

REVIEW

Open Access



# Ownership and usage of insecticide-treated nets in Ghana: a scoping review of facilitators and barriers

Patience Fakornam Doe<sup>1</sup>, Andrews Adjei Druye<sup>3</sup>, Theodora Dedo Azu<sup>2</sup>, Christian Makafui Boso<sup>3</sup>, Isaac Tetteh Commey<sup>4</sup>, Dorcas Frempomaa Agyare<sup>3</sup>, Joyce Agyeiwaa<sup>2</sup>, Gifty Osei Berchie<sup>2</sup>, Rita Opoku-Danso<sup>3</sup>, Gifty Owusu<sup>2\*</sup>, Naomi Kyeremaa Yeboa<sup>2</sup>, Seth Selassie Dzah<sup>3</sup>, Anita Efua Davis<sup>3</sup>, Godson Obeng Ofori<sup>3</sup>, William Akoto-Buabeng<sup>5</sup>, Frank Offei Odonkor<sup>3</sup>, Amidu Alhassan<sup>3</sup>, Thomas Boateng Gyan<sup>6</sup>, Christiana Okantey<sup>3</sup>, Jerry Paul Ninnoni<sup>4</sup>, Irene Korkoi Aboh<sup>1</sup>, Susanna Aba Abraham<sup>1</sup> and Mustapha Amodu<sup>7</sup>

## Abstract

**Background** Insecticide-treated nets (ITNs) are pivotal tools for malaria prevention in endemic regions like Ghana. Understanding the protective factors and barriers influencing ITN ownership and usage is crucial for designing effective interventions. A scoping review was conducted to identify studies exploring protective factors and barriers related to ITN ownership and usage.

**Methods** This review followed the guidelines by Askey and O'Malley. Search was done in four major databases including PubMed, Science Direct, PubMed CENTRAL, and JSTOR. Additional searches were done in Google Scholar and Google. Peer-reviewed and grey literature were included.

**Results** A total of 24 papers met the eligibility criteria and were included in the review. Included studies found regional disparities in ITN ownership and usage. Furthermore, included studies reported ownership rates between 97.8 and 28% and usage rates between 94 and 20%. Protective factors facilitating ITN ownership were marital status, higher educational attainment, higher income levels, and being aged 25 years or older. In contrast, the factors for its use included community-level campaigns advocating for ITN use and awareness, individuals with secondary education or higher and those residing in urban areas. Missed opportunities in free distribution exercises and the unavailability of subsidized ITNs at health facilities were barriers to ownership.

**Conclusion** Understanding and addressing protective factors and barriers influencing ITN ownership and usage are crucial for enhancing malaria prevention strategies and achieving sustainable progress in combating malaria in endemic areas. Collaborative and evidence-based interventions are essential for addressing these challenges effectively.

**Keywords** Insecticide treated net, Ownership, Utilisation, Scoping review, Ghana

\*Correspondence:

Gifty Owusu

gifty.owusu@ucc.edu.gh

Full list of author information is available at the end of the article



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

## Background

Malaria remains a pressing global health concern, particularly in regions like sub-Saharan Africa, where the burden is disproportionately high [1]. In 2022, the World Health Organization (WHO) reported an estimated 249 million cases and 608,000 deaths globally, with the WHO African Region accounting for 94% of cases and 95% of deaths [2, 3]. Ghana, is among the 15 countries with the highest burden of malaria, contributing 2.2% of global malaria cases and deaths, and 4% of cases in West Africa [2–4]. Despite ongoing efforts to combat the disease, including significant progress in malaria control in recent years in Ghana, the challenge persists, necessitating continued vigilance and innovative strategies [1, 4]. Malaria remains endemic in all parts of Ghana, with the highest prevalence in rural areas where healthcare infrastructure is often limited [1, 4].

Prevention is fundamental to reducing the malaria burden, with measures like insecticide-treated nets (ITNs) playing a pivotal role in this endeavour. ITNs are widely recognized for their effectiveness in reducing malaria transmission by providing a physical barrier against mosquito bites, especially during peak biting hours [5, 6]. In Ghana, the distribution of ITNs serves as a vital component of malaria prevention efforts, employing various channels such as periodic mass campaigns, school-based distribution, and ongoing initiatives aimed at pregnant women and children [4, 7]. Despite a notable increase in ITN accessibility in Ghana from 30 in 2008 to 67% in 2019, the corresponding rise in ITN usage has been modest, climbing from 21 to 43% over the same period [4, 8]. While access to ITNs has improved significantly over the years, challenges in consistent usage persist, particularly in urban and peri-urban areas where barriers like reluctance to register or redeem ITNs and preference for alternative mosquito control methods hinder uptake [9].

Additionally, cultural beliefs and misconceptions about ITNs, as well as the perceived discomfort of sleeping under nets, contribute to the low usage rates despite high ownership [1, 4, 8]. Environmental factors, such as the warm and humid climate, also discourage regular use of ITNs, as people may find them stifling during sleep [4, 9]. Addressing these challenges requires not only the distribution of ITNs but also targeted education campaigns to change perceptions and behaviours, ensuring that the benefits of ITN usage are widely understood and embraced by all communities.

For decades of ITN introduction and distribution, comprehensive reviews of the factors influencing ITN ownership and usage in the Ghanaian context have been lacking. Hence, this scoping review aims to address this gap by exploring the protective (facilitators) and risk factors (barriers) associated with ITN ownership and usage

in Ghana. This review also maps evidence on the ownership and usage of ITN in Ghana. By identifying these factors, this review seeks to inform targeted interventions and strategies to improve ITN coverage and usage rates, ultimately contributing to enhanced malaria prevention efforts and reducing the disease burden in Ghana. Moreover, given the persistent challenges in achieving universal ITN coverage and consistent usage [10], a comprehensive understanding of the predictors influencing ITN ownership and usage is crucial for designing effective and sustainable malaria control programmes tailored to the Ghanaian context. This scoping review will also inform future systematic reviews and meta-analyses.

## Methods

### Approach and reporting guidelines

This scoping review followed the methodological framework outlined by Askey and O'Malley [11], encompassing the following six iterative steps: (1) identifying the research question; (2) identifying relevant studies; (3) selecting studies; (4) charting the data; (5) collating, summarizing, and reporting the results; and (6) consultation (optional). Furthermore, the reporting of this scoping review aligned with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist, as proposed by Tricco et al. [12]. Adhering to this guideline ensured transparent and comprehensive reporting of the review process, methods, and findings, and thus, enhancing the credibility and reproducibility of the study.

### Research questions

Three research questions guided this scoping review:

1. What is the rate of ITN ownership and usage in Ghana?
2. What are the facilitators of ITN ownership and usage in Ghana?
3. What are the barriers to ITN use and ownership in Ghana?

