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Original Article

Factors Associated with Insecticide-Treated Nets Utilization Among Childbearing Women in East Province, Rwanda: 2019-2020 Demographic and Health Survey Analysis.

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Abstract

Introduction: Insecticide-treated nets (ITNs) are among the most effective and widely promoted interventions for malaria prevention, particularly in sub-Saharan Africa, where the disease remains a major public health challenge. Despite the large-scale distribution of ITNs in Rwanda, disparities in usage persist across different regions and population groups. This study aims to assess the prevalence of ITN utilization and identify associated factors among women of reproductive age in Eastern Province, using data from the 2019-2020 Rwanda Demographic and Health Survey (RDHS). Understanding these factors is crucial for designing targeted interventions to improve ITN uptake and reduce malaria-related morbidity and mortality in vulnerable populations.

Method: This cross-sectional study utilized secondary data from the 2019-2020 RDHS, focusing on 3,010 women aged 15–49 years residing in Eastern Province. A two-stage stratified sampling design was employed to ensure representativeness across districts, urban-rural settings, and demographic strata. Data extraction, coding, and cleaning were conducted using SPSS version 25. Descriptive statistics were used to summarize participant characteristics. Chi-square tests assessed associations between ITN use and selected background variables. Binary logistic regression both unadjusted and adjusted was applied to identify predictors of ITN use, using backward elimination to retain variables significantly associated with the outcome. Statistical significance was set at $p \leq 0.05$.

Results: The results showed that the prevalence of ITN utilization among the childbearing women in Eastern Province of Rwanda is 73.82%. The study revealed that some variables were significant to the ITN utilization. In the bivariate logistic regression, poorer households (COR: 0.792, p=0.013), households with four or fewer children (COR: 0.785, p=0.025), those lacking a mosquito bed net (COR: 0.813, p=0.014), and women who never attended antenatal care (COR: 0.610, p=0.011) were less likely to sleep under a bed net. In contrast, home deliveries were more likely (COR: 1.603, p=0.025), while hospital deliveries were less likely (COR: 0.648, p=0.001) to use a bed net compared to health center deliveries. After adjustment, fewer children (AOR: 0.571, p=0.004) and no bed net ownership (AOR: 0.672, p=0.023) remained significant, while women who attended fewer antenatal visits (AOR: 9.677, p=0.033) and those delivering at home (AOR: 3.165, p=0.009) were more likely to sleep under a bed net.

Conclusion: The study found that ITN utilization among childbearing women in Rwanda's Eastern Province was 73.82%, with significant associations observed for socioeconomic, demographic, and healthcare-related factors. Poorer households, fewer children, lack of bed nets, and non-attendance of antenatal care were key determinants of lower ITN use. These findings suggest a need for targeted interventions, especially in vulnerable groups, including intensified public health campaigns, reliable ITN distribution, and ANC-based malaria prevention education, to further reduce malaria transmission and improve maternal health outcomes. Strengthening these efforts can contribute significantly to malaria prevention and improve maternal and child health outcomes in the region.

Key words: Factors, Insecticide-Treated Nets, Utilization, Childbearing Women, Rwanda

Background

Malaria remains a major public health challenge, particularly in sub-Saharan Africa, where it contributes significantly to disease burden, mortality, and economic hardship (WHO, 2021; Bhatt et al., 2016). Globally, the World Health Organization (WHO) has emphasized vector control primarily through the use of insecticide-treated nets (ITNs) and indoor residual spraying (IRS) as a cornerstone for malaria prevention and control (WHO, 2021). ITNs offer a cost-effective and sustainable intervention, reducing malaria-related morbidity and mortality across endemic regions (Burnett et al., 2023; Gansané et al., 2022; Gleave et al., 2021). Despite these interventions, malaria caused an estimated 247 million cases and 619,000 deaths globally in 2021, with 95% of these cases and deaths occurring in the WHO African Region (WHO, 2022b).

