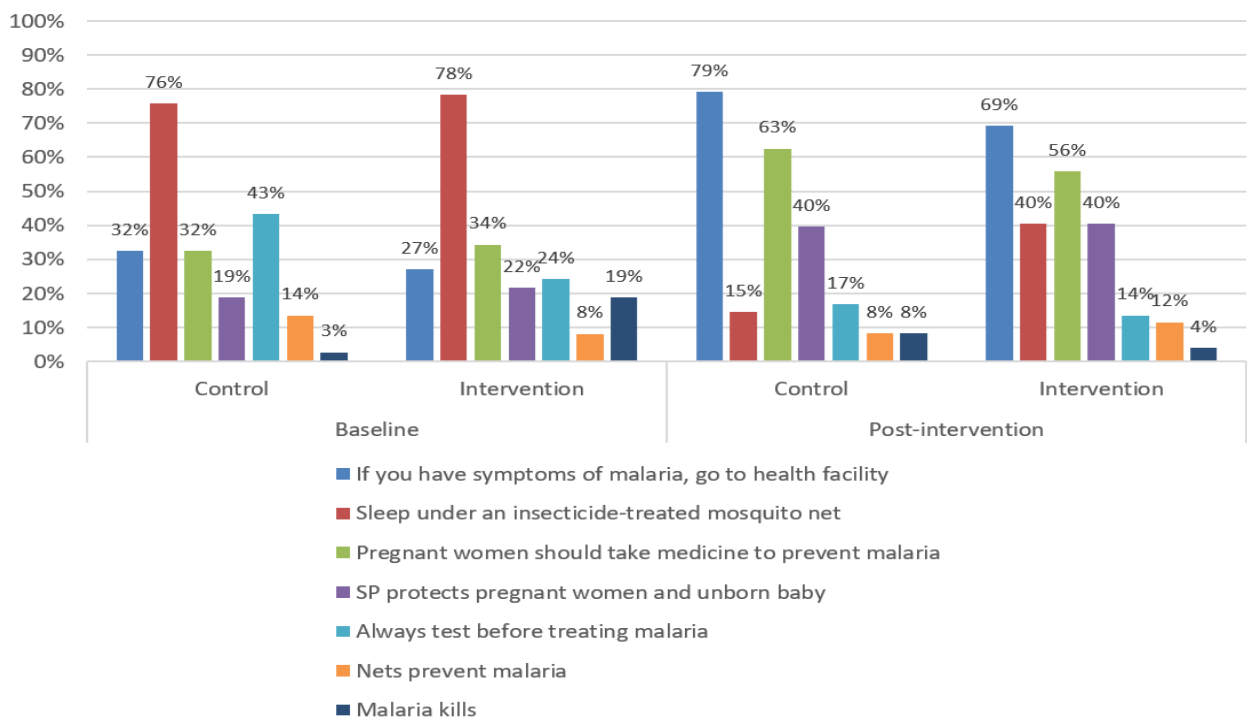


Figure 2. Messages recalled on malaria prevention.

### 3.3. Attitude Towards Malaria Prevention

Participant attitudes toward nets were assessed using Likert scale questions on agreement with specific statements (Table 2).

Table 1. Attitudes toward malaria: Pre- and post-intervention comparison between control and intervention groups.