### Identifying relevant studies

Five main databases (PubMed, Scopus, JSTOR, Central and Embase) were searched for relevant papers. Additional hand search was conducted in other databases such as HINARI, Dimensions AI, Google, Google Scholar and institutional repositories such as WHO library and university repositories. The initial search in PubMed was conducted using a combination of Medical Subject Headings (MeSH) terms and synonyms with controlled vocabularies relevant to the topic of interest. Boolean operators such as "AND" and "OR" were employed to combine the search terms (Table 1). Furthermore, reference lists of

**Table 1** Examples of search strategies conducted in main databases

Database	Search strategy
PubMed	Determinants[All Fields] OR ("risk factors"[MeSH Terms] OR ("risk"[All Fields] AND "factors"[All Fields]) OR "risk factors"[All Fields]) OR ("etiology"[Subheading] OR "etiology"[All Fields] OR "causes"[All Fields] OR "causality"[MeSH Terms] OR "causality"[All Fields]) OR Predictors[All Fields] AND (("insecticides"[All Fields] OR "insecticides"[MeSH Terms] OR "insecticides"[All Fields] OR "insecticide"[All Fields]) AND Treated[All Fields] AND Net[All Fields]) OR ITN[All Fields] AND ("ownership"[MeSH Terms] OR "ownership"[All Fields]) OR Uptake[All Fields] AND Utilization[All Fields] OR Usage[All Fields] AND ("ghana"[MeSH Terms] OR "ghana"[All Fields]) (English[lang] AND ("2010/01/01"[PDAT]: "2024/04/31"[PDAT]))
Scopus	(TITLE-ABS-KEY(determinants OR "risk factors" OR etiology OR causes OR causality OR predictors) AND (TITLE-ABS-KEY(insecticides OR insecticide AND treated AND net) OR TITLE-ABS-KEY(ITN AND ownership) OR TITLE-ABS-KEY(uptake AND utilisation OR usage)) AND TITLE-ABS-KEY(ghana)) AND PUBYEAR > 2009 AND (LIMIT-TO(LANGUAGE, "English"))
PubMed Central	Determinants[All Fields] OR ("risk factors"[MeSH Terms] OR ("risk"[All Fields] AND "factors"[All Fields]) OR "risk factors"[All Fields]) OR ("etiology"[Subheading] OR "etiology"[All Fields] OR "causes"[All Fields] OR "causality"[MeSH Terms] OR "causality"[All Fields]) OR Predictors[All Fields] AND (("insecticides"[All Fields] OR "insecticides"[MeSH Terms] OR "insecticides"[All Fields] OR "insecticide"[All Fields]) AND Treated[All Fields] AND Net[All Fields]) OR ITN[All Fields] AND ("ownership"[MeSH Terms] OR "ownership"[All Fields]) OR Uptake[All Fields] AND Utilisation[All Fields] OR Usage[All Fields] AND ("ghana"[MeSH Terms] OR "ghana"[All Fields])
Embase	('determinants' OR 'risk factor'/exp OR ('risk' AND 'factors') OR 'risk factors' OR 'etiology'/exp OR 'causes' OR 'causality'/exp OR 'causality' OR 'predictors') AND (('insecticides'/exp OR 'insecticides' OR 'insecticide') AND 'treated' AND 'net') OR 'ITN' AND ('ownership'/exp OR 'ownership') OR 'uptake' AND 'utilisation' OR 'usage') AND ('ghana'/exp OR 'ghana') AND [2010–2024]/py AND [english]/lim
JSTOR	(abstract:(determinants OR "risk factors" OR etiology OR causes OR causality OR predictors) AND (abstract:(insecticides OR insecticide AND treated AND net) OR abstract:(ITN AND ownership) OR abstract:(uptake AND utilisation OR usage)) AND abstract:(ghana)) AND datrange:2010–2024 AND language:("English")

eligible papers were checked for additional records. This search strategy aimed to capture all relevant studies on ITN ownership and usage in the Ghanaian context. Peer reviewed studies, grey literature and the studies conducted on ITN usage and ownership among Ghanaians leaving in Ghana were considered for this review. Papers written and published in English language from 2010 or later were also included in this review. Letters to editors, preprint, reviews, commentaries, conference papers and abstract only were not included in this review.

### Selecting relevant studies

Screening was conducted in three phases. Initially, Mendeley was used to identify and remove duplicates from the retrieved records. Following this, ten graduate students were trained and supervised to screen the titles and abstracts of the remaining records, assessing them against the predetermined eligibility criteria. This approach ensured thoroughness and consistency in the screening process while managing the large volume of records. Subsequently, the reference lists of the full-text eligible records were scrutinized to identify any additional relevant studies that met the inclusion criteria. Two groups of researchers, each group comprising three members, independently reviewed the full-text eligible records to determine their inclusion in the scoping review. After the screening by the two independent groups, the selected records underwent an additional review process. An independent reviewer, separate from the screening teams, examined the decisions made by each group to ensure accuracy and consistency in the

selection of eligible studies. This rigorous review process enhanced the reliability and credibility of the scoping review by incorporating multiple perspectives and expertise. This collaborative approach to screening allowed for a comprehensive assessment of the literature while minimizing the potential for bias or oversight.

### Data extraction/charting

Data extraction was conducted systematically following predefined criteria to ensure consistency and accuracy. A standardized data extraction form was developed and piloted to extract relevant information from three of the selected studies. This form included fields such as study characteristics (e.g., author, year of publication, study design, population, and sample size), prevalence and factors influencing ITN ownership and usage data. Two independent reviewers extracted data from each included study to minimize errors and bias. Any discrepancies or uncertainties were resolved through discussion and consultation with a third reviewer. The extracted data were then compiled and synthesized to provide a comprehensive overview of the prevalence and factors influencing ITN ownership and usage in the Ghanaian context. See details of extraction on Table S1 (Supplementary File 1).

### Collating, summarizing, and reporting the results

Data extracted from the included studies were synthesized to provide a comprehensive overview of the rates of ITN usage and ownership across different population groups and geographic regions in Ghana. Additionally, the identified factors influencing ITN usage and

ownership were summarized, categorizing them into themes or categories based on commonalities observed in the literature. The results were reported descriptively, highlighting the main findings regarding ITN usage and ownership rate and the key factors associated with these outcomes. This process provided valuable insights into the current status of ITN usage and ownership in Ghana and the factors that may have contributed to variations in these practices across different contexts within the country.

### Consultation

Throughout the scoping review process, consultations with various stakeholders were instrumental in enhancing the comprehensiveness and relevance of the review. Initially, a chartered librarian provided expert guidance in structuring the search strategy, ensuring optimal retrieval of relevant literature. Subsequent consultations with households, malaria programme implementers, academic researchers, and public health experts enriched the understanding of factors influencing ITN usage and ownership in Ghana. Household perspectives offered first hand insights into ITN behaviours, while programme implementers shared operational challenges and strategies. Academic researchers and public health experts contributed valuable expertise, informing emerging trends and best practices. By engaging diverse stakeholders, the scoping review not only gained multidimensional insights but also fostered knowledge exchange and collaboration, ultimately enhancing the relevance and applicability of the findings for informing malaria control efforts.

## Results

### Search results

The search identified a total of 4033 papers, consisting of 4014 from electronic database searches and 19 from supplementary searches. After removing duplicates, 3268 articles remained. Screening of titles and abstracts resulted in the exclusion of 3231 articles, leaving 37 for full-text screening. Five additional studies were added following reference searches on full text articles. Following full-text reading, 18 articles were further excluded. The commonest reasons for exclusion were; studies not reporting variables of interest (11) and studies conducted outside Ghana (7). Finally, 24 articles were included in the analysis (Fig. 1).