In Rwanda, malaria is endemic, and the entire population is at risk of infection, with the highest vulnerability observed among pregnant women and children under five years (MOH, 2020; PMI, 2022a). The Eastern Province of Rwanda, due to its geographical and climatic conditions, continues to report the highest malaria burden

compared to other regions, particularly during the two annual rainy seasons (Eckert et al., 2017; RBC, 2021). According to the 2019–20 Rwanda Demographic and Health Survey (RDHS), ITN ownership stood at 66% of households, while individual-level usage was 71% among those with access to an ITN the night before the survey (NISR & MOH, 2021). This represents a decline from the previous years; in the East Province, the proportion of the population sleeping under ITNs dropped significantly from 65% in 2014–15 to 41% in 2019–20 (NISR & MOH, 2021).

This study focuses on all women of reproductive age (15–49), regardless of pregnancy status. Women of childbearing age (15–49 years) are a particularly vulnerable group due to the severe consequences of malaria during pregnancy, including maternal anemia, miscarriage, preterm delivery, and low birth weight (Lawn et al., 2016; WHO, 2017). Although numerous malaria prevention programs have targeted pregnant women and children under five, less focus has been placed on the broader population of childbearing women. Existing literature shows disparities in ITN utilization across regions, socioeconomic groups, and education levels (Ameyaw et al., 2020; Nkoka et al., 2018; Auta, 2015). In Eastern Rwanda, the persistent gap in ITN use may be attributed to various factors, including household size, wealth index, education, number of sleeping rooms, availability of ITNs, and knowledge of malaria prevention (Solanke et al., 2023; Ndam et al., 2018).

Studies such as those by Kawuki et al. (2023) and Habimana et al. (2020) suggest that being from the Eastern Province negatively correlates with ITN use among pregnant women, yet few have focused exclusively on the broader group of childbearing women in this region. This represents a significant knowledge gap, especially given that the 2017 Rwanda Malaria Indicator Survey (RMIS) reported the highest malaria prevalence (11%) among childbearing women in the East Province (RMIS, 2017). Furthermore, global distribution of ITNs peaked in 2021, with around 220 million nets delivered, yet actual usage rates remain suboptimal in many regions (WHO, 2022b). Despite these findings, limited evidence exists on what drives ITN usage among all women of childbearing age, particularly in the East Province. Therefore, this study analyzes data from the 2019–20 RDHS to examine individual-, household-, and community-level determinants of ITN utilization among women aged 15–49 in Eastern Province, Rwanda.

Materials and Methods

Research design and settings

This study employed a cross-sectional quantitative design to assess the factors associated with insecticide-treated nets utilization among childbearing women in Eastern Province, Rwanda. The secondary data were extracted from the Rwanda Demographic and Health Survey (RDHS) 2019-2020. The study encompassed the entire East Province of Rwanda, which covers an area of 9,458 km^2(3,652 sq mi) and has seven districts: Bugesera, Gatsibo,

Kayonza, Ngoma, Kirehe, Nyagatare and Rwamagana. According to the National Institute of Statistics of Rwanda (NISR) in 2012, the Eastern Province has the highest population, with a total of 2,595,703 residents.

Study participants and sampling technique

The 2019–20 Rwanda Demographic and Health Survey (RDHS) used a two-stage stratified sampling design to ensure representativeness across key demographic and health indicators. In the Eastern Province, a representative sample of 3,010 women of reproductive age (15–49 years) was interviewed (NISR et al., 2021). The sampling strategy involved selecting enumeration areas (EAs) in the first stage across urban and rural strata within districts and sectors. In the second stage, households were systematically sampled from the selected EAs. Women who were usual residents or who had spent the night before the survey in the household were eligible for inclusion. This approach enabled stratified estimates not only at the provincial level but also by urban versus rural settings and across the seven districts of the Eastern Province. Further methodological details are available in the official RDHS report (NISR et al., 2021).

Statistical analysis

Prior to conducting statistical analyses, secondary data were downloaded from the DHS Program and imported into SPSS, version 25.0 for analysis. The dataset was thoroughly cleaned to ensure accuracy before proceeding with analysis. Descriptive statistics were used to summarize the variables, followed by chi-square tests to examine associations between key background characteristics and the primary outcome variable.