	Baseline				Post-intervention			
	Total N=156	Control N=77	Intervention N=79	p-value	Total N=130	Control N=62	Intervention N=68	p-value
Q49. Mosquitoes cause malaria.								
Agree	154 (99%)	77 (100%)	77 (97%)	0.16	129 (99%)	62 (100%)	67 (99%)	0.34
Disagree	2 (1%)	0 (0%)	2 (3%)		1 (1%)	0 (0%)	1 (1%)	
Q50. People in this community only get malaria during the rainy season.								
Agree	102 (65%)	54 (70%)	48 (61%)	0.42	74 (57%)	42 (68%)	32 (47%)	0.017
Disagree	46 (29%)	19 (25%)	27 (34%)		56 (43%)	20 (32%)	36 (53%)	
Don't know/Uncertain	8 (5%)	4 (5%)	4 (5%)		0 (0%)	0 (0%)	0 (0%)	
Q51. Getting malaria is not a problem because it can be easily treated.								
Agree	107 (69%)	54 (70%)	53 (67%)	0.82	85 (65%)	42 (68%)	43 (63%)	0.38
Disagree	46 (29%)	22 (29%)	24 (30%)		43 (33%)	20 (32%)	23 (34%)	
Don't know/Uncertain	3 (2%)	1 (1%)	2 (3%)		2 (2%)	0 (0%)	2 (3%)	
Q52. You can sleep under a mosquito net for the entire night when there are lots of mosquitoes.								
Agree	136 (87%)	65 (84%)	71 (90%)	0.31	126 (97%)	61 (98%)	65 (96%)	0.36
Disagree	20 (13%)	12 (16%)	8 (10%)		4 (3%)	1 (2%)	3 (4%)	
Q53. You can sleep under a mosquito net for the entire night when there are few mosquitoes.								
Agree	127 (81%)	65 (84%)	62 (78%)	0.34	116 (89%)	56 (90%)	60 (88%)	0.45
Disagree	29 (19%)	12 (16%)	17 (22%)		13 (10%)	5 (8%)	8 (12%)	
Don't know/Uncertain					1 (1%)	1 (2%)	0 (0%)	
Q54. You do not like sleeping under a mosquito net when the weather is too warm.								
Agree	52 (33%)	26 (34%)	26 (33%)	0.99	27 (21%)	15 (24%)	12 (18%)	0.65
Disagree	102 (65%)	50 (65%)	52 (66%)		99 (76%)	45 (73%)	54 (79%)	
Don't know/Uncertain	2 (1%)	1 (1%)	1 (1%)		4 (3%)	2 (3%)	2 (3%)	
Q55. I am confident in my ability to hang a mosquito net in my household.								
Agree	144 (92%)	71 (92%)	73 (92%)	0.8	127 (98%)	60 (97%)	67 (99%)	0.21
Disagree	9 (6%)	4 (5%)	5 (6%)		2 (2%)	2 (3%)	0 (0%)	
Don't know/Uncertain	3 (2%)	2 (3%)	1 (1%)		1 (1%)	0 (0%)	1 (1%)	
Q56. You can protect yourself and your children from getting malaria using mosquito nets.								
Agree	151 (97%)	75 (97%)	76 (96%)	0.67	128 (98%)	61 (98%)	67 (99%)	0.95
Disagree	5 (3%)	2 (3%)	3 (4%)		2 (2%)	1 (2%)	1 (1%)	
Q57. You can sleep under a bed net every night of the year.								
Agree	138 (88%)	70 (91%)	68 (86%)	0.34	127 (98%)	60 (97%)	67 (99%)	0.51
Disagree	18 (12%)	7 (9%)	11 (14%)		3 (2%)	2 (3%)	1 (1%)	

Responses were used to identify positive attitudes toward malaria prevention, which were then analyzed using a chi-square test (Table 3). Positive attitudes toward ITNs and IPTp were high (>90%) across both groups with no significant difference pre- or post-intervention.

**Table 2.** Positive attitudes toward ITN and IPTp use for malaria prevention among pregnant women in busia county.

	Baseline			p <sup>¥</sup>	Post-intervention			p <sup>¥</sup>
	Total N=156	Control N=77	Intervention N=79		Total N=130	Control N=62	Intervention N=68	
Positive attitude regarding ITNs and IPTp for malaria prevention								
No	11 (7%)	4 (5%)	7 (9%)	0.282	1 (0.8%)	0	1 (1.5%)	0.523
Yes	145 (93%)	75 (95%)	72 (91%)		129 (99%)	62 (100%)	67 (99%)	

In the control group, 58 of 77 participants (75%) maintained a positive attitude toward ITNs and IPTp for malaria prevention both before and after the intervention. In the intervention group, 62 of 68 participants (91%) consistently held a positive attitude across both periods (Table 4). A significant decrease in positive attitude was observed in the control group from pre- to post-intervention (McNemar’s  $\chi^2 = 0.33$ ,  $p = 0.019$ ). In contrast, the increase in positive attitudes in the intervention group post-intervention was not statistically significant (McNemar’s  $\chi^2 = 1.29$ ,  $p = 0.218$ ).

**Table 4.** Change in positive attitudes toward ITN and IPTp use among pregnant women in busia county: pre- to post-intervention.

