Utilization of insecticides treated mosquito bed nets among pregnant women in Kassena-Nankana East municipality in the upper east region of Ghana

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INTRODUCTION
Malaria is a disease that threatens the lives of 3.2 billion people worldwide and has dire consequences on pregnant women and children. Insecticides Treated Mosquito Nets (ITNs) are the simplest way of preventing malaria. The main objective of this study was to assess the utilization of ITNs among pregnant women in the Kassena-Nankana East Municipality.

METHODS
A descriptive cross-sectional study was used. The study recruited 362 pregnant women using simple random sampling technique. All statistics were performed at a 95% confidence level with p<0.05 considered significant.

RESULTS
Almost all (99.7%) respondents had heard about mosquito bed nets, of which 98.6% have ever seen bed nets. The majority (96.2%) of the respondents stated that ITNs could be obtained from health facilities and over 90% knew the general use of ITNs. The majority of the respondents (97.8%) had mosquito bed nets. Out of those who owned ITNs, 94.8% use them. Reasons for not using ITNs included the fact that some feel: not being necessary (26.2%), being expensive, cannot afford it (15.8%), inadequate public education (47.5%), and difficulty in accessing ITNs (10.5%). The study revealed a significant association between area of residence (χ²=3.4; p=0.04), increasing average monthly income (χ²=46.4; p<0.001), and utilization of ITNs.

CONCLUSIONS
There is high awareness and knowledge about ITNs. Though the majority of the participants owned ITNs, it does not translate to effective utilization of ITNs. The challenges identified in this study showed that there are still fundamental issues that require immediate attention for the effective utilization of ITNs.
In Ethiopia, 39% of pregnant women did not have a positive attitude towards ITNs. In the Democratic Republic of Congo, about 82% reported having an ITN in their household, of these only 78.4% used ITNs the night before the study survey. In Sudan, the ownership of ITNs was nearly 57%, however, only 11.5% used ITNs frequently. About 92% demonstrated sufficient knowledge on the cause of malaria, and 60% exhibited appreciable knowledge on the reasons why ITNs are used. Despite the above, only 22.1% knew the correct usage of ITNs.

Ghana is one of the world’s fifteen countries with the greatest malaria infection rate. Malaria infection is among the ten topmost diseases in Ghana. Malaria affects all people, but it is common with expectant mothers and babies with very dire consequences. Ghana saw the biggest increase in absolute case counts (about 0.5 million new cases) between 2017 and 2018, indicating a 5% increase over 2017 levels (from 213 to 224 per 1000 at risk). In Sub-Saharan Africa, Ghana has the highest incidence of Intermittent Preventive Treatment in Pregnancy (IPTp) for pregnant women (78%). The percentage of pregnant women taking the third dosage of IPTp climbed from 39% to 60% in 2016, to 61% in 2019. IPTp involves giving all pregnant women a curative dose of an effective antimalarial medicine (now sulfadoxine-pyrimethamine) without first determining whether or not they have malaria. It is recommended that pregnant women take at least three doses of IPTp starting from second trimester till birth.

The intentional campaign and intervention on ITNs have resulted in a rise in household ownership of ITNs from 49% in 2011 to 68% in 2014. In Ghana, the usage of ITNs among pregnant women grew from roughly 33% in 2011 to 43% in 2014. Lack of availability of ITNs, as well as a lack of information and perception about ITNs and malaria, have previously been identified as significant hurdles to ITN adoption in Africa. Indication from Ghana has shown that over 40% of ITNs available in the households go unused. A study conducted in the middle belt of Ghana showed that pregnant women knew how crucial ITNs are to preventing malaria. Some pregnant women due to financial constraints, and missed chance during the free distribution of ITNs, do not own a bed net and do not sleep under one. Aside from the above genuine excuses, some of the pregnant women were also not using ITNs because of discomfort resulting from heat, the smell of the net, and difficulty in hanging the net.

Despite the progress achieved in carrying out active preventive and treatment measures, malaria is still very prevalent in Ghana. Malaria accounts for 38.1% of all outpatient department cases and more than half of all hospital admissions in Ghana among children aged <5 years. Malaria infection is responsible for about half of all fatalities among children aged <5 years in Ghana. Available literature in Ghana has demonstrated that the most households who own bed nets, do not sleep under them. In addition, research performed in seven districts of Ghana’s Upper East region found that while 79% of pregnant women had bed nets, only 62% utilized them the night before the survey. In addition to the above, there is a vast difference with regard to the utilization of bed nets between urban and rural areas of Ghana.