### Study characteristics

Eleven (11) of the included studies used a national representative sample. Out of the 13 studies that did not use a national representative sample, most were conducted in the Eastern (4) and Greater Accra (4) regions (See details

in Fig. 2). Also, 18 of the included studies were cross-sectional surveys. See details in Fig. 3.

### Rate of ITN ownership and usage

In terms of ITN ownership rates across various regions of Ghana, notable disparities were observed. Asumah et al. [13] documented the highest ownership rate in the Upper East region at 97.8%, followed by the Greater Accra region with an ownership rate of 95.2% [14]. Studies [5, 6] reported ownership rates of 83.2% in the Northern region. Conversely, a study conducted in Ahafo, Bono, and Bono East regions reported a lower ownership rate of 57.2% [15]. Studies that utilized a national representative sample reported ITN ownership rates between 88 [16] and 28% [17] (See Table 2).

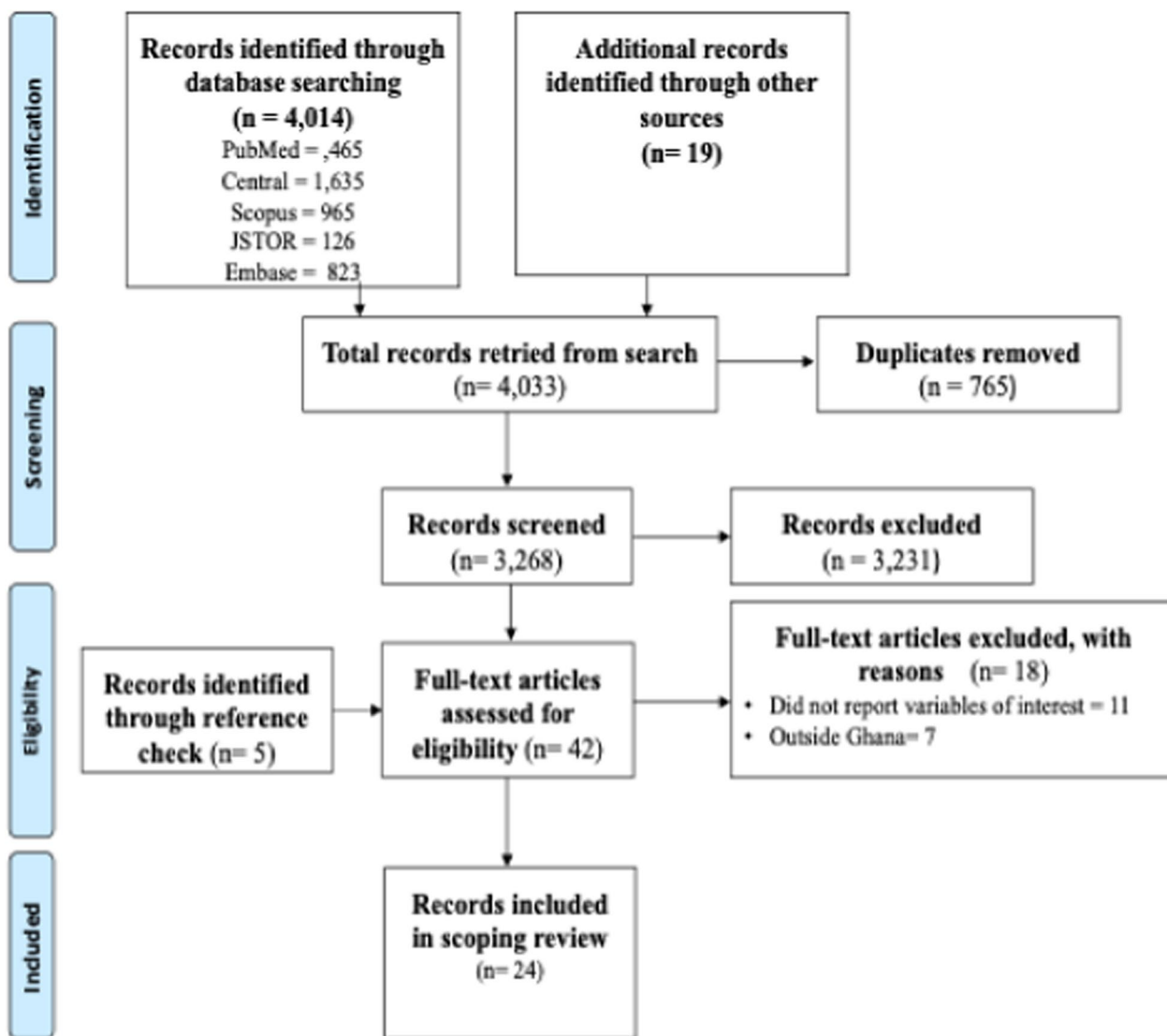
Regarding the rate of ITN usage, a similar pattern of regional variations emerged. The highest rate of 94% was reported in the Upper East region [18]. Conversely, the lowest usage rate of 20% was reported in the Bono-Ahafo region (now Bono, Ahafo and Bono East regions) [15]. However, substantial variations were observed within studies conducted using nationally representative samples with utilization rates between 81.4 [18] and 49.2% [8]. Notably, a significant disparity was recorded between ownership rate of 57.2% in the Bono, Bono East and Ahafo regions and the utilization rate of 20% [15]. In the Greater Accra region, Tweneboah-Kodua et al. [14] reported a sharp disparity of 95.2% ownership and 41% utilization. Similarly, Klu et al. [8] also reported a similar observation in a nationwide study recording 84.7 per cent ITN ownership while the rate of usage was 49.2% (see Table 3).

### Protective factors for ownership and usage of ITN

#### *ITN usage protective factors*

Higher levels of education among household heads are significant protective factors for ITN usage. Specifically, household heads with secondary education or higher are more likely to use ITNs [8, 22]. Additionally, tertiary education is associated with increased ITN usage [5]. Households with no formal education also exhibit higher ITN usage, indicating the importance of varied educational backgrounds in influencing ITN utilization [8, 9]. Economic factors play a crucial role in ITN usage. Households with higher income levels are more likely to use ITNs [7, 22]. Similarly, households within the second wealth quintile or above demonstrated higher usage rates [22]. Lower socioeconomic status also correlates with increased ITN usage, highlighting a diverse economic influence on ITN practices [27]. Poor women and rural pregnant women are particularly likely to use ITNs [9].