Cases	Controls		Proportion with factors			McNemar’s ( $\chi^2$ )	p-value
	Exposed	Unexposed	Cases	Controls	Difference (95%CI)		
Positive attitude regarding ITNs and IPTp for malaria prevention among CONTROLS							
Exposed	58	15					
Unexposed	4	0	0.95	0.81	0.14 (0.02, 0.26)	0.33	0.019
Positive attitude regarding ITNs and IPTp for malaria prevention among the INVERVENTION							
Exposed	62	1					
Unexposed	5	0	0.92	0.98	-0.06 (-0.14, 0.03)	1.29	0.218

### 3.4. Practices Towards Malaria Prevention: A Health Belief Model Perspective.

#### 3.4.1. Perceived Susceptibility

At baseline, 48% (75) strongly agreed that Busia had higher malaria prevalence, and 79% (124) strongly agreed on heightened susceptibility for pregnant women. Post-intervention, this remained high (96; 74%) as did the belief in increased susceptibility among pregnant women (107; 82%) (Table 5).

**Table 5.** Perceived susceptibility.

	Perceived susceptibility							
	Baseline				Post-intervention			
	Total N=156	Control N=77	Intervention N=79	p-value	Total N=130	Control N=62	Intervention N=68	p-value
Q58. Prevalence of malaria is higher in Busia County than in other parts of the country								
Somewhat agree	38 (24%)	17 (22%)	21 (27%)	0.49	23 (18%)	10 (16%)	13 (19%)	0.29
Somewhat disagree	29 (19%)	17 (22%)	12 (15%)		8 (6%)	3 (5%)	5 (7%)	
Strongly agree	75 (48%)	38 (49%)	37 (47%)		96 (74%)	46 (74%)	50 (74%)	
Strongly disagree	14 (9%)	5 (6%)	9 (11%)		3 (2%)	3 (5%)	0 (0%)	
Q59. Pregnant women are more likely to get malaria than non-pregnant women.								
Somewhat agree	14 (9%)	7 (9%)	7 (9%)	0.97	11 (8%)	6 (10%)	5 (7%)	0.11
Somewhat disagree	7 (4%)	3 (4%)	4 (5%)		5 (4%)	0 (0%)	5 (7%)	
Strongly agree	124 (79%)	61 (79%)	63 (80%)		107 (82%)	54 (87%)	53 (78%)	
Strongly disagree	11 (7%)	6 (8%)	5 (6%)		7 (5%)	2 (3%)	5 (7%)	

### 3.5. Perceived Severity

At baseline, most participants (146; 94%) strongly agreed that malaria poses serious risks to mothers and infants, with 131 (84%) affirming its links to low birth weight, infant mortality, and maternal death. Post-intervention, strong agreement on malaria’s severity remained high, with 128 (98%) and 124 (95%) of participants strongly agreeing with the respective statements (Table 6).

Table 6. Perceived severity.

Questions	Perceived severity							
	Baseline				Post-intervention			
	Total N=156	Control N=77	Intervention N=79	p- value	Total N=130	Control N=62	Intervention N=68	p- value
Q60. Malaria can be risky for the mother and their babies.								
Somewhat agree	9 (6%)	2 (3%)	7 (9%)	0.14	1 (1%)	0 (0%)	1 (1%)	0.40
Somewhat disagree	1 (1%)	0 (0%)	1 (1%)		1 (1%)	0 (0%)	1 (1%)	
Strongly agree	146 (94%)	75 (97%)	71 (90%)		128 (98%)	62 (100%)	66 (97%)	
Q61. Malaria can lead to low birthweight, child death and maternal death.								
Somewhat agree	18 (12%)	7 (9%)	11 (14%)	0.18	5 (4%)	2 (3%)	3 (4%)	0.59
Somewhat disagree	6 (4%)	1 (1%)	5 (6%)		1 (1%)	0 (0%)	1 (1%)	
Strongly agree	131 (84%)	69 (90%)	62 (78%)		124 (95%)	60 (97%)	64 (94%)	
Strongly disagree	1 (1%)	0 (0%)	1 (1%)		0 (0%)	0 (0%)	0 (0%)	

### 3.6. Perceived Benefits

Positive perceptions of ITNs and IPTp remained high (146; 94%), with a greater increase in perceived benefits for participants and infants in the intervention group (19% vs. 8%, p = 0.018) (Table 7).

Table 3. Perceived benefits.