Ghana is still working to achieve universal ITN coverage (defined as use by 80% or more of the population in an endemic region) to provide the best possible protection. As a result, continuous monitoring and assessment of access to and use of treated bed nets are required to guide malaria control policy and practice, particularly in high-risk parts of the nation. There are vast studies on ITNs utilization in Ghana but most are often in the urban settings with limited studies in deprived areas. Malaria prevention especially among pregnant women and children aged <5 years is a topmost priority for the Ghana government. As such, studies across the countries are required to inform policy decisions aimed at eradicating or reducing malaria infection among the general population. The Kassena-Nankana East Municipality is mostly rural with no study conducted in this area on ITN usage. To bridge this gap, this study aims to assess the utilization of Insecticides Treated Mosquito Nets (ITNs) among pregnant women in Kassena-Nankana East Municipality in the Upper East Region of Ghana.

METHODS

Study setting
The study setting was conducted in the Kassena-Nankana East Municipality, which was upgraded by legislative instrument (LI) 2106 from the District level in 2012. The municipality has Navrongo as its political and administrative capital. The study setting was chosen because the municipality is predominately rural with no study conducted on ITN.

Study design
The study employed a descriptive cross-sectional survey with a quantitative approach to explore the utilization of ITNs among pregnant women in Kassena-Nankana East from May to July 2021.

Inclusion and exclusion criteria
The study included pregnant women who resided in the Kassena-Nankana East Municipality, who were of sound mind, and agreed to participate in the study voluntarily. All other persons who were outside these criteria were excluded including pregnant women who were on admission.

Sample size determination, sampling techniques, and procedure
The sample size was computed using the Snedecor and Cochran formula for a point estimate sample. The utilization of ITNs among pregnant women was 62%. From the Snedecor and Cochran formula, the sample size was calculated as 362. All communities with a hospital, health...
center or community-based health planning and service (CHPS) center, were all written on pieces of paper; and ten health facilities were chosen at random without replacement. The study used simple random sampling in recruiting the sample unit in each facility. Thus, for each of the communities (health facilities) visited, 30 pregnant women were recruited at random, except the District Hospital where 92 pregnant women were recruited. The District Hospital serves as a referral center for all the other facilities and most pregnant women choose to go there for their ANC irrespective of the distance.

**Data collection tools and procedures**

The questionnaire was adapted from existing literature and modified to suit the study objectives (Supplementary file Questionnaire). The questionnaire was structured for the specific objectives of the study consisting of Section A: Sociodemographic data of the respondents; Section B: knowledge on ITNs; Section C: utilization of ITNs; and Section D: barriers to the use of ITNs as a preventive and control tool against malaria among pregnant women. The questions were both open and close-ended.

The study explored the use of self-administered questionnaire techniques. A total of six field assistants were trained on the data collection tool to gather the data within the shortest possible time. Data collectors were also trained on the simple random sampling procedure for the selection of respondents.

**Reliability and validity of the study**

To ensure that the data collected were reliable and valid, the field enumerators were trained on the use of data collection tools. Thirty pregnant women in Paga (a community similar to the study area) were interviewed during pre-testing (piloting). Pre-testing helped in restructuring the questionnaire to elicit the right response for the specific objective. It also offered the field enumerators the chance to familiarize themselves with the data collection process and to rectify all difficulties before the main data collection process. For the validity of this study, the questionnaires were asked in plain language to solicit the right response. The questionnaire was also shown to experienced researchers in the area for face validity. The Supplementary file Dataset contains a dataset from the pre-testing (piloting). Internal consistency (reliability) of the measurement scales of the instrument was computed using Cronbach’s alpha. The overall alpha of the instrument was $\alpha=0.81$ while the alpha values for the scales of knowledge, utilization and barriers of ITNs were $\alpha=0.86$, $\alpha=0.89$ and $\alpha=0.68$, respectively. The overall alpha was considered as good.

**Data analysis and presentation**

Data were analyzed using SPSS version 25.0. Data are presented using descriptive and inferential statistics. Chi-squared analysis was used to determine the statistical association between background characteristics and ITN utilization. All statistics were performed at a 95% confidence level, and $p<0.05$ was considered significant.