Several household characteristics influence ITN usage. Households with two or more members are more inclined

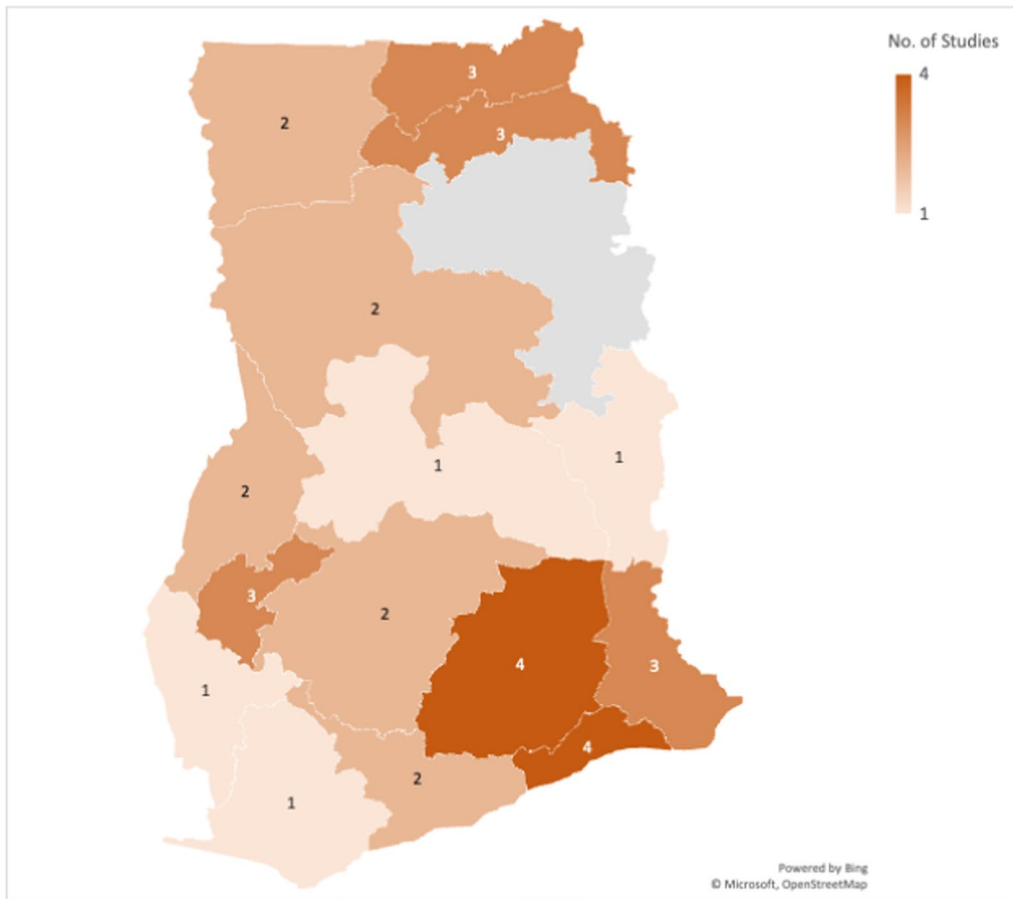


**Fig. 1** PRISMA flow chart [12] for search results and screening process

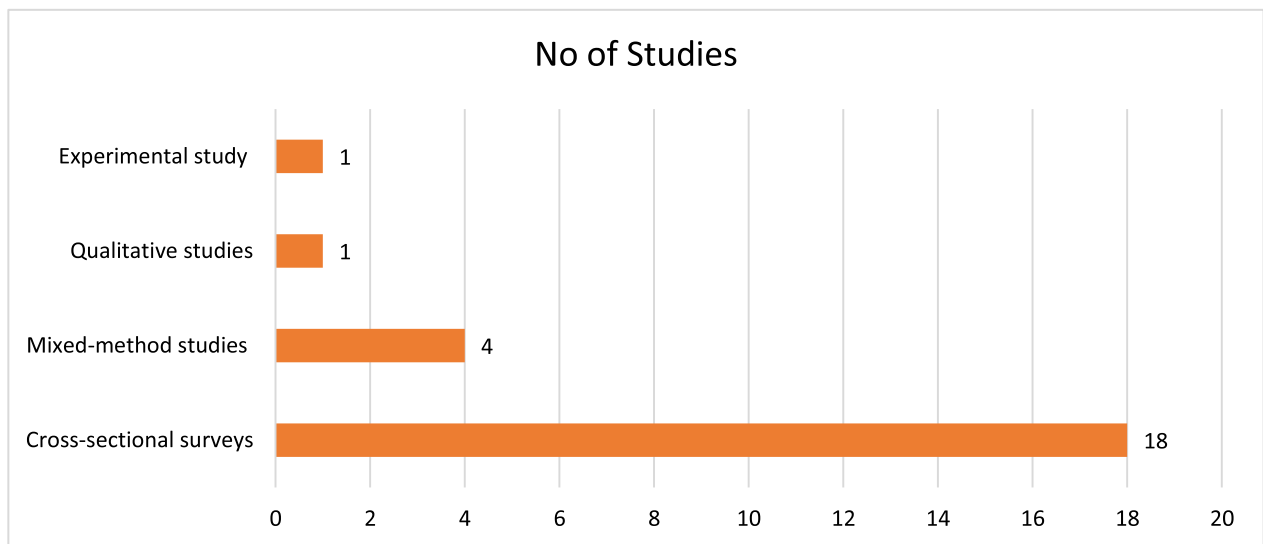
to use ITNs [16, 22]. Those with four or more ITNs have higher usage rates [7, 22]. Additionally, households with wooden wall materials [25] and those with three or more children under five years old [25] show increased ITN usage. Also, household with children under-five serve as a protective factor [16]. Smaller households with fewer than five members also exhibit higher usage [23]. Households that have received LLINs from recent Point Mass Distribution campaigns demonstrate significant ITN usage [16]. Marital status significantly impacts ITN usage. Married household heads show higher usage rates [7, 16]. Pregnant women aged 35–49 are also more likely to use ITNs [8]. Additionally, married people in general demonstrate higher ITN usage [16]. The place of

residence affects ITN usage. Urban residents have higher usage rates [22]. Conversely, rural location is also associated with increased ITN usage, indicating that both urban and rural settings can positively influence ITN practices [27]. Children in rural areas specifically are more likely to use ITNs [25].

Gender dynamics and the role of household heads play a role in ITN usage. Male-headed households show higher usage rates [8, 23]. Women living in male-headed households are particularly more likely to use ITNs [8]. Additionally, ITN owners in rural areas tend to use them more frequently [23]. Health-related factors and immunization programmes significantly boost ITN usage. Households that receive ITNs through immunization



**Fig. 2** Regions where included studies were conducted (excluding studies that used nationwide sample)



**Fig. 3** Compilation of study designs of included studies

**Table 2** Distributions of ownership rate of ITN in Ghana

Region	Authors	Ownership rate
Ahafo	[15]	57.2
Bono	[15]	57.2
Bono East	[15]	57.2
Eastern	[7]	58
Greater Accra	[14]	95.2
Northern	[6]	83.2
Oti	[19]	62.6
Upper East	[13]	97.8
	[20]	79
Upper West	[21]	82.2
Nationwide studies	[5]	79.9
	[8]	84.7
	[9]	65
	[22]	28
	[17]	62
	[23]	88
	[16]	45
	[18]	71

**Table 3** Distribution of usage rate of ITN in Ghana

Region	Authors	Prevalence of usage
Ahafo	[15]	20
Bono	[15]	20
Bono East	[15]	20
Greater Accra	[14]	41
Northern	[16]	82.3
	[24]	70
	[6]	82.3
Oti	[19]	61.2
Upper East	[13]	94.8
	[20]	74
Upper West	[21]	69.3
Nationwide studies	[8]	49.2
	[25]	57.4
	[9]	49.7
	[26]	63
	[22]	51.9
	[23]	71
	[16]	65.6
	[18]	81.4
	[27]	59

programmes exhibit higher usage rates [22]. The perceived protection against malaria also strongly motivates ITN usage [15]. Similarly, the barrier provided by the buzzing noise of mosquitoes encourages ITN use [15].