Both bivariate and multivariable binary logistic regression analyses were performed to examine the association between insecticide-treated net (ITN) usage and selected explanatory variables. In the multivariable model, all variables with a p-value ≤ 0.20 in the bivariate analysis were initially included to ensure important covariates were considered. A backward elimination method was then employed, with a removal criterion set at $p > 0.05$, to retain only statistically significant predictors in the final model. This approach was chosen to reduce model complexity while maintaining explanatory power, especially appropriate given the exploratory nature of the analysis and the relatively large number of potential predictors. All statistical analyses were conducted using SPSS version 25**,** with significance set at a p-value ≤ 0.05**.**

Socio-economic and demographic Characteristics of Respondents

Table 1 presents the study population's socio-economic and demographic characteristics, providing essential insights into their background. Most respondents were aged 15-24 years (41.45%), followed by 25-34 years (25.81%), and 34-49 years (32.75%). Geographically, the highest proportion came from Kirehe District (15.54%), with significant representation from Nyagatare (14.68%) and Bugesera (14.61%). The majority (87.18%) lived in rural areas, and most respondents were married (71.97%). Protestants formed the largest religious group (52.31%), followed by Catholics (31.35%). Education levels were generally low, with most respondents having

primary education (67.26%), and only 3.07% having higher education. Among men, 64.50% had primary education, while 3.39% had higher education. Most households were male-headed (70.77%), and respondents were categorized as poorer (40.65%), middle-income (22.22%), or richer (37.13%). A majority (68.71%) were employed, with 70.81% having households of 1-5 members. Parity showed 71.62% had four or fewer children, and 28.38% had more than four.

Regarding health, 60.51% owned mosquito nets, and 85.66% were aware of insecticide-treated nets (ITNs). Antenatal care was common, with 80.79% attending 1-4 visits. Reasons for not using mosquito nets included damage (34.52%) and dislike (30.90%). Most respondents (94.52%) were not pregnant, and 5.48% were currently pregnant. While 21.77% delivered in hospitals and 28.00% at health centers, 42.17% gave birth in other locations, with 8.06% delivering at home. Media exposure was low, with 72.40% not reading newspapers, 68.05% listening to the radio weekly, and 53.64% not watching television. Finally, 73.82% reported sleeping under a mosquito net.

Table 1:Socio-economic and Demographic characteristics of the study population

Study variables	Category	Frequency	%
Respondents' age	15-24	1248	41.45
	25-34	777	25.81
	34-49	986	32.75
District	Bugesera	440	14.61
	Gatsibo	414	13.75
	Kayonza	418	13.88
	Ngoma	416	13.82
	Kirehe	468	15.54
	Nyagatare	442	14.68
	Rwamagana	413	13.72
Type of place of residence	Urban	386	12.82
	Rural	2625	87.18
Marital Status	Never in union	177	5.88
	Married	2167	71.97
	Not living together with partner	667	22.15
Religion	Catholic	944	31.35
	Protestant	1575	52.31
	Adventist	357	11.86
	Muslim	66	2.19
	Others	69	2.29
Mother's highest educational level	No education	40	10.23
	Primary	263	67.26
	Secondary	76	19.44
	Higher	12	3.07
Father's highest educational level	No education	145	12.59
	Primary	743	64.50
	Secondary	225	19.53
	Higher	39	3.39

Sex of head of household	Male	2131	70.77
	Female	880	29.23
Wealth index combined	Poorer	1224	40.65
	Middle	669	22.22
	Richer	1118	37.13
Respondent currently working	No	942	31.29
	Yes	2069	68.71
Parity	<=4	1663	71.62
	>4	659	28.38
Family size	1-5	2132	70.81
	>=6	879	29.19
Has mosquito bed net for sleeping	No	1189	39.49
	Yes	1822	60.51
Number of rooms used for sleeping	1-5	2986	99.17
	>=6	25	0.83
Insecticide-Treated Net (ITN)	No, don't know	297	14.34
	Yes	1774	85.66
Number of antenatal visits during pregnancy	No antenatal visits	179	5.95
	1-4	2431	80.79
	>4	399	13.26
Why no one slept under the mosquito net	Damaged	629	34.52
	Difficult to hang	207	11.36
	No sleeping bed	99	5.43
	Don't like it	563	30.90
	Other	324	17.78
Currently pregnant	No or unsure	2846	94.52
	Yes	165	5.48
Place of delivery	HOME	199	8.06
	Hospital	538	21.77
	Health Center	692	28.00
	Other	1042	42.17
Frequency of reading newspaper or magazine	Not at all	2180	72.40
	Less than once a week	559	18.57
	At least once a week	272	9.03
Frequency of listening to radio	Not at all	491	16.31
	Less than once a week	471	15.64
	At least once a week	2049	68.05
Frequency of watching television	Not at all	1615	53.64
	Less than once a week	881	29.26
	At least once a week	515	17.10
Respondent slept under mosquito bed net	No	788	26.18
	Yes	2222	73.82