## RESULTS

**Sociodemographic characteristics**

Most (46.4%) of the respondents were aged 30–39 years. Over 90% of the respondents had some level of education, with only 9.10% not having gone to school. A majority, 64.9%, 87.6%, and 52.2% of the respondents were Christians, married, and resided in rural areas, respectively (Table 1).

**Knowledge on ITNs**

Almost all (99.7%) respondents had ever heard of ITNs, of which 98.6% had seen and handled mosquito bed nets.

### Table 1. Sociodemographic characteristics of the participants

| Characteristics         | n   | %    |
|-------------------------|-----|------|
| **Age (years)**         |     |      |
| <20                     | 72  | 19.90|
| 20–29                   | 92  | 25.40|
| 30–39                   | 168 | 46.40|
| ≥40                     | 30  | 8.30 |
| **Education level**     |     |      |
| No formal education     | 33  | 9.10 |
| Junior high school and below | 137 | 37.80|
| Senior high school      | 91  | 25.10|
| Tertiary                | 101 | 27.90|
| **Religion**            |     |      |
| Christianity            | 235 | 64.90|
| Islam                   | 125 | 34.50|
| Traditionalist          | 2   | 0.60 |
| **Marital status**      |     |      |
| Single                  | 33  | 9.10 |
| Cohabitng               | 2   | 0.60 |
| Married                 | 317 | 87.60|
| Divorced                | 6   | 1.70 |
| Separated               | 4   | 1.10 |
| **Occupation**          |     |      |
| Trader                  | 96  | 26.50|
| Farmer                  | 82  | 22.70|
| Teacher                 | 68  | 18.70|
| Health worker           | 27  | 7.50 |
| Housewife               | 41  | 11.30|

Continued
Sources of information on ITNs included: media (radio/television) 91.4% (331), health workers 271 (74.9%), friends 100 (27.6%), and books/journals 70 (19.3%). Over half (50.8%) of respondents knew that ITNs are used to prevent malaria. The majority (89.0%) of respondents dried their ITNs in the shade before using them. On whether ITNs can be retreated, 71.3% agreed (Table 2).

Utilization of ITNs

The majority (97.8%) of respondents owned mosquito bed nets. Of these, 94.8% used their nets. Majority (90.3%) of respondents have been beneficiaries of free distribution of ITNs from health workers (69.1%) and their friends (30.9%). Of the main reason for using an ITN, 84.0% believe it prevents malaria, 14.4% believe it prevents insect bites, and 1.7% believed it prevents mosquito nuisance. The majority (89.0%) of the respondents slept under ITNs the previous night while 11.0% did not sleep under ITNs the

| Characteristics | n  | %   |
|----------------|----|-----|
| Seamstress     | 16 | 4.40|
| Students       | 14 | 3.90|
| Hairdresser    | 9  | 2.50|
| Other          | 9  | 2.50|
| Number of children |  |     |
| 1–2            | 259| 71.50|
| 3–4            | 85 | 23.50|
| 5–6            | 17 | 4.70 |
| >6             | 1  | 0.30 |
| Area of residence |    |     |
| Rural          | 189| 52.20|
| Urban          | 173| 47.80|
| Average monthly income (GHS) |  |     |
| <500           | 181| 50.00|
| 500–1000       | 98 | 27.10|
| 1001–1500      | 62 | 17.10|
| 1501–2000      | 15 | 4.10 |
| >2000          | 6  | 1.70 |
| Ethnicity      |    |     |
| Frafra         | 58 | 16.00|
| Nankam         | 79 | 21.80|
| Kassena        | 174| 48.10|
| Builsa         | 16 | 4.40 |
| Mamprusi       | 11 | 3.10 |

GHS: 1000 Ghanaian Cedis about US$160.

Table 1. Continued

Table 2. Knowledge on insecticide treated mosquito nets (ITNs)