Community campaigns and media messages significantly impact ITN usage. Community-level campaigns promoting ITN use and its benefits increase usage rates [28]. Hearing malaria messages through media and health workers also boosts ITN usage [18]. Additional factors influencing ITN usage include not using mosquito coils for a year [27], households with no more than one net [27], and a positive attitude towards malaria prevention [5].

**ITN ownership protective factors**

ITN ownership is influenced by various demographic and socioeconomic factors. Married individuals tend to have higher ownership rates [6, 17]. Higher educational levels are also associated with increased ownership [6]. Economic factors play a crucial role, with higher income [6], low-income household [23] and being rich [6, 20] contributing positively to ITN ownership. Age is another factor, with those aged 25 years or more showing higher ownership [6]. The number of children under five years old in a household positively impacts ITN ownership, as does residing in rural areas [23]. Other factors include the marital status of individuals [17], and male household heads [23]. See Table 4 for details.

**Barriers to ITN ownership and usage**

**Barriers to ITN ownership**

Several barriers prevent effective ITN ownership. A significant factor is the missed opportunity during free distribution exercises [15]. Additionally, the unavailability of ITNs at health facilities where prices are subsidized poses a barrier [15]. Financial constraints, such as the lack of money to purchase ITNs from other sources, further hinder ownership [15]. Households with electricity experience additional barriers due to the costs and physical discomfort associated with using ITNs [17]. Interestingly, wealthier households also face barriers to ITN ownership, which suggests that higher socioeconomic status does not necessarily facilitate ITN acquisition [23].

**Barriers to ITN usage**

The usage of ITNs is hampered by various discomforts and perceptions. Physical discomforts, such as entrapment of heat during warm weather [15], the cumbersome nature of hanging ITNs [15], and the unpleasant smell of chemicals in the nets [15], are significant barriers. The perception of ITNs as unnecessary and expensive [13], along with inadequate education on their benefits [13], also limits their usage. Challenges in accessing ITNs and the judgmental attitudes of health workers further deter usage [13]. Physical reactions such as body itching, rashes, and sensations are additional barriers [13].

**Table 4** Protective factors for ownership and usage in Ghana

Main theme	Sub-theme	Author
Ownership	Married people	[6, 17]
	Higher educational level	[6]
	Higher income	[6]
	Aged 25 years or more	[6]
	Number of children less than 5 years of age	[17]
	Residence in a rural area	[17]
	Being rich	[20]
	Male household heads	[23]
	Residence in rural areas	[23]
	Low-income households	[23]
Usage	Household heads with secondary education or higher	[8, 22]
	Urban residence	[22]
	Household with members 2 or more	[16, 22]
	Received ITN through immunization	[22]
	Perceived protection against malaria	[15]
	Barrier to the buzzing noise made by mosquitoes	[15]
	Married household heads	[7]
	Heads with 4 or more ITN	[7, 22]
	Head who are formal workers	[7]
	Heads with higher income	[7, 22]
	Pregnant women 35–49 years	[8]
	No formal education	[8]
	Women living in male headed households	[8]
	Children in rural areas	[25]
	Household with wooden wall materials	[25]
	Households with 3 or more children under five	[25]
	Poor women	[9]
	No formal education	[9]
	Rural pregnant women	[9]
	Wealth index (quintile) 2nd or above	[22]
	Male headed households	[23]
	ITN owners in rural owners	[23]
	Less than 5 household members	[23]
	Perceived protection against malaria	[15]
	Barrier to the buzzing noise made by mosquitoes	[15]
	Tertiary education	[5]
	Positive attitude towards malaria prevention	[5]
	Community-level campaign for ITN use and benefits	[28]
	Hearing malaria messages in the media and from health workers	[18]
	Rural location	[16, 27]
Lower socioeconomic status	[27]	
Not using a coil for mosquito control for a year	[27]	
Households with no more than 1 net	[27]	
Households who received LLINs from recent Point Mass Distribution campaign,	[16]	
Married people	[16]	
Children under 5 years in household	[16]	



Over complacency and the perception of ITNs as unreliable in preventing malaria reduce their usage [29]. Male dominance and claustrophobia also negatively impact ITN utilization [29]. Inappropriate handling and treatment of ITNs, including the need for retreatment, are significant issues [29]. Continuous shortages at regional and district stores and lack of access to modern health services further exacerbate the problem [29]. Feeling too hot to sleep under an LLIN and the preference for mosquito spray instead of ITNs are notable deterrents [21]. Additional barriers include being rich, which again suggests that higher income does not facilitate ITN usage

[20], and lack of household access to ITNs [19]. Large family sizes of more than ten members also hinder effective ITN use [19]. See Table 5 for details.

## Discussion

### Summary of findings

In this scoping review, notable disparities were observed in the ownership and usage rates of ITNs across various regions of Ghana. While some regions, such as the Upper East and Greater Accra, reported high ownership and usage rates, others, like the Upper West, exhibited lower rates. At the national level, significant variations

**Table 5** Barriers to ITN ownership and usage in Ghana

Main theme	Sub-theme	Author
Ownership	Missed opportunity of the free distribution exercise	[15]
	Unavailability of ITNs at health facilities where prices are subsidised	[15]
	Lack of money to purchase one from other sources	[15]
	Electricity in the household (cost, physical discomfort)	[17]
	Wealthier households	[23]
Usage	Discomfort with usage	[15]
	Entrap heat during warm weather	[15]
	The size of ITN not big enough	[15]
	Art of hanging ITNs is a cumbersome task	[15]
	Unpleasant smell of chemical in the nets	[15]
	Perception of ITN as unnecessary and expensive	[13]
	Inadequate education	[13]
	Challenges in accessing ITNs	[13]
	Judgmental attitudes of health workers	[13]
	Body itching	[13]
	Body rashes	[13]
	Body sensation as a reaction to using ITN	[13]
	Over complacency	[29]
	Perception of ITN as unreliable in preventing malaria	[29]
	Influence of male dominance	[29]
	Claustrophobia	[29]
	Inappropriate handling of ITN	[29]
	Retreatment of ITN	[29]
	Lack of access to the ITN	[29]
	Improper usage	[29]
	Lack of knowledge on usage	[29]
	Inappropriate treatment of the ITN	[29]
	Continuous shortages of the ITN both at the regional and district stores	[29]
Lack of access to modern health services	[29]	
Feeling hot to sleep under LLIN	[21]	
Not having LLIN	[21]	
Prefer using mosquito spray	[21]	
Being rich	[20]	
Lack of household access to ITN	[19]	
Having family size of more than 10 members	[19]	

were noted, with some studies reporting high ownership rates but lower usage rate. The disparity between ownership and usage rates could be attributed to factors such as improper usage practices, shared nets within households, and cultural influences on utilization. Additionally, barriers to both ownership and usage were identified, including missed opportunities for free distribution, financial constraints, discomfort with usage, inadequate education, and misconceptions about ITNs' effectiveness. Protective factors facilitating ITN ownership and usage included higher education levels, urban residence, positive attitudes towards malaria prevention, and exposure to malaria-related messages. Understanding these disparities and factors influencing ownership and usage rates is crucial for developing targeted interventions to improve ITN utilization and enhance malaria prevention efforts in Ghana.