Source: Researcher, 2024

Prevalence of Insecticide-Treated Nets Utilization

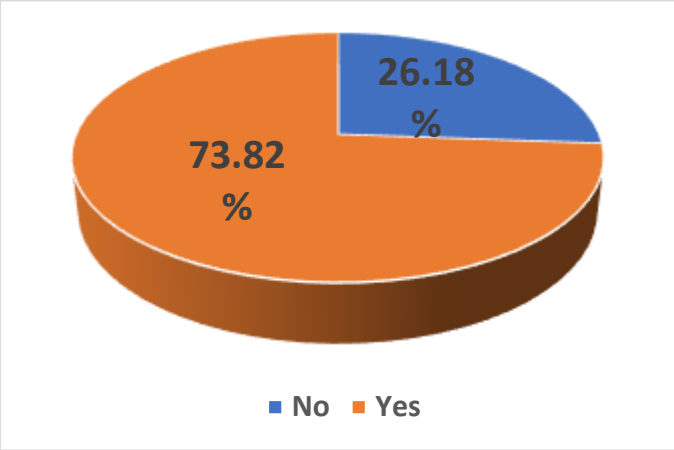

Figure 1:Prevalence of Insecticide - treated Nets utilization among women of reproductive age in East Province, using RDHS 2019-20.

Figure 1 presents the prevalence of respondents who slept under an Insecticide-Treated Net (ITN) the night before the survey among women of reproductive age in the Eastern province of Rwanda using RDHS 2019-2020 data. The results show that 73.82% among them slept under an ITN.

Factors associated with sleeping under Insecticide-Treated Net.

During bivariate analysis, chi-square test was used to test if there is an association between sociodemographic and sleeping under mosquito bed net. The results show that sleeping under insecticide-treated bed net was significantly associated with Man's highest education level (P=0.03), Household wealth index (P=0.022), parity (P=0.025), having mosquito bed net for sleeping (P=0.014), Number of rooms used for sleeping (P=0.038), Insecticide-Treated Net (ITN) (P<0.001), Number of antenatal visits during pregnancy (P=0.006), and Place of delivery (P=0.027).

Table 2:Bivariate analysis of the association between sociodemographic and sleeping under mosquito bet net.

Study variables	Category	Respondent slept under mosquito bed net				
		No		Yes		P-value
		N	%	N	%	
Respondents' age	15-24	329	41.75	918	41.31	0.622
	25-34	211	26.78	566	25.47	
	34-49	248	31.47	738	33.21	
District	Bugesera	130	16.50	310	13.95	0.604
	Gatsibo	100	12.69	314	14.13	
	Kayonza	116	14.72	302	13.59	
	Ngoma	106	13.45	310	13.95	
	Kirehe	119	15.10	349	15.71	
	Nyagatare	111	14.09	331	14.90	
	Rwamagana	106	13.45	306	13.77	
Type of place of residence	Urban	89	11.29	297	13.37	
	Rural	699	88.71	1925	86.63	
Marital Status	Never in union	39	4.95	138	6.21	0.285
	Married	582	73.86	1585	71.33	
	Not living together with partner	167	21.19	499	22.46	
Religion	Catholic	255	32.36	688	30.96	0.794
	Protestant	407	51.65	1168	52.57	
	Adventist	90	11.42	267	12.02	
	Muslim	15	1.90	51	2.30	
	Others	21	2.66	48	2.16	
Mother's highest educational level	No education	14	13.86	26	8.97	0.416
	Primary	62	61.39	201	69.31	
	Secondary	22	21.78	54	18.62	
	Higher	3	2.97	9	3.10	
Man's highest educational level	No education	54	16.31	91	11.08	**0.03**
	Primary	196	59.21	547	66.63	
	Secondary	72	21.75	153	18.64	
	Higher	9	2.72	30	3.65	
Sex of head of household	Male	567	71.95	1564	70.39	0.406
	Female	221	28.05	658	29.61	
Wealth index combined	Poorer	353	44.80	870	39.15	**0.022**
	Middle	163	20.69	506	22.77	
	Richer	272	34.52	846	38.07	
Respondent currently working	No	244	30.96	698	31.41	0.815
	Yes	544	69.04	1524	68.59	
Parity	<=4	451	75.17	1212	70.38	**0.025**