| Variables                           | n     | %   |
|-------------------------------------|-------|-----|
| Ever heard of ITNs                  |       |     |
| Yes                                 | 361   | 99.70|
| No                                  | 1     | 0.30 |
| Ever seen or handled ITNs           |       |     |
| Yes                                 | 357   | 98.60|
| No                                  | 5     | 1.40 |
| Sources of information on ITNs*     |       |     |
| Media (radio/television)            | 331   | 91.40|
| Health workers                      | 271   | 74.90|
| Friends                             | 100   | 27.60|
| Books/journal                       | 70    | 19.30|
| Where to get ITNs                   |       |     |
| Cosmetic stores                     | 5     | 1.40 |
| Health facilities                   | 348   | 96.20|
| Super market                        | 9     | 2.50 |
| Uses of ITNs                        |       |     |
| To avoid mosquito bites             | 184   | 50.80|
| To have a good night                | 5     | 1.40 |
| To prevent malaria                  | 173   | 47.80|
| How long does ITN effectiveness last|       |     |
| <6 months                           | 69    | 19.10|
| 6–12 months                         | 30    | 8.30 |
| More than a year                    | 85    | 23.50|
| 3 years                             | 131   | 36.20|
| <5 years                            | 2     | 0.60 |
| What is done before first usage of an ITN |       |     |
| Dry it in the shade                 | 322   | 89.00|
| Dry it in the sun                   | 25    | 6.90 |
| Wash it                             | 15    | 4.10 |
| Can ITNs be retreated               |       |     |
| Yes                                 | 258   | 71.30|
| No                                  | 104   | 28.70|
| When to retreat ITNs*               |       |     |
| After washing once                  | 155   | 42.80|
| After you have a mosquito bite despite sleeping in an ITN | 173   | 47.80|
| After 3 to 5 years of usage         | 225   | 62.20|
| After washing 3 times               | 176   | 48.60|
| When it is dirty                    | 138   | 38.10|

*Multiple response.
previous night. Most (47.0%) of the respondents sleep under ITNs throughout the year, and the majority (83.4%) of respondents would consider using the ITNs if they are readily made available (Table 3).

**Barriers to the use of ITNs as a preventive and control tool against malaria**

The majority (96.1%) of the respondents would recommend ITNs to others. Reasons for not using an ITN include: it being unnecessary (26.2%), being expensive and unaffordable (15.8%), inadequate public education (47.5%), and difficulty in accessing an ITN (10.5%). Other barriers included: cultural belief (2.20%), personal reaction after sleeping under an ITN (14.9%), and the discriminatory attitude of health workers against their household (5.2%). The majority (51.9%) of the respondents complained of body itching when they used ITNs, 31.5% mentioned body rashes, and 16.6% mentioned body sensation as a personal reaction upon using ITNs (Table 4).

### Table 3. Utilization of insecticides treated mosquito bed nets (ITNs)

| Variables                                      | n   | %  |
|------------------------------------------------|-----|----|
| **Do you have an ITN**                        |     |    |
| Yes                                            | 354 | 97.80 |
| No                                             | 8   | 2.20 |
| **Do you use an ITN**                         |     |    |
| Yes                                            | 343 | 94.80 |
| No                                             | 19  | 5.20 |
| **Ever been a beneficiary of free distribution of ITNs** |     |    |
| Yes                                            | 327 | 90.30 |
| No                                             | 35  | 9.70 |
| **From whom did you benefit**                 |     |    |
| Health worker                                  | 226 | 69.10 |
| Friend                                         | 101 | 30.90 |
| **What type of ITN do you have**               |     |    |
| Ever treated nets                              | 5   | 1.40 |
| Insecticide-treated mosquito nets              | 191 | 52.80 |
| Long-lasting insecticide nets                  | 147 | 40.60 |
| Ordinary nets                                  | 11  | 3.00 |
| Don’t know                                     | 8   | 2.20 |
| **Main reason for using ITNs**                 |     |    |
| Prevent insect bites                           | 52  | 14.40 |
| Prevent malaria                                | 304 | 84.00 |
| Prevent mosquito nuisance                      | 6   | 1.70 |
| **Level of ITN protection in terms of preventing malaria among pregnant women** |     |    |
| Average                                        | 7   | 1.90 |
| Effective                                      | 68  | 18.80 |
| Very effective                                 | 268 | 74.00 |
| Not effective at all                           | 1   | 0.30 |
| I don’t know                                   | 18  | 4.90 |
| **Slept under ITN last night**                 |     |    |
| Yes                                            | 322 | 89.00 |
| No                                             | 40  | 11.00 |
| **How consistently do you (pregnant women) sleep under ITNs** |     |    |
| Throughout the night during the season for mosquitoes | 121 | 33.40 |
| All year round                                 | 170 | 47.00 |
| Most of the night                              | 55  | 15.10 |
| Once in a while                                | 10  | 2.80 |
| I don’t know                                   | 6   | 1.70 |
| **If ITNs are readily available, would you consider using them daily** |     |    |
| Yes                                            | 302 | 83.40 |
| No                                             | 12  | 3.30 |
| Sometimes                                      | 48  | 13.30 |