#### **Rate of ITN ownership and use**

The observed disparities in ITN ownership and usage rates across various regions of Ghana reveal complex dynamics influenced by a multitude of factors. The regional variations in ownership rates may be attributed to differences in access to ITN distribution programmes, socioeconomic status, and geographical factors [30, 31]. For instance, regions like the Upper East and Greater Accra, which reported higher ownership rates, may have benefited from targeted distribution campaigns, better access to healthcare facilities, and higher socioeconomic status, enabling residents to afford and acquire ITNs more easily [13, 14]. Conversely, regions like Ahafo, Bono, and Bono East, with lower ownership rates, may face challenges such as limited access to distribution channels, lower income levels, and fewer health infrastructure resources, hindering widespread ownership of ITNs [15].

Similarly, the disparities in usage rate reflect a combination of individual, household, and contextual factors. Despite high ownership rates in some regions, low levels of usage may be attributed to improper or inconsistent usage practices, cultural beliefs, and perceptions about ITN effectiveness [26]. Factors such as discomfort with ITN usage, perceived inconvenience, or lack of awareness about the importance of consistent usage may contribute to lower prevalence rates, particularly in regions with high ownership but low usage [15, 21]. Additionally, shared nets within households, inadequate education on ITN benefits, and competing preferences for alternative mosquito control methods may further diminish usage rates [19].

The implications of these disparities are significant for malaria prevention efforts in Ghana. While high ownership rates suggest successful distribution programmes

and increased access to ITNs, the gap between ownership and usage underscores the importance of targeted interventions to promote proper and consistent ITN usage [2, 4, 32]. Strategies aimed at addressing barriers to usage, such as community education campaigns, behaviour change interventions, and ensuring equitable access to ITNs, are crucial for maximizing the public health impact of ITN interventions [13]. Furthermore, efforts to tailor interventions to the specific needs and contexts of different regions, considering socioeconomic factors, cultural beliefs, and infrastructure constraints, will be essential for achieving sustained reductions in malaria morbidity and mortality nationwide [1].

#### **Facilitators of ITN ownership and use**

Our scoping review reveals several protective factors that influence the ownership and usage of ITNs for malaria prevention. Understanding these factors is crucial for designing effective interventions and policies to improve ITN coverage and usage rates in endemic regions. Several studies have identified key protective factors associated with increased ITN usage [1]. Individuals with higher education levels and those residing in urban areas are more likely to utilize ITNs effectively [22]. This suggests that education and access to urban infrastructure play a significant role in promoting ITN usage [27]. Additionally, households with larger family sizes, those receiving ITNs through immunization programmes, and those perceiving strong protection against malaria are more inclined to use ITNs [15, 22]. Community-level campaigns advocating for ITN use, positive attitudes towards malaria prevention, and exposure to malaria-related messages also contribute to increased ITN utilization [5, 18, 33].

On the contrary, residing in rural areas, having a lower socioeconomic status, and using mosquito control measures such as coils are barriers to effective ITN usage [34]. These findings highlight the need for targeted interventions to address barriers related to geographical location, economic status, and awareness of malaria prevention strategies. Protective factors facilitating ITN ownership include marital status, higher educational attainment, higher income levels, and older age [26, 28]. Additionally, residing in rural areas and being a male household head are associated with an increased likelihood of ITN ownership [23, 29]. Conversely, factors such as having no more than one net per household and having a smaller household size are negatively correlated with ITN ownership [32].

#### **Barriers against ITN ownership and use**

Under the theme of ownership, several barriers contribute to the limited possession of ITNs among households.

Missed opportunities in free distribution exercises and the unavailability of subsidized ITNs at health facilities highlight systemic challenges in accessing these essential malaria prevention tools [2, 4, 27]. Financial barriers further exacerbate the issue, with households lacking the funds to purchase ITNs from other sources. Adeyeri's [17] exploration of the cost and discomfort associated with electricity adds a unique perspective, illustrating how broader socioeconomic factors and household conditions can influence decisions regarding ITN ownership. Disparities in ownership based on socioeconomic status, as suggested by Bawuah and Ampaw [23], underscore the need for equitable distribution strategies and affordability schemes to address these barriers.

The underutilization of ITNs in Ghana highlights several challenges and implications for malaria prevention [23]. Discomfort and perceptions of ITNs trapping heat during warm weather suggest a need for designing more comfortable and user-friendly nets [13]. The lack of proper education on ITN use points to a gap in health education that needs to be addressed through targeted community outreach and training programmes [26, 28]. The judgmental attitudes of health workers suggest a need for better training and sensitization among healthcare providers to create a more supportive environment for ITN distribution and usage [13]. Psychological factors, such as complacency and male dominance, reflect deeper cultural and social issues that influence health behaviours [13]. Addressing these requires community-based interventions that engage men and women equally and emphasize the health benefits of ITNs. Claustrophobia and inappropriate handling of ITNs suggest that some individuals may require additional support and education on the benefits and proper use of ITNs [29]. The continuous shortages of ITNs at regional and district levels highlight systemic issues in the supply chain that need to be addressed through better logistics and inventory management [4, 13]. Limited access to modern health services underscores the need for improved healthcare infrastructure and services, particularly in rural and underserved areas. These findings imply that a multifaceted approach is necessary to promote ITN use and enhance malaria prevention.

#### **Implications for public health practice and policy**

Implications for public health practice and policy arising from the observed disparities and barriers in ITN ownership and usage are multifaceted and require targeted interventions tailored to address specific challenges. Addressing the systemic barriers to ITN ownership, such as missed opportunities for free distribution and the unavailability of subsidized nets at health facilities, necessitates policy interventions focused on improving

access and affordability. Strategies may include strengthening supply chains to ensure consistent availability of ITNs, implementing targeted distribution programmes in underserved areas, and subsidizing costs for vulnerable populations [15, 17]. Thus, to enhance the reach and efficiency of ITN distribution, Ghana Health Service has to integrate it with other routine health services. For instance, ITNs can be distributed during vaccination campaigns, antenatal visits, outreach programmes, in hard-to-reach areas and child health days. This integration ensures that nets are provided to vulnerable populations, particularly pregnant women and young children, during critical health touchpoints. Moreover, coupling ITN distribution with health services leverages existing health infrastructure and increases the likelihood of reaching underserved communities, thereby boosting overall ITN coverage [16].

Secondly, efforts to promote ITN usage should target both individual and community-level barriers. Community education campaigns and behaviour change interventions are essential for raising awareness about the importance of consistent ITN usage, addressing misconceptions, and promoting positive attitudes towards malaria prevention [5, 21]. Health education initiatives delivered through media channels and by healthcare workers can help disseminate accurate information about ITN benefits and usage guidelines, contributing to increased acceptability and adoption [22]. These campaigns should involve local leaders, healthcare workers, and community members to create culturally sensitive messages that promote the benefits of regular ITN use. By using local languages and relatable scenarios, these initiatives can effectively dispel myths about ITNs and encourage consistent usage. Additionally, involving the community in the creation and dissemination of these messages ensures they are relevant and accepted, leading to higher adoption rates and sustained behavioural change.