Questions	Perceived benefits							
	Baseline				Post-intervention			
	Total N=156	Control N=77	Intervention N=79	p- value	Total N=130	Control N=62	Intervention N=68	p- value
Q62. Mosquito nets are valuable.								
Somewhat agree	8 (5%)	4 (5%)	4 (5%)	0.37	130 (100%)	62 (100%)	68 (100%)	0.61
Somewhat disagree	2 (1%)	0 (0%)	2 (3%)		3 (2%)	1 (2%)	2 (3%)	
Strongly agree	146 (94%)	73 (95%)	73 (92%)		127 (98%)	61 (98%)	66 (97%)	
Q63. Getting IPTp is important.								
Somewhat agree	9 (6%)	2 (3%)	7 (9%)	0.18	2 (2%)	1 (2%)	1 (1%)	0.95
Somewhat disagree	2 (1%)	0 (0%)	2 (3%)		128 (98%)	61 (98%)	67 (99%)	
Strongly agree	143 (92%)	74 (96%)	69 (87%)					
Strongly disagree	2 (1%)	1 (1%)	1 (1%)					
Q64. Protecting myself from malaria has health benefits to me and my baby.								
Somewhat agree	12 (8%)	9 (12%)	3 (4%)	0.064	46 (35%)	26 (42%)	20 (29%)	0.018
Strongly agree	144 (92%)	68 (88%)	76 (96%)		18 (14%)	5 (8%)	13 (19%)	

### 3.7. Perceived Barriers

At baseline, participants strongly agreed that ITN access was challenging for 35% (intervention) vs. 17% (control) (p = 0.005). Post-intervention, more control participants reported access difficulties (21% control vs. 16% intervention, p = 0.003) (Table 8).



Table 4. Perceived barriers.

Questions	Perceived barrier							
	Baseline				Post-intervention			
	Total N=156	Control N=77	Intervention N=79	p- value	Total N=130	Control N=62	Intervention N=68	p- value
Q65. Getting nets is difficult.								
Somewhat agree	32 (21%)	21 (27%)	11 (14%)	0.005	41 (32%)	24 (39%)	17 (25%)	0.003
Somewhat disagree	30 (19%)	20 (26%)	10 (13%)		25 (19%)	7 (11%)	18 (26%)	
Strongly agree	41 (26%)	13 (17%)	28 (35%)		24 (18%)	13 (21%)	11 (16%)	
Strongly disagree	53 (34%)	23 (30%)	30 (38%)		19 (15%)	10 (16%)	9 (13%)	
Q66. Going to clinic for IPTp is a challenge.								
Somewhat agree	35 (22%)	21 (27%)	14 (18%)	0.21	27 (21%)	20 (32%)	7 (10%)	0.23
Somewhat disagree	43 (28%)	16 (21%)	27 (34%)		60 (46%)	19 (31%)	41 (60%)	
Strongly agree	27 (17%)	15 (19%)	12 (15%)		14 (11%)	10 (16%)	4 (6%)	
Strongly disagree	51 (33%)	25 (32%)	26 (33%)		23 (18%)	12 (19%)	11 (16%)	

### 3.8. Cues To Action and Self-Efficacy

In both study rounds, most participants strongly agreed on their ability to obtain a bed net (baseline 68%, post-intervention 65%), protect themselves and children from malaria (baseline 78%, post-intervention 95%), use a bed net every night (baseline 74%, post-intervention 95%), and take preventive actions (baseline 70%, post-intervention 91%). At baseline, a higher percentage of control participants believed in the effectiveness of protective actions compared to the intervention group (78% vs. 62%,  $p = 0.038$ ), but post-intervention, this difference was no longer significant (92% vs. 90%,  $p = 0.520$ ). Perception of SMS reminders as effective tools remained high, with participants agreeing that SMS messages could remind them to use bed nets daily (baseline 81%, post-intervention 78%) and visit the clinic for malaria medication (baseline 87%, post-intervention 88%) (Table 9).

Table 5. Cues to action and self-efficacy.