### Table 4. Barriers to the use of insecticides treated mosquito bed nets (ITNs) as a preventive and control tool against malaria among pregnant women

| Variables                                      | n   | %  |
|------------------------------------------------|-----|----|
| **Reasons you did not use ITN last night (n=40)** |     |    |
| Don’t feel comfortable under it                | 23  | 57.50 |
| Not effective                                  | 2   | 5.00 |
| Side effects                                   | 8   | 20.00 |
| Lazy in hanging it                             | 9   | 22.50 |
| Weather is warm                                | 21  | 52.50 |
| **Noticed decline in malaria following usage of ITN** |     |    |
| Yes                                            | 348 | 96.10 |
| No                                             | 14  | 3.90 |
| **Would you recommend ITN use to others**      |     |    |
| Yes                                            | 360 | 99.40 |
| No                                             | 2   | 0.60 |
| **Do you always get ITNs from the hospitals**  |     |    |
| Yes                                            | 254 | 70.20 |
| No                                             | 108 | 29.80 |
| **Do they sell ITNs to you**                   |     |    |
| Yes                                            | 10  | 2.80 |
| No                                             | 352 | 97.20 |

Continued
### Table 4. Continued

| Variables                                                                 | n   | %    |
|--------------------------------------------------------------------------|-----|------|
| If you were to buy an ITN, would you be able to pay for it               |     |      |
| Yes                                                                      | 330 | 91.20|
| No                                                                       | 32  | 8.80 |
| What cost would be considered affordable (GHS)                           |     |      |
| <5                                                                      | 92  | 25.40|
| 5–10                                                                    | 150 | 41.40|
| 11–20                                                                   | 120 | 33.10|
| Has the attitude of health personnel made you refuse to get an ITN      |     |      |
| Yes                                                                      | 13  | 3.60 |
| No                                                                       | 349 | 96.40|
| Are the health workers discriminatory in distributing ITNs               |     |      |
| Yes                                                                      | 16  | 4.40 |
| No                                                                       | 346 | 95.60|
| How long do you have to travel to get an ITN                             |     |      |
| Short                                                                   | 282 | 77.90|
| Long                                                                    | 80  | 22.10|
| Does the distance to an ITN distribution site hinder you from getting one|     |      |
| Yes                                                                      | 28  | 7.70 |
| No                                                                       | 33  | 92.30|

### Table 5. Association between sociodemographic characteristics and utilization of insecticides treated mosquito bed nets (ITNs)

| Variables              | Total | Do you use ITNs? | Statistical test |
|------------------------|-------|------------------|------------------|
|                        |       | Yes n (%)        | No n (%)         |                  |
| Age (years)            |       |                  |                  |
| <20                    | 72    | 71 (98.6)        | 1 (1.4)          | $\chi^2=5.4$     |
| 20–29                  | 92    | 89 (96.7)        | 3 (3.3)          | $p=0.14$         |
| 30–39                  | 168   | 156 (92.9)       | 12 (7.1)         |                  |
| ≥40                    | 30    | 27 (90.0)        | 3 (10.0)         |                  |
| Education level        |       |                  |                  |
| No formal education    | 33    | 32 (97.0)        | 1 (3.0)          | $\chi^2=3.1$     |
| Junior high school and below | 137  | 128 (93.4)       | 9 (6.6)          | $p=0.38$         |
| Senior high school     | 91    | 89 (97.8)        | 2 (2.2)          |                  |
| Tertiary               | 101   | 94 (93.1)        | 7 (6.9)          |                  |

*Multiple response. GHS: 1000 Ghanaian Cedis about US$160.*
Association between sociodemographic characteristics and utilization of ITNs

With regard to place of stay, 96.8% of respondents in rural and 92.5% in urban areas used ITNs, while 3.2% and 7.5% of respondents in rural and urban areas, respectively, did not use the treated nets. The study revealed a significant association between area of residence and utilization of ITNs ($\chi^2=3.4; p=0.04$). Also, increasing average monthly income was associated with utilization of ITNs ($\chi^2=46.4; p<0.001$) (Table 5).