Furthermore, addressing socioeconomic disparities in ITN ownership and usage requires a multifaceted approach involving collaboration between public health agencies, policymakers, and community stakeholders. Equitable distribution strategies that target vulnerable populations, such as rural and low-income households, are essential for reducing disparities and ensuring universal access to ITNs [24]. Income-generating initiatives, microfinance programmes, or voucher schemes can help improve affordability and empower individuals to invest in ITNs for malaria prevention [17, 24].

Additionally, efforts to strengthen health systems and improve access to modern healthcare services are critical for enhancing ITN utilization. Investing in healthcare infrastructure, training healthcare workers on malaria

prevention, and integrating ITN distribution into routine healthcare services can help increase access and uptake among underserved populations [25]. Collaborative partnerships between the public and private sectors, non-governmental organizations, and community-based organizations are vital for mobilizing resources, implementing effective interventions, and sustaining gains in ITN ownership and usage over the long term [21, 25].

#### **Limitations in this review**

Despite efforts to comprehensively search multiple databases and sources, there is a possibility of missing relevant studies due to the exclusion of unpublished literature. This could introduce publication bias, limiting the generalizability of the findings and potentially overlooking valuable insights from non-English literature and grey literature sources. The inclusion criteria for this scoping review focused on studies conducted in Ghana, which may limit the transferability of findings to other contexts or regions with different socio-economic, cultural, and geographic characteristics. While the focus on Ghana provides in-depth insights into ITN ownership and usage within this specific context, caution should be exercised when extrapolating the findings to other settings.

Additionally, the reliance on self-reported data in the included studies may introduce social desirability bias and recall bias, leading to overestimation or underestimation of ITN ownership and usage rates. Variability in survey methodologies, sampling techniques, and measurement tools across studies may also contribute to heterogeneity in the reported outcomes, complicating comparisons and synthesis of findings. Furthermore, the scoping review focused primarily on identifying and summarizing existing literature on ITN ownership and usage in Ghana without conducting quality assessment or critical appraisal of the included studies. While this approach allows for a comprehensive overview of the available evidence, it may limit the ability to assess the robustness and validity of the findings presented in individual studies. Consultations with stakeholders enriched the understanding of ITN ownership and usage dynamics, the scope of engagement may have been limited, potentially overlooking perspectives from marginalized or vulnerable populations. Future research should consider more extensive stakeholder engagement strategies to ensure inclusivity and representation of diverse voices in shaping malaria control policies and interventions.

#### **Suggestions for future studies**

Future studies and systematic reviews should focus on longitudinal research to track changes in ITN

ownership and usage patterns over time, complemented by qualitative methods to explore underlying reasons and beliefs. Implementation research is needed to evaluate the effectiveness of existing ITN distribution programmes and behaviour change interventions, while socio-economic analyses can shed light on economic determinants and disparities in access. Comparative studies across diverse settings will provide insights into contextual factors influencing ITN behaviours, while systematic reviews should synthesize existing evidence and identify gaps in knowledge. Intervention studies should assess innovative approaches to promoting ITN ownership and usage, with a focus on equity analysis to address disparities among different population groups. By addressing these recommendations, future research can contribute to a deeper understanding of ITN behaviours and inform the development of effective malaria control strategies.

#### **Conclusion**

This scoping review aimed to provide a comprehensive overview of the rates, facilitators, and barriers of ITN ownership and usage in Ghana. The data from this review suggest notable disparities in ITN ownership and usage rates across different regions of Ghana, influenced by a multitude of individual, household, and contextual factors. While some regions exhibit high ownership and usage rates, others experience lower rates, highlighting the need for targeted interventions to promote proper and consistent ITN usage. Protective factors facilitating ITN ownership and usage include higher education levels, urban residence, positive attitudes towards malaria prevention, and exposure to malaria-related messages, while barriers encompass financial constraints, discomfort with usage, inadequate education, and misconceptions about ITN effectiveness. Addressing socioeconomic disparities in ITN ownership and usage requires a multifaceted approach involving collaboration from public health agencies, policymakers, and community stakeholders. Also, equitable distribution strategies targeting vulnerable populations, such as rural and low-income households, are essential for reducing disparities and ensuring universal access to ITNs. Further longitudinal studies, implementation studies, and systematic reviews to deepen understanding and address gaps in knowledge. Future studies and systematic reviews should focus on longitudinal research to track changes in ITN ownership and usage patterns over time, complemented by qualitative methods to explore underlying reasons and beliefs.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12936-024-05072-0>.

Supplementary Material 1.

### Acknowledgements

We appreciate Dr. Kodua-Ntim of the Sam Jonah Library, University of Cape Coast, for his immense support during the data search and screening process.

### Author contributions

MA, SAA, PFD, AAD, TDA, and TBG conceptualised the study. TDA, JPKN, NKY, DFA, ROD, SAA, ITC, GO, WAB, GOO, FOO, and AA independently extracted the data for analysis. MA, PFA, JA, GOB, DFA, ROD, SAA, ITC, SSD, IKA, GOO, FOO, AED and AA conducted thematic analysis and data synthesis. PFA, CMB, CO, GO, BN, TBG and IKA drafted the manuscript. All authors read and approved the final draft.

### Funding

The authors did not receive support from any organization for the submitted work.

### Availability of data and materials

No datasets were generated or analysed during the current study.

### Declarations

#### Ethics approval and consent to participate

Not applicable.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare no competing interests.

#### Author details

<sup>1</sup>Department of Public Health, School of Nursing and Midwifery, College of Health and Allied Science, University of Cape Coast, Cape Coast, Ghana. <sup>2</sup>Department of Maternal and Child Health, School of Nursing and Midwifery, College of Health and Allied Science, University of Cape Coast, Cape Coast, Ghana. <sup>3</sup>Department of Adult Health, School of Nursing and Midwifery, College of Health and Allied Science, University of Cape Coast, Cape Coast, Ghana. <sup>4</sup>Department of Mental Health, School of Nursing and Midwifery, College of Health and Allied Science, University of Cape Coast, Cape Coast, Ghana. <sup>5</sup>Department of Education and Psychology, Faculty of Educational Foundations, College of Education Studies, University of Cape Coast, Cape Coast, Ghana. <sup>6</sup>Department of Health, Education and Recreation, College of Education Studies, University of Cape Coast, Cape Coast, Ghana. <sup>7</sup>Biomedical and Clinical Research Centre, College of Health and Allied Science, University of Cape Coast, Cape Coast, Ghana.