Questions	Cues to action and self efficacy							
	Baseline				Post-intervention			
	Total N=156	Control N=77	Intervention N=79	p- value	Total N=130	Control N=62	Intervention N=68	p- value
Q67. I can obtain a bed net to for me and my child.								
Somewhat agree	25 (16%)	12 (16%)	13 (16%)	0.56	14 (11%)	10 (16%)	4 (6%)	0.23
Somewhat disagree	23 (15%)	12 (16%)	11 (14%)		23 (18%)	12 (19%)	11 (16%)	
Strongly agree	106 (68%)	53 (69%)	53 (67%)		85 (65%)	36 (58%)	49 (72%)	
Strongly disagree	2 (1%)	0 (0%)	2 (3%)		8 (6%)	4 (7%)	4 (6%)	
Q68. I can protect myself and my children from getting malaria.								
Somewhat agree	24 (15%)	6 (8%)	18 (23%)	0.048	6 (5%)	1 (2%)	5 (7%)	0.18
Somewhat disagree	9 (6%)	5 (6%)	4 (5%)		1 (1%)	0 (0%)	1 (1%)	
Strongly agree	122 (78%)	66 (86%)	56 (71%)		123 (95%)	61 (97%)	63 (93%)	
Strongly disagree	1 (1%)	0 (0%)	1 (1%)		0 (0%)	0 (0%)	0 (0%)	
Q69. I can sleep under a bed net every night of the year.								
Somewhat agree	18 (12%)	8 (10%)	10 (13%)	0.58	5 (4%)	1 (2%)	4 (6%)	0.45
Somewhat disagree	10 (6%)	6 (8%)	4 (5%)		2 (2%)	1 (2%)	1 (2%)	
Strongly agree	116 (74%)	59 (77%)	57 (72%)		123 (95%)	60 (97%)	63 (93%)	
Strongly disagree	12 (8%)	4 (5%)	8 (10%)		0 (0%)	0 (0%)	0 (0%)	
Q70. There are actions I can take to protect me and my child from getting malaria								
Somewhat agree	25 (16%)	11 (14%)	14 (18%)	0.038	10 (8%)	4 (6%)	6 (9%)	0.52
Somewhat disagree	16 (10%)	6 (8%)	10 (13%)		1 (1%)	1 (2%)	0 (0%)	
Strongly agree	109 (70%)	60 (78%)	49 (62%)		118 (91%)	57 (92%)	61 (90%)	
Strongly disagree	6 (4%)	0 (0%)	6 (8%)		1 (1%)	0 (0%)	1 (1%)	
Q71. SMS text messages can remind me to use my nets every day.								
Somewhat agree	12 (8%)	5 (6%)	7 (9%)	0.91	14 (11%)	6 (10%)	8 (12%)	0.46
Somewhat disagree	7 (4%)	4 (5%)	3 (4%)		8 (6%)	5 (8%)	3 (4%)	
Strongly agree	126 (81%)	63 (82%)	63 (80%)		101 (78%)	46 (74%)	55 (81%)	
Strongly disagree	11 (7%)	5 (6%)	6 (8%)		7 (5%)	5 (8%)	2 (3%)	
Q72. SMS text messages can remind me to go to the clinic to get my medication for malaria.								
Somewhat agree	10 (6%)	3 (4%)	7 (9%)	0.63	7 (5%)	4 (7%)	3 (4%)	0.107
Somewhat disagree	7 (4%)	4 (5%)	3 (4%)		3 (2%)	0 (0%)	3 (4%)	
Strongly agree	135 (87%)	68 (88%)	67 (85%)		114 (88%)	53 (86%)	61 (90%)	
Strongly disagree	4 (3%)	2 (3%)	2 (3%)		6 (5%)	5 (8%)	1 (2%)	

## 4. DISCUSSION

### 4.1. Knowledge

This study demonstrated shifts in participants' knowledge about ITNs and IPTp, with healthcare providers and CHWs as primary sources of malaria information, consistent with prior research on trusted health information sources (Ajayi & Emeto, 2023). CHWs are essential in spreading malaria prevention and treatment knowledge, often integrating with community health initiatives to improve care access (Paintain et al., 2014; Sunguya, Mlunde, Ayer, & Jimba, 2017). After the intervention, SMS reminders became a prominent source of information for the intervention group, demonstrating their effectiveness in reinforcing malaria prevention messages. The focus of message recall shifted from ITN use to encouraging prompt healthcare-seeking, consistent with findings on the critical role of timely care in maternal health (Hill et al., 2015). Increased recall of IPTp messages aligns with evidence highlighting IPTp's importance in reducing malaria risks among vulnerable groups, including pregnant women (Gunn et al., 2015; Okoyo et al., 2021). Integrating IPTp messaging into existing health communication strategies has been shown to enhance awareness and encourage pregnant women to seek preventive care and treatment (Wanzira, Katamba, Okullo, & Rubahika, 2016). This integrated approach not only boosts knowledge but also supports better health-seeking behaviors, contributing to improved maternal and child health outcomes in malaria-endemic areas (Martínez-Pérez et al., 2018). Using SMS reminders to reinforce the benefits of IPTp may be a particularly effective way to promote these behaviors among pregnant women.