DISCUSSION

This study aimed to assess the use of ITNs among pregnant women in the Kassena-Nankan East Municipality. The study revealed that almost all respondents had heard about ITNs. This is consistent with other studies conducted elsewhere. For instance, in the Ho municipality, Ghana, a study showed that 98.7% of pregnant women had heard about bed nets. Amara revealed that, in the Greater Accra Region of Ghana, over 60% of the mothers with children aged <5 years had heard about ITNs. Also, in the Nanumba South District in the Northern Region of Ghana, over 80% of pregnant mothers had heard about bed nets. In Nigeria, 93.2% of pregnant women were aware of bed nets. These similarities are justified by the fact that, in Ghana and in most African countries, there have been focused attempts by the Ministry of Health, through the support of WHO and UNICEF, to provide education on malaria prevention. This is because malaria is among the key causes of maternal anemia. Maternal anemia is one of the leading causes of infant and maternal morbidity and mortality in Sub-Saharan Africa (SSA). Insecticides treated mosquito nets are the simplest most effective way of preventing malaria. This, therefore, explains why most respondents in Africa are aware of ITNs.

The study revealed varied sources of information on ITNs including the media, health workers, friends, and relatives. However, the majority of the pregnant women heard about them from the media (tv, radio, and internet) followed by health workers. This is consistent with other studies conducted in Ghana where the majority of respondents had heard about ITNs through the media. More people get information from the media because, in Ghana, there are a lot of sponsors for malaria advertisements and talk shows on radio and TV. In the Kassena-Nankan East municipality,

Table 5. Continued

| Variables                  | Total | Do you use ITNs? | Statistical test |
|----------------------------|-------|------------------|------------------|
|                            |       | Yes n (%)        | No n (%)         |
| Religion                   |       |                  |                  |
| Christianity               | 235   | 220 (93.6)       | 15 (6.4)         | $\chi^2=1.8$ |
| Islam                      | 125   | 121 (96.8)       | 4 (3.2)          | p=0.41       |
| Traditionalist             | 2     | 2 (100.0)        | 0 (0.0)          |              |
| Marital status             |       |                  |                  |
| Single                     | 2     | 30 (90.9)        | 3 (9.1)          | $\chi^2=3.1$ |
| Cohabitating               | 2     | 2 (100.0)        | 0 (0.0)          | p=0.54       |
| Married                    | 317   | 302 (95.3)       | 15 (4.7)         |              |
| Divorced                   | 6     | 5 (83.3)         | 1 (16.7)         |              |
| Separated                  | 4     | 4 (100.0)        | 0 (0.0)          |              |
| Area of residence          |       |                  |                  |
| Rural                      | 189   | 183 (96.8)       | 6 (3.2)          | $\chi^2=3.4$ |
| urban                      | 173   | 160 (92.5)       | 13 (7.5)         | p=0.04       |
| Average monthly income (GHS)|       |                  |                  |
| <500                       | 181   | 170 (93.9)       | 11 (6.1)         | $\chi^2=46.4$ |
| 500–1000                   | 98    | 92 (93.9)        | 6 (6.1)          | p<0.001      |
| 1001–1500                  | 62    | 60 (96.8)        | 2 (3.2)          |              |
| 1501–2000                  | 15    | 15 (100.0)       | 0 (0.0)          |              |
| >2000                      | 6     | 6 (100.0)        | 0 (0.0)          |              |

GHS: 1000 Ghanaian Cedis about US$160.
there are two main radio stations with very wide coverage and a community radio. This could explain why the media are considered a major source of information on ITNs. Also, 74.9% of the pregnant women in this study had heard about ITNs through health workers, it was not the main source of information. This is, however, similar to a study conducted by Amara where 80% of respondents had heard of ITNs from health professionals. During antenatal care (ANC) visits, pregnant women are educated on a variety of conditions including malaria. Those who attend ANC regularly might have heard about ITNs in the clinic. Given the varied sources of information, what we learn is that to be able to reach a wider coverage with information regarding ITNs and malaria prevention, there is a need to adopt multiple sources of delivery of information, so that those who may not be attending ANC regularly could still get reliable information on ITNs through radio, TV or internet.

The majority of the pregnant women in this study reported having obtained their ITNs from a health facility. According to Nungbaso et al., the majority of the respondents in the Tamale metropolis benefitted from the free distribution of bed nets from the health facilities. Even though the respondents are different, the policies regarding the free distribution of ITNs are often targeted at the general population with interest among pregnant women and children aged <5 years.