	>4	149	24.83	510	29.62	
Family size	1-5	557	70.69	1574	70.84	0.936
	>=6	231	29.31	648	29.16	
Has mosquito bed net for sleeping	No	340	43.15	848	38.16	**0.014**
	Yes	448	56.85	1374	61.84	
Number of rooms used for sleeping	1-5	786	99.75	2199	98.96	**0.038**
	>=6	2	0.25	23	1.04	
Insecticide-Treated Net (ITN)	No, don't know	17	3.74	280	17.32	**<0.001**
	Yes	437	96.26	1337	82.68	
Number of antenatal visits during pregnancy	No antenatal visits	65	8.25	114	5.14	**0.006**
	1-4	620	78.68	1810	81.53	
	>4	103	13.07	296	13.33	
Why no one slept under the mosquito net	Damaged	163	36.38	466	33.92	0.631
	Difficult to hang	48	10.71	159	11.57	
	No sleeping bed	24	5.36	75	5.46	
	Don't like it	143	31.92	420	30.57	
	Other	70	15.63	254	18.49	
Currently pregnant	No or unsure	749	95.05	2096	94.33	0.445
	Yes	39	4.95	126	5.67	
Place of delivery	HOME	33	5.08	165	9.07	**<0.001**
	Hospital	178	27.38	360	19.78	
	Health Center	168	25.85	524	28.79	
	Other	271	41.69	771	42.36	
Frequency of reading newspaper or magazine	Not at all	577	73.22	1603	72.14	0.736
	Less than once a week	139	17.64	420	18.90	
	At least once a week	72	9.14	199	8.96	
Frequency of listening to radio	Not at all	131	16.62	360	16.20	0.821
	Less than once a week	118	14.97	353	15.89	
	At least once a week	539	68.40	1509	67.91	
Frequency of watching television	Not at all	419	53.17	1196	53.83	0.884
	Less than once a week	230	29.19	651	29.30	
	At least once a week	139	17.64	375	16.88	

Source: Researcher, 2024

Crude and Adjusted Odds Ratios and 95% confidence intervals (CIs) for factors associated with sleeping under insecticide-treated bed net.

The table 3 presents the results of bivariate logistic regression and multivariate analyses examining the association between the study variables and sleeping under insecticide-treated net among the women of reproductive age in Eastern province of Rwanda. The findings indicate that in the bivariate logistic regression, most variables showed a significant association with sleeping under ITN. The analysis of the wealth index reveals that poorer households are less likely to sleep under mosquito bed net (COR: 0.792, 95% CI: 0.659-0.953, p=0.013), compared to richer households. Moreover, for parity**,** the households with four or fewer children are less likely to sleep under the mosquito bed net (COR: 0.785, 95% CI: 0.635-0.971, p=0.025) compared to those with more than four children. The results also show that the households who has no mosquito bed net for sleeping, are less likely to sleep under mosquito bed net (COR: 0.813, 95% CI: 0.690-0.959, p=0.014) compared to those who has the mosquito bed net for sleeping. Furthermore, the research reveals that the women who have never attended antenatal care visit are less likely to sleep under mosquito bed net (COR: 0.610, 95% CI: 0.418 – 0.891, p= 0.011) compared to women who attended antenatal care visits more than 4 times (>4). In addition, women whose place of delivery is at home, and hospital are more likely (COR: 1.603, 95% CI: 1.062 – 2.421, p= 0.025), and less likely (COR: 0.648, 95% CI: 0.505 – 0.833, p= 0.001) to sleep under mosquito bed net compared to those whose place of delivery is at a health Center.