### 4.2. Attitudes

Positive attitudes toward ITNs and IPTp were observed in both groups, but the intervention group receiving SMS reminders maintained these attitudes more effectively, while the control group showed a decline post-intervention. This highlights the value of SMS reminders in reinforcing positive perceptions, aligning with earlier studies that show how digital health tools can support preventive behaviors (Jones et al., 2012; Raifman, Lanthorn, Rokicki, & Fink, 2014). Regular reminders help counter the natural waning of motivation, ensuring consistent adherence to malaria prevention practices, which is especially critical for pregnant women at heightened risk (Githinji et al., 2015; Modrek et al., 2014). Beyond sustaining knowledge, such interventions encourage proactive health-seeking behaviors, which are vital in reducing malaria's impact on vulnerable groups like pregnant women (Liu & Modrek, 2016; Talisuna et al., 2017).

### 4.3. Practices

#### 4.3.1. Perceived Susceptibility and Severity

Participants consistently acknowledged the widespread prevalence and serious risks of malaria in Busia County, demonstrating a level of awareness that plays a critical role in driving preventive behaviors, as noted in previous research (Okoyo et al., 2021). These persistent perceptions highlight the need to incorporate risk-related information into health campaigns, as sustained awareness has been shown to encourage ongoing preventive practices (Onochie & Egwunyenga, 2019). Emphasizing the dangers of malaria in public health messaging can further support adherence to ITN use and IPTp, as evidenced by the consistent preventive behaviors observed in this study and others (Garba et al., 2023). By continually reinforcing the risks associated with malaria, health programs can sustain and strengthen the adoption of critical preventive measures, such as the use of ITNs and IPTp (Asher, 2023; Oladeinde, Omeregie, Odiya, & Oladeinde, 2012; Oladokun, Oladokun, & Adesina, 2011).

#### *4.4. Perceived Benefits and Barriers*

Participants expressed strong appreciation for the benefits of ITNs and IPTp, with positive perceptions remaining high throughout the study. In the intervention group, recognition of malaria prevention's health benefits increased, and reports of bed net access issues decreased after the intervention. These findings align with research showing that targeted communication strategies can effectively boost awareness and adoption of malaria prevention measures (Sabin et al., 2018). The improved access to bed nets observed in the intervention group highlights the potential of combining SMS reminders with strengthened ANC distribution programs to further encourage preventive behaviors among pregnant women. This underscores the importance of adopting integrated approaches to malaria prevention (Rodvalho et al., 2023).

#### *4.5. Self-Efficacy and Cues to Action*

Participants demonstrated a strong sense of confidence in their ability to use ITNs and take preventive measures, with many viewing SMS reminders as helpful prompts for using bed nets and attending antenatal clinic visits. This aligns with behavior change theories like the Health Belief Model, which emphasizes the role of cues to action in reinforcing self-efficacy and encouraging positive behavioral shifts (Liu & Modrek, 2016). These findings highlight the practicality and acceptance of SMS-based interventions as a tool for supporting malaria prevention efforts among pregnant women.

#### *4.6. Study Limitations*

This study has several limitations: possible influence from Community Health Workers on both groups, limited evaluation of the intervention at different frequencies, focus on user factors over systemic issues, potential recall bias in self-reported data, and limited regional scope, affecting generalizability. While the insights are valuable, caution is advised in extrapolating results. Further research with other digital health interventions, such as interactive SMS messaging, longer follow-ups, and attention to systemic factors is recommended. Comparative research across regions with varying malaria prevalence could also inform targeted malaria prevention strategies.

## **5. CONCLUSIONS**

This study assessed knowledge, attitudes, and practices (KAP) toward malaria prevention, focusing on ITN and IPTp use among pregnant women in Busia County, Kenya. Results for this study reported elsewhere revealed high ITN utilization at baseline and follow-up and increased IPTp uptake across both groups. While SMS reminders did not significantly impact ITN use, they may have bolstered IPTp uptake and helped maintain positive attitudes toward malaria prevention. High perceptions of malaria's severity and benefits of ITN and IPTp use contributed to strong adherence, highlighting the need for continuous education. These findings suggest that combining CHW education with SMS reminders could be an effective strategy for malaria prevention in pregnant women, with potential application in other high-risk settings to sustain malaria prevention practices and improve maternal and infant health outcomes.

### **List of Abbreviations**

ANC	Anti Natal Clinic
CHW	Community Health Worker
CI	Confidence Interval
GRT	Group Randomized Trial
ITN	Insecticide Treated Nets

JKUAT	Jomo Kenyatta University of Agriculture and Technology
KEMRI	Kenya Medical Research Institute
MIS	Malaria Indicator Survey
SERU	Scientific and Ethics Review Unit
SMS	Short Messaging Services
SP	Sulfadoxine Pyrimethamine
WHO	World Health Organization

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