About 90% of the respondents knew that ITNs were used to prevent malaria. Available literature in Ghana supports the current findings. For instance, 91.1% and 97.8% of the respondents in Ho and Greater Accra, respectively, knew about the general usage of ITNs. However, in Nigeria, Musa showed that only 36% of the respondents knew the correct usage of ITNs. This difference could be attributed to the geographical difference, beliefs, and sociocultural characteristics of the respondents.

The ownership of ITNs was determined as 97.8% in this study. The current findings are higher than the 71% reported in Western Kenya by Atieli et al. and 64.9% reported in Nigeria by Ezire. Though these studies indicate that the majority of their respondents owned ITNs, they were observed to be lower than the findings of the current studies. This suggests that the Ministry of Health of Ghana has adopted a robust method to distribute the ITNs.

The majority of the respondents indicated that they believed ITNs were effective. This is consistent with a study by Aboh et al. where over 95% of respondents believed ITNs were very effective in preventing malaria. This is crucial in determining the utilization of ITNs because, if the population does not believe in the efficacy of ITNs, the patronage would be lower. This is evident by the 94.8% of pregnant women in this study using ITNs. In other studies, the majority of respondents said that they were using ITNs. However, Amara reported very low usage of ITNs. This could be attributed to the differences in government policies on free ITN distribution and behavioral and personal preferences of the respondents.

Though the use of ITNs was observed to be high in the study, only 47.8% were using ITNs every day. The actual utilization of ITNs is varied across the globe. For example, Atieli et al. showed that the majority used ITNs throughout the year, Bukari reported 34.4% actual utilization, and 19% were using ITNs in another study. What this tells us is that ownership of ITNs does not always result in utilization due to sociocultural and logistic reasons. Some of the women having ITNs, do not use them all year round. For some of the respondents in this study, ITNs were used frequently only in the rainy season. This is because the cases of malaria often increase during rainy periods. Some also reported dissatisfaction with the use of ITNs and as such resort to other preventive measures. This is supported by available literature, where some people prefer other methods of protection such as mosquito coils, repellents, electric fans, etc. From the foregoing, the use of other preventive measures could be a reason for the difference between ownership and actual utilization of ITNs.

The study revealed a wide variety of challenges such as ITNs being inaccessible, side effects, ITNs being warm, among others. This is similar to a study where respondents currently using ITNs complained of scarcity of new nets, difficulty in getting chemicals for re-treatment of nets, non-availability of quality ITNs for sale, resulting in disuse of ITNs. Also, the cost of the nets was featured among the barriers to effective utilization of ITNs. In Ghana, there are free distributions of ITNs at antenatal care (ANC) units, child welfare clinics (CWC), postnatal care (PNC) service centers as well as household distributions. The authors do not understand why issues of cost and accessibility are being raised by the respondents. These revelations by the respondents are sensitive and as such require further studies on the reasons for not using ITNs, using a mixed-method approach to bring in-depth understanding to these issues especially among those who cite cost as a barrier to ITN utilization.

The study also showed a significant association between area of residence and use of ITNs. This is similar to in the Upper West Region, Ghana where pregnant women in urban areas tend to use ITNs more than their counterparts in the rural setting. In relation to the above, increasing average monthly income is associated with utilization of ITNs. This is consistent to a study in Northern and a systematic review in Sub-Saharan Africa where higher wealth index is associated with higher ITN ownership and usage, and vice versa. However, García-Basteiro et al. did not establish any association between wealth index and ITN ownership and use. This means that, depending on the unique characteristics of each area and the tactics employed to deploy ITNs, the impoverished and relatively well-off may gain differentially. Often, the person with higher wealth index stays in the urban areas which are accessible and could be reached during distribution of ITNs. Also, people with a high
Research paper

1. Dodd R, Hill P, Huntington D. Strengthening country office at local level to aid in the distribution of bed nets. Recommend to the Ghana Health Service to train volunteers in ITNs, which they think are very expensive. To resolve this, we free distribution of ITNs. They are therefore compelled to buy ITNs. However, some persons whose residence was hard to reach due to bad roads are often left out of the free distribution of ITNs. They are therefore compelled to buy ITNs, which they think are very expensive. To resolve this, we recommend to the Ghana Health Service to train volunteers at local level to aid in the distributions of bed nets.

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DATA AVAILABILITY
The data supporting this research can be found in the Supplementary file.

PROVENANCE AND PEER REVIEW
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