After adjusting for potential confounders by conducting the multivariate analysis, the results revealed that, the women with four or fewer children remained significant less likely to sleep under ITN (AOR: 0.571, 95% CI: 0.388 - 0.839, p=0.004) compared to those with more than four children. Moreover, households without access to an ITN for sleeping were significantly less likely to use one compared to those with access. Specifically, the odds of ITN use were about 33% lower among individuals in households without an ITN (AOR: 0.672, 95% CI: 0.477–0.946, p = 0.023), indicating a statistically significant association. Surprisingly, the findings reveal that women who have never attended antenatal care visit and those who attended at least 1-4 times, are 9.68 times more likely to sleep under ITN (AOR: 9.677, 95% CI: 1.199 – 78.120, p= 0.033), (AOR: 1.591, 95% CI: 1.1013 – 2.500, p= 0.044) compared to women who attended antenatal care visits more than 4 times (>4), respectively. Furthermore, women who delivered at home remained significantly 3 times more likely to sleep under ITN (AOR: 3.165, 95% CI: 1.326 – 7.556, p= 0.009) compared to those who delivered at health Center.

Table 3:Bivariate logistic regression and Multivariate Analysis for factors associated with sleeping under mosquito bed net, RDHS 2019/2020.

Study variable	Category	Respondent slept under mosquito bed net							
		COR	95% C. I		*P-value*	AOR	95% C. I		*P-value*
			Lower	Upper			Lower	Upper	
Man's highest educational level	No education	0.506	0.223	1.145	0.102	0.367	0.095	1.411	0.145
	Primary	0.837	0.391	1.795	0.648	0.619	0.172	2.231	0.463
	Secondary	0.638	0.288	1.413	0.268	0.422	0.115	1.553	0.194
	Higher		**Ref**				**Ref**		
Wealth index combined	Poorer	0.792	0.659	0.953	**0.013**	0.740	0.493	1.112	0.148
	Middle	0.998	0.798	1.248	0.986	0.909	0.589	1.404	0.667
	Richer		**Ref**				**Ref**		
Parity	<=4	0.785	0.635	0.971	**0.025**	0.571	0.388	0.839	**0.004**
	>4		Ref				**Ref**		
Has mosquito bed net for sleeping	No	0.813	0.690	0.959	**0.014**	0.672	0.477	0.946	**0.023**
	Yes		**Ref**				Ref		
Number of antenatal visits during pregnancy	No antenatal visits	0.610	0.418	0.891	**0.011**	9.677	1.199	78.120	**0.033**
	1-4	1.016	0.797	1.294	0.899	1.591	1.013	2.500	**0.044**
	>4		**Ref**				**Ref**		
Place of delivery	HOME	1.603	1.062	2.421	**0.025**	3.165	1.326	7.556	**0.009**
	Hospital	0.648	0.505	0.833	**0.001**	0.854	0.537	1.357	0.504
	Health Center		**Ref**				**Ref**		
	Other	0.912	0.730	1.139	0.417	1.150	0.767	1.723	0.499

COR: Crude Odd Ratio
AOR: Adjusted Odd Ratio
Ref: Reference category
CI: Confidence interval

Source: Researcher,2024

Discussion

The study identified significant associations between socio-demographic factors and the utilization of Insecticide-Treated Nets (ITNs) among women of reproductive age in the Eastern Province of Rwanda. Several studies have found similarities with the current research regarding factors associated with ITN utilization. A similar study conducted in Nigeria by Onoka et al. (2015), titled *"Prevalence and determinants of insecticide-treated bed net use among children under five in Nigeria,"* found a prevalence of ITN utilization of 60.8%. Although slightly

lower than the 73.82% found in our study, the results highlight that ITN use is relatively widespread in both countries, though the Rwandan population may benefit from more effective national campaigns.

A study conducted in Malawi by Chipeta et al. (2019), titled *"Malaria prevention and care seeking behavior among adults living in Malawi: Results from a household survey,"* reported that ownership of ITNs was a significant factor influencing bed net usage, similar to the findings of this study where having mosquito bed nets for sleeping was significantly associated with ITN use (AOR: 0.672, 95% CI: 0.477-0.946, p=0.023). This aligns with global evidence indicating that access to ITNs is a key determinant of usage, underscoring the need for increasing ITN availability as a critical intervention to enhance bed net utilization. In contrast, a study conducted in Kenya by Ng'ang'a et al. (2016), titled *"Factors influencing bed net use among pregnant women in Kenya,"* found a significant association between maternal education and ITN use, with more educated women being more likely to utilize bed nets. This differs from the findings of the current study, where maternal education did not emerge as a significant predictor of ITN utilization. This discrepancy may be attributed to contextual differences between Rwanda and Kenya**,** including variations in health communication strategies, the quality and content of health education curricula, or broader access to health services**.** In Rwanda, community health worker programs and mass ITN distribution campaigns may have reduced information gaps among less-educated populations, potentially mitigating the effect of formal education on ITN-related behaviors. Additionally, cultural perceptions of malaria risk and trust in preventive interventions may differ between regions, influencing how education translates into action. When examining socio-economic factors, the wealth index was significantly associated with ITN use in both this study and research conducted in Tanzania by Ngondi et al. (2017), titled *"Socio-economic factors associated with the ownership and use of ITNs in Tanzania."* Both studies revealed that poorer households were less likely to sleep under mosquito bed nets. This highlights the ongoing challenge of equitable ITN distribution, where wealthier households tend to have better access to malaria prevention tools, pointing to the necessity for targeted interventions to ensure that poorer populations are adequately covered.