Received: 9 April 2024 Accepted: 7 August 2024

Published online: 10 August 2024

### References

- Sarfo JO, Amoadu M, Kordorwu PY, Adams AK, Gyan TB, Osman AG, et al. Malaria amongst children under five in sub-Saharan Africa: a scoping review of prevalence, risk factors and preventive interventions. *Eur J Med Res.* 2023;28:80.
- The VP. WHO World malaria report. *Lancet Microbe.* 2023;2024(5): e214.
- WHO. World malaria report 2022. Geneva, World Health Organization, 2022. <https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2022>. Accessed 20 Jun 2024.
- Severe Malaria Observatory. Malaria in Ghana: statistics and facts—severe malaria observatory 2023. <https://www.severemalaria.org/countries/ghana>. Accessed 20 Jun 2024.
- Alhassan Y, Dwomoh D, Amuasi SA, Nonvignon J, Bonful H, Tetteh M, et al. Impact of insecticide-treated nets and indoor residual spraying on self-reported malaria prevalence among women of reproductive age in Ghana: implication for malaria control and elimination. *Malar J.* 2022;21:120.
- Duut TB, Alhassan AR. Factors associated with ownership of insecticide-treated nets for malaria prevention among pregnant women in Ghana. *Public Health Toxicol.* 2022;2:1–8.
- Seidu S. Use of insecticide-treated nets at the household level in the Yilo Krobo Municipality of the Eastern Region of Ghana. *Ensign Global College,* 2017.
- Klu D, Aberese-Ako M, Manyeh AK, Immurana M, Doegah P, Dalaba M, et al. Mixed effect analysis of factors influencing the use of insecticides treated bed nets among pregnant women in Ghana: evidence from the 2019 Malaria Indicator Survey. *BMC Pregnancy Childbirth.* 2022;22:1–11.
- Budu E, Okyere J, Mensah F, Azure SA, Seidu AA, Ameyaw EK, et al. Inequalities in the use of insecticide-treated nets by pregnant women in Ghana, 2011 and 2017. *Malar J.* 2022;21:258.
- Nyunt MH, Aye KM, Kyaw MP, Kyaw TT, Hlaing T, Oo K, et al. Challenges in universal coverage and utilization of insecticide-treated bed nets in migrant plantation workers in Myanmar. *Malar J.* 2014;13:211.
- Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol Theory Pract.* 2005;8:19–32.
- Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Ann Intern Med.* 2018;169:467–73.
- Asumah MN, Akugri FA, Akanlu P, Taapena A, Boateng F. Utilization of insecticides treated mosquito bed nets among pregnant women in Kassena-Nankana East municipality in the upper east region of Ghana. *Public Health Toxicol.* 2021;1:9.
- Tweneboah-Koduah EY, Abdulai S, Coffie IS, Mahmoud MA. The role of social marketing theory in assessing insecticide-treated net usage intentions among pregnant women in Ghana. *J Soc Market.* 2022;12:495–512.
- Manu G, Boamah-Kaali EA, Febir LG, Ayipah E, Owusu-Agyei S, Asante KP. Low utilization of insecticide-treated bed net among pregnant women in the Middle Belt of Ghana. *Malar Res Treat.* 2017;2017:7481210.
- Afagbedzi SK, Alhassan Y, Kenu E, Malm K, Bando DAB, Peprah NY, et al. Universal coverage and utilization of free long-lasting insecticidal nets for malaria prevention in Ghana: a cross-sectional study. *Front Public Health* 2023;11.
- Adeyeri O. Determinants of Insecticide Treated Nets (ITNs) Ownership and Use in Ghana. Duke University, 2011.
- Owusu Adjah ES, Panayiotou AG. Impact of malaria related messages on insecticide-treated net (ITN) use for malaria prevention in Ghana. *Malar J.* 2014;13:123.
- Akuffo R, Wilson M, Sarfo B, Dako-Gyeke P, Adanu R, Anto F. Insecticide-treated net (ITN) use, factors associated with non-use of ITNs, and occurrence of sand flies in three communities with reported cases of cutaneous leishmaniasis in Ghana. *PLoS ONE.* 2021;16: e0261192.
- Kanmiki EW, Awoonor-Williams JK, Phillips JF, Kachur SP, Achana SF, Akazili J, et al. Socio-economic and demographic disparities in ownership and use of insecticide-treated bed nets for preventing malaria among rural reproductive-aged women in northern Ghana. *PLoS ONE.* 2019;14: e0211365.
- Darko E, Tetteh J, Ayanore MA, Damoah-Af I, Damoah-Af I. Socio-demographic determinants associated with ownership and use of long lasting insecticide treated nets among pregnant women in the Wa Municipality of Ghana. *Pan Afr Med J.* 2019;33:81.
- Yeboah A. Comparative analysis of factors associated with insecticide-treated net utilization between rural and urban areas in Ghana: implication for malaria control and prevention. University of Bergen, 2023.
- Bawuah A, Ampaw S. Ownership and use of insecticide-treated nets under Ghana's National Malaria Control Program: what are the correlates? *Trop Med Int Health.* 2021;26:1593–608.
- Bukari MK. Ownership and utilization of insecticide treated nets (ITNS) among pregnant women and children under five years in the prevention of malaria in the Nanumba South District of the Northern Region of Ghana. Kwame Nkrumah University of Science and Technology, 2015.

25. Aheto JMK, Babah R, Dzokoto MK, Kwarah W, Alhassan Y. Predictors of mosquito bed net use among children under-fives in Ghana: a multilevel analysis of the 2019 malaria indicator survey. *Malar J.* 2023;22:196.
26. Orkoh E, Annim SK. Source and use of insecticide treated net and malaria prevalence in Ghana. *SSRN Electron J.* 2017. <https://doi.org/10.2139/SSRN.3020694>.
27. Baume CA, Franca-Koh AC. Predictors of mosquito net use in Ghana. *Malar J.* 2011;10:265.
28. Glozah Id FN, Teg-Nefaah P, Id T, Bazant IdE, Asampong E, Id RH, et al. Implementation and effectiveness outcomes of Community Health Advocacy Teams to improve long-lasting insecticide net distribution and use in six districts in Ghana: a one-group pre-post-test study. *PLoS Glob Public Health.* 2024;4: e0002123.
29. Diema KK, Dodam KK, Aarah-Bapuah M, Asibi AJ. Barriers to sustained use of the insecticide treated bed net in the upper east region of Ghana. *Int J Commun Med Public Health.* 2017;4:500–5.
30. Doumbia S, Toure M, Sogoba N, Alifrangis M, Diakite M, Diarra A, et al. The West Africa ICEMR Partnerships for Guiding Policy to Improve the Malaria Prevention and Control. *Am J Trop Med Hyg.* 2022;107:84.
31. D'Souza B. Evidence use for global health policy development: a case study of malaria preventive treatment policy processes at the World Health Organization. *London School Hyg Trop Med.* 2018. <https://doi.org/10.17037/PUBS.04650971>.
32. Chilot D, Mondelaers A, Alem AZ, Asres MS, Yimer MA, Toni AT, et al. Pooled prevalence and risk factors of malaria among children aged 6–59 months in 13 sub-Saharan African countries: a multilevel analysis using recent malaria indicator surveys. *PLoS ONE.* 2023;18: e0285265.
33. Ochomo E, Rund SSC, Mthawanji RS, Antonio-Nkondjio C, Machani M, Samake S, et al. Mosquito control by abatement programmes in the United States: perspectives and lessons for countries in sub-Saharan Africa. *Malar J.* 2024;23:8.
34. Diabaté S, Druetz T, Bonnet E, Kouanda S, Ridde V, Haddad S. Insecticide-treated nets ownership and utilization among under-five children following the 2010 mass distribution in Burkina Faso. *Malar J.* 2014;13:353.

### Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.