Parity was another significant factor in both the current study and research by Koenker et al. (2014) in Ghana titled *"Factors influencing the use of insecticide-treated nets in Ghana."* Similar to the findings here, Koenker et al. found that women with fewer children were less likely to use ITNs compared to those with more children. This suggests that larger families may prioritize the use of ITNs due to the perceived higher risk of malaria in households with more children, a finding consistent across different contexts.

Contrary to expectations, this study found that women who attended fewer or no antenatal care (ANC) visits were more likely to use insecticide-treated nets (ITNs) than those with frequent ANC attendance. This contrasts with studies in Cameroon and Nigeria (Fokam et al., 2017; Yaya et al., 2018), where higher ANC attendance was associated with increased ITN use due to more consistent health education and access. A possible explanation for

the Rwandan context is that targeted messaging through community outreach may be more effective among those with limited facility-based contact. Similarly, women who delivered at home were more likely to use ITNs compared to those delivering at health facilities. This finding also diverges from research in Tanzania (Mkumbo et al., 2021), which linked institutional delivery with better ITN use. In Rwanda, community health workers may play a stronger role in promoting ITN use directly within households, particularly among those outside the formal healthcare system.

The findings of this study align with several previous studies regarding the significant influence of ITN ownership, socio-economic status, and family size on bed net utilization. However, discrepancies in the influence of education and antenatal care attendance on ITN use highlight the need for further investigation into how these factors operate differently across regions. Addressing these disparities requires context-specific approaches to improving ITN distribution and utilization, particularly for vulnerable populations such as the less educated and those from poorer households.

Conclusion

Taken together, these findings reinforce the complexity of ITN utilization behavior among women in malaria-endemic Regions. The study revealed that 73.82% of women of childbearing age in Eastern Province, Rwanda, use insecticide-treated nets (ITNs), indicating a relatively high level of adherence to malaria prevention practices. The findings also show that several sociodemographic factors, including household wealth, parity, the availability of mosquito nets, antenatal care visits, and place of delivery, significantly influence ITN usage. Poorer households and women with fewer children are less likely to use bed nets. These results reflect the positive impact of public health campaigns but also underscore the need for targeted interventions to address gaps in ITN utilization, especially among vulnerable populations.

Data availability

The dataset used and analyzed during the current study are available from the corresponding author on request.

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The datasets utilized in this study were obtained from the RDHS database, with authorized access granted through the official DHS Program website.

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Contributions

MKB conceptualized the study; designed the methodology and analyzed the data; AH and JO supervised the overall research work; MKB, AH, and JO participated in writing the draft of the manuscript, reviewed and edited the final manuscript. All authors approved the final manuscript.

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Declarations

Ethics approval and consent to participate

Access to the 2019-20 RDHS data used in this study was obtained through an online application to the DHS Program website and the dataset was downloaded from the DHS online archive. The procedures and methodologies employed, consistent with the standard DHS survey, have undergone rigorous review and obtained approval from both the Rwanda National Ethics Committee and the Institutional Review Board of ICF International. The ICF International Institutional Review Board ensures the survey's alignment with the U.S. Department of Health and Human Services regulations for the protection of human subjects, while the host country's institutional review board (IRB) ensures compliance with the legal, ethical, and normative standards of the respective nation. All procedures used in this study were made in accordance with the principles of ethical standards according to the Declaration of Helsinki.

Consent for publication

Not applicable

Competing interests

The authors declare no competing interests